AMTRAK
MAINTENANCE MANUAL G-79-6
SUPPLEMENT

Section A	1203-72	Baggage Car
Section B	1350-79	Baggage Car
Section C	2900-97	Sleeper Car
Section D	10400-10403	Wheel Car

February 15, 1982

DRAWING LIST

HEP Conversion by RSI:

Single Line and Heat Circuits	C-04-456
64 Volt Power System	C-04-457
Trainline Circuits	D-04-458
Baggage Car Arrangement	KC-301
Undercar Arrangement	KC-313
Receptacle Arrangement and 27 Point Cable Routing	KC-312
480V Trainline Arrangement	KC-108
Heat Controls	KC-122
Selector Switch Wiring	KC-928
Nelco Heater Wiring	KC-956
AC Wiring	KC-103
64V DC Single Line Schematic	KC-305
27 Point Trainline Schematic	KC-304
Electric Locker	KC-318
Ceiling Lighting Wiring	KC-123

HEP Reconversion By Beech Grove:

Temperature Control Schematic	D-01-565
Single-line Schematic	D-01-716
480V Junction Box	R-00-519
480V Trainline Schematic	D-01-910
27 Point Trainline Schematic	E-01-911
Electric Locker Wiring	R-01-722
480 Volt Switchboard	D-00-431 sht.-1
Lighting Switchboard	D-00-536 sht.-1
Loop Relay Panel	D-00-684
Marker Light Resistor Panel	D-00-686
Heat Contactor Panel	D-00-704

DRAWING LIST

Beech Grove - Converted:

Temperature Control Schematic	D-01-915	
Single-Line Schematic	D-01-912	
480V Junction Box	R-00-519	
480V Trainline Schematic	D-01-910	
27 Point Trainline Schematic	E-01-911	
Electric Locker Wiring	E-04-913	
480V Switchboard	D-00-431	Sht.-1
Lighting Switchboard	D-00-536	Sht.-1
Loop Relay Panel	D-00-684	
Marker Light Resistor Panel	D-00-686	
Heat Contactor Panel	D-00-914	

AMTRAK
MAINTENANCE MANUAL G-79-6
SUPPLEMENT

SECTION C
2900-97 SLEEPING CAR

This book is meant as a supplement to the Amtrak Maintenance Manual #G-79-6. Most details of these cars are described in the main manual; things unique to these cars are described here in the supplement.

Figure 0.1
Maintenance Manual
Revisions

DATE	CHAPTER	PAGES	CHANGES

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Preface

CHAPTER 1 GENERAL

CHAPTER 2 CAR BODY

Refer to Main Manual

CHAPTER 3 HEATING VENTILATION AND AIR CONDITIONING

CHAPTER 4 LIGHTING

CHAPTER 5 COMMUNICATIONS AND PUBLIC ADDRESS

CHAPTER 6 ELECTRICAL SYSTEM

CHAPTER 7 AIR BRAKE SYSTEM

CHAPTER 8 HANDBRAKE

Refer to Main Manual

CHAPTER 9 FOOD SERVICE EQUIPMENT

N/A

CHAPTER 10 TRUCKS

Refer to Main Manual

CHAPTER 11 COUPLER AND DRAFT GEAR

Refer to Main Manual

CHAPTER 12 WATER SYSTEM

CHAPTER 13 TOILET APPOINTMENTS

Refer to Main Manual

CHAPTER 14 MISCELLANEOUS EQUIPMENT

Refer to Main Manual

CHAPTER 15 PERIODIC INSPECTION AND MAINTENANCE SCHEDULES

Refer to Main Manual

CHAPTER 16 RETROFITS

Refer to Main Manual

CHAPTER 1 GENERAL

List of Illustrations

1.0 GENERAL

This manual is prepared for the 31 conventional sleeping cars converted to head end power beginning in June, 1977. Work was accomplished by the Amtrak facilities at Beech Grove, Indiana; engineering was provided by Equipment Engineering, Amtrak, Washington, DC.

The direct current electrical equipment and steam heating systems were removed and the cars were rewired for all electric 480 volt 3 phase head end power operation.

The maximum operating speed is 105 mph for the cars.

Standard HEP equipment was utilized as much as possible to minimize inventory and facilitate maintenance.

Standard HEP Equipment Used:

1. Power trainlines, receptacles and jumpers.
2. 480 volt power junction box.
3. Communication trainline receptacles and jumpers.
4. Batteries and battery charger.
5. Conductors signal pushbuttons.
6. Marker lamps.
7. Loop relays.
8. Cars are equipped with 4 emergency sash units.
9. Rooms equipped with new type rugged design industrial type thermostat.
10. All relays and contactors are stock General Electric and most parts are interchangeable.
11. Some transformers and circuit breakers.
12. Air vane switch and klixon.
13. Water antifreeze system.

Features Unique To These Cars

1. Floor heaters.

2. Overhead heater (Do not interchange with Std. HEP unit).

3. A/C System:

   a. Freon 12
   b. A/C starter panel
   c. Compressor
   d. Condenser
   e. Evaporator and blower
   f. No reheat

4. Temperature Controls

5. Switchboards - Lighting and 480 V

6. CF brakes

7. P-3 Pneumatic Decelostat

8. No Fresh Air Damper

9. No PA Unit

10. Floor Heat Transformers (If all 3 are changed out together, std. HEP parts can be used).

11. No Brake Applied and Released Pressure Switches

12. Water Heater (Some parts common to standard HEP cars).

1.1 Car Numbers

QTY	New HEP Number	Original Number	Year Built	Builder
13	2900-41	2600-41	1949	Budd
18	2980-97	2710-33	1949	Budd

All cars are 10-6 sleepers with similar appearance.

CHAPTER 1.2
FLOOR PLANS, ARRANGEMENT OF EQUIPMENT AND CAR WEIGHTS

LEGEND

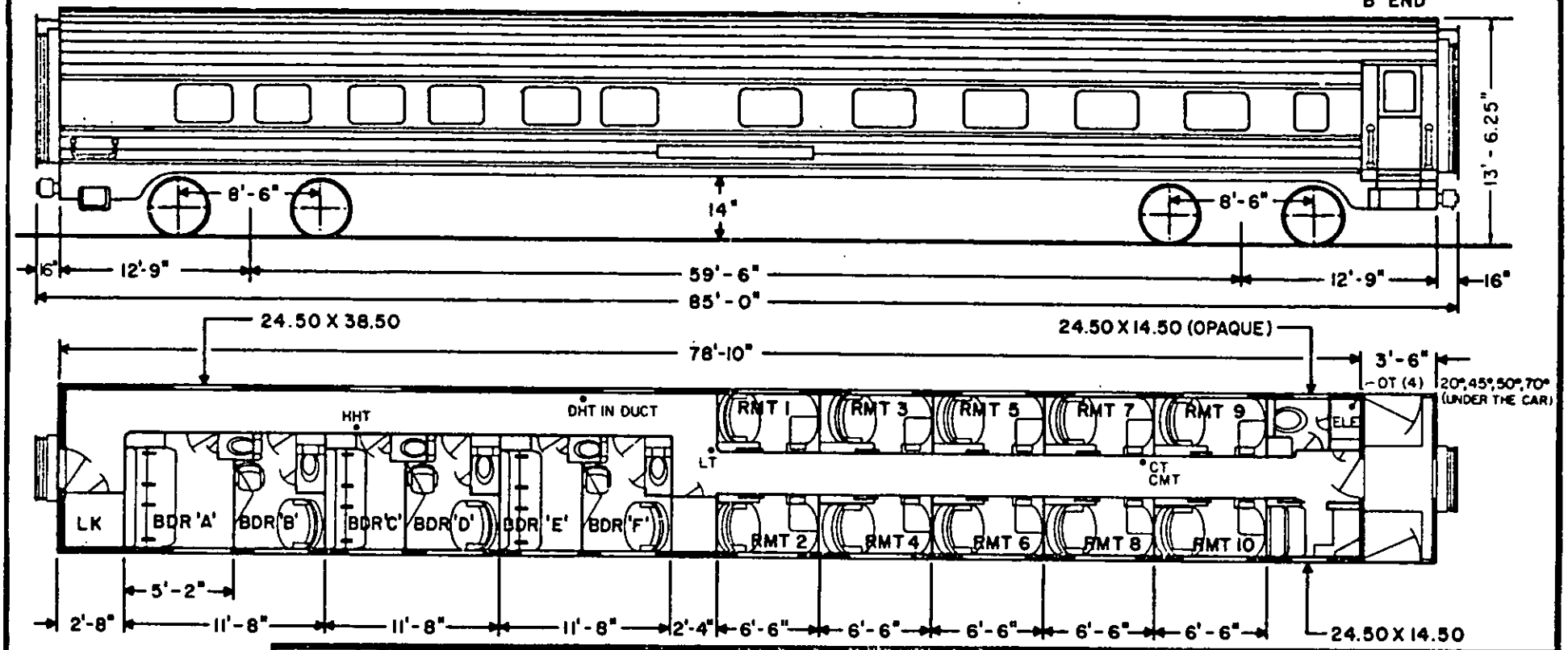
WC	Water Cooler
LK	Locker
ELE	Electric Locker
SWB	Switch Locker
OHV	Overhead Unit (A/C)
HB	Handbrake
WH	Water Heater

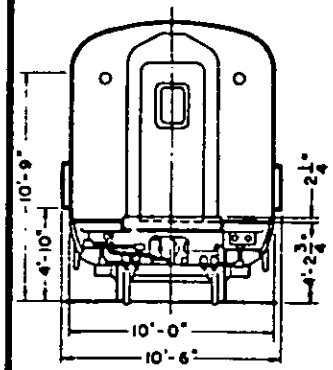
THERMOSTATS:

RAT	Return Air Thermostat
FAT	Fresh Air Thermostat
FHT	Floor Heat Thermostat
LHT	Layover Heat Thermostat
HHT	Hall Heat Thermostat
OHT	Overhead Heat Thermostat

FIG. 1.1A

AMTRAK EQUIPMENT PLAN AND SPECIFICATION DATA FOR CARS





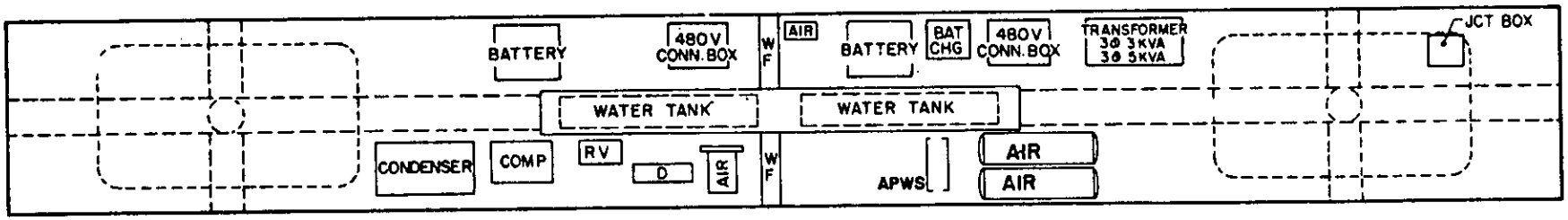
SPECIFICATION DATA

BUILDER: *BUDD* DATE: *1950* FOR: *UP* PLAN: *9655*	ELECTRICAL SYSTEM: *HEAD END POWER 480V, 3PHASE, 60HZ*	AIR CONDITIONING TYPE: *EM - FREON F12*
LOT: *9600-039* BODY CONSTRUCTION: *SS*	BATTERY MODEL & NO *EDISON ED-80*	EVAP. *SAFETY B-1444-10*
REVENUE CAPACITY: *JORMT-68OR* NON REVENUE CAPACITY *1*	VOLTAGE *64 NOM* CAPY. *80 AH*	COMP. *SAFETY B-3988-4*
CAR LOADED C.G.:	LIGHTING: AC: *INC.* DC *INC*	COND. *SAFETY B-2247-10*
TYPE & YEAR *CONVERTED TO HEP 1977*	MARKER LTS. *PAR-46*	TEMP CONTROLS *VAPOR 177X6475*
	TRAINLINE RECEPTACLE: *480V 27PT*	AC MOTOR CONTROLS *SAFETY B-3096*
TRUCKS: SUSPENSION TYPE: *OSH*	STANDBY RCPT.:	HEATING *ELECTRIC OVERHEAD 20KW*
WHEEL DIA.: *36"* CLASS: *BE*	COMM EQUIP. TYPE: *N/A*	HEATING *FLOOR HEAT 19.3KW*
JOURNAL SIZE: *6"X11"* PEDESTAL SIZE: *13"*	ANTI FREEZE *HEATING TAPE - WATER TANKS (2)*	WATER SYSTEM TYPE: *APWS* TANK CAPY.: *400 GAL*
BEARING TYPE: *ROLLER* ADAPTER TYPE:	ANTI FREEZE: *HEATING TAPE - UNDER CAR PIPING*	WASHSTANDS: *SS* HOPPER TYPE: *WHVC-VC*
BOLSTER SPRINGS: No.:		COOLER MOD. No. *120V AC*
EQUALIZER SPRING NO.:		
TYPE:		STEPS: *FOLDING*
SHOCKS: VERT NO LAT. NO		DIAPHRAGM: *MODIFIED DM 77-22* FOLDS
WEIGHT: 'A' END *61,600* 'B' END: *64,700*		
BRAKES TYPE: *D8 (CFM)* SCHEDULE		
CONTROL VALVE TYPE: *D-22AR* QUICK SERVICE		
RELAY VALVE TYPE: *B* HAND BRAKE TYPE: *NTBOOLE*		
ANTI-SLIDE TYPE: *AP-3* CYLINDER SIZE: *7 1/2" (8)*		
SHOE TYPE & NO *C* SLACK ADJ TYPE & NO		
DRAFT GEAR TYPE & NO *WMT WM-6-DP*		
COUPLER *N* YOKE		
COUPLER CARRIER		

Amtrak
National Railroad Passenger Corporation

2900-2941

FIG. 1.1B



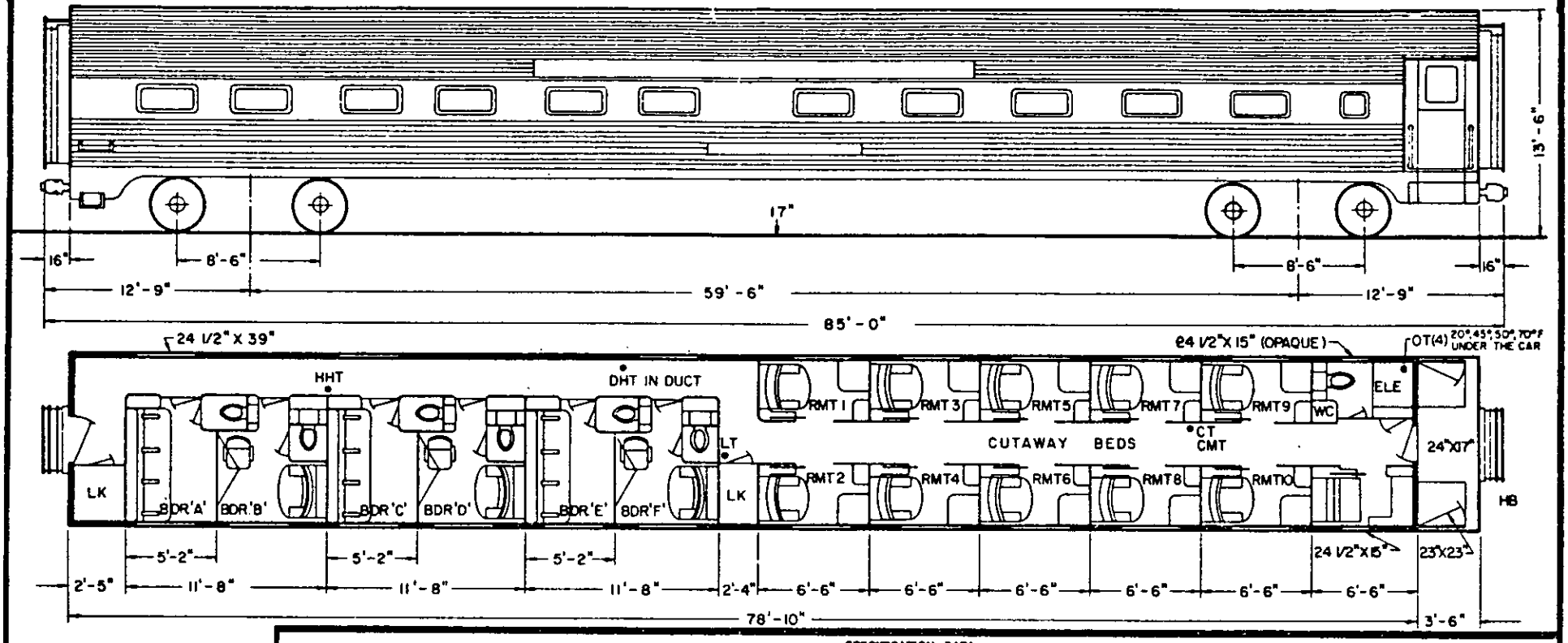
UNDERBODY VIEW THROUGH FLOOR

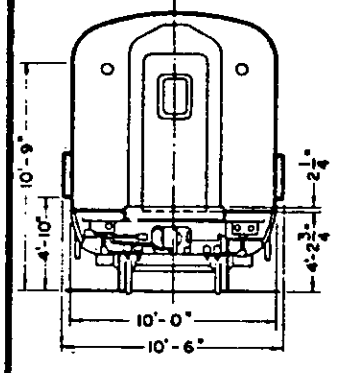
FORMER AMTRAK CARS: 2600 - 41
(FORMER CARS: UP 1401-1449)

FIG. 1.2A

AMTRAK EQUIPMENT PLAN AND SPECIFICATION DATA FOR CARS

'A' END: TOTAL WT.: 'B' END:





SPECIFICATION DATA

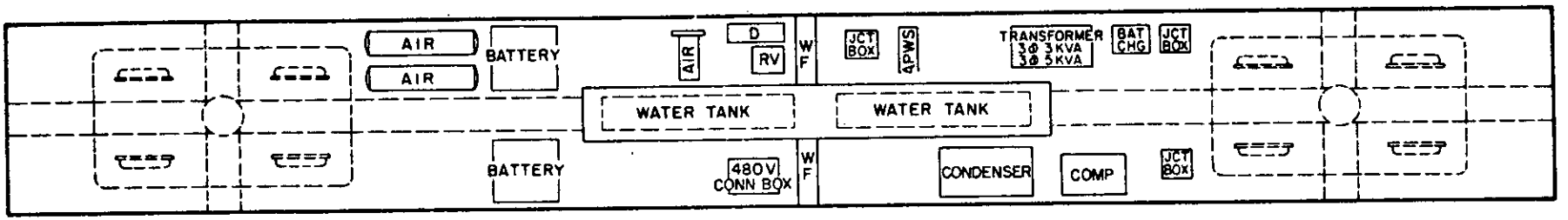
BUILDER: *BUDD* DATE: *1950* FOR: *SFE* PLAN: *9521*	ELECTRICAL SYSTEM: *HEAD END POWER 480V, 3PHASE, 60HZ*	AIR CONDITIONING TYPE *EM - FREON F12*
LOT: *9660-038* BODY CONSTRUCTION: *SS*	BATTERY MODEL & NO *EDISON ED-80*	EVAP.: *SAFETY B-1444-10*
REVENUE CAPACITY: *10RMT-6BDR* NON REVENUE CAPACITY	VOLTAGE: *64 NOM* CAPY *80 AH*	COMP.: *SAFETY B-3988-4*
CAR LOADED C. G.:	LIGHTING: AC: *FLUOR* DC *INC*	COND.: *SAFETY B-2247-10*
TYPE & YEAR *CONVERTED TO HEP 1977*	MARKER LTS.: *PAR-46*	TEMP CONTROLS *VAPOR 177X6475*
	TRAINLINE RECEPTACLE: *480V 27PT*	AC MOTOR CONTROLS *SAFETY B-3096*
TRUCKS: SUSPENSION TYPE: *OSH*	STANDBY RCPT.: *N/A*	HEATING *ELECTRIC OVERHEAD 20KW*
WHEEL DIA.: *36"* CLASS: *BE*	COMM. EQUIP TYPE: *N/A*	HEATING *FLOOR HEAT 19.3KW*
JOURNAL SIZE: *6"X11"* PEDESTAL SIZE: *13"*	ANTI FREEZE: *HEATING TAPE* *WATER TANKS (2)*	WATER SYSTEM TYPE: *APWS* TANK CAPY.: *400 GAL*
BEARING TYPE: *ROLLER* ADAPTER TYPE:	ANTI FREEZE: *HEATING TAPE - UNDER CAR PIPING*	WASHSTANDS: *SS* HOPPER TYPE: *WHVC-VC*
BOLSTER SPRINGS. No.:		COOLER MOD. No. *120V AC*
EQUALIZER SPRING NO.:		
TYPE:		STEPS: *FOLDING*
SHOCKS VERT. NO LAT. NO		DIAPHRAGM: *MODIFIED DM 77-22* FOLDS
WEIGHT 'A' END. 'B' END:		
BRAKES TYPE: *DB (CFM)* SCHEDULE		
CONTROL VALVE TYPE *D22* QUICK SERVICE		
RELAY VALVE TYPE *F-6* HAND BRAKE TYPE: *PK 800 L*		
ANTI-SLIDE TYPE *AP-3* CYLINDER SIZE *7 1/2"(8)*		
SHOE TYPE & NO *C* SLACK ADJ TYPE & NO.		
DRAFT GEAR TYPE & NO *MR A-4X8*		
COUPLER *CS-60* YOKE		
COUPLER CARRIER		

Amtrak — National Railroad Passenger Corporation

2980 - 2996

C-1-6

FIG. 1.2B



UNDERBODY VIEW THROUGH FLOOR

FORMER AMTRAK CARS: 2710 - 2733
(FORMER CARS: SFE 1617 - 1632)

CHAPTER 2 CAR BODY

Refer to Main Manual

CHAPTER 3 HEATING, VENTILATION AND AIR CONDITIONING

CHAPTER 3 HEATING, VENTILATION AND AIR CONDITIONING

LIST OF ILLUSTRATIONS

CHAPTER 3 - HEATING, VENTILATION & AIR CONDITIONING

3.0 General

NOTE: All Heating and A/C circuit breakers should remain on year round. While it may seem a good idea to turn off the A/C breaker in the winter or heating breakers in the summer, this is not the case. The temperature controls will turn on the heat or A/C as needed and have logic interlocks to prevent incorrect operation. Also, while it might be cool in one part of the country, it may be hot in another region. Many of the heating or cooling failures reported on HEP cars have been caused by breakers being off when they should not have been.

Climate control for passenger comfort on these cars consists of 4 operations:

1. Ventilation
2. Circulation
3. Filtration
4. Temperature Control

Ventilation is accomplished by introducing fresh air into the car from outside, replacing the stale air being exhausted.

A one horsepower blower fan (unique to the 2900 cars) is located above the vestibule ceiling, and is responsible for car air circulation. It takes fresh air, normally 600 cfm, and mixes it with recirculated air, delivering 2,400 cfm to the car's main air duct. (See Fig. 3-1) The blower is also responsible for car pressurization. To keep dust and dirt out of the car, the car is kept slightly pressurized. Thus, all the tiny openings in the carbody will have a small draft flowing out through them, keeping dust and dirt out.

The car air is filtered to remove dirt and lint by the air filters. These cars use two sets of filters, one for fresh air, and one for recirculating air (See Fig. 3-2). It is very important to keep these filters clean (as well as the thermostats). Otherwise, the car air conditioning and heating system will not function properly.

Note that the air filters are meant to have air flowing through them in only one direction, as indicated by the arrows on the side of the frame.

Air Filter, 16" x 20" x 2" AMT #24A9001385 AMMS # _____

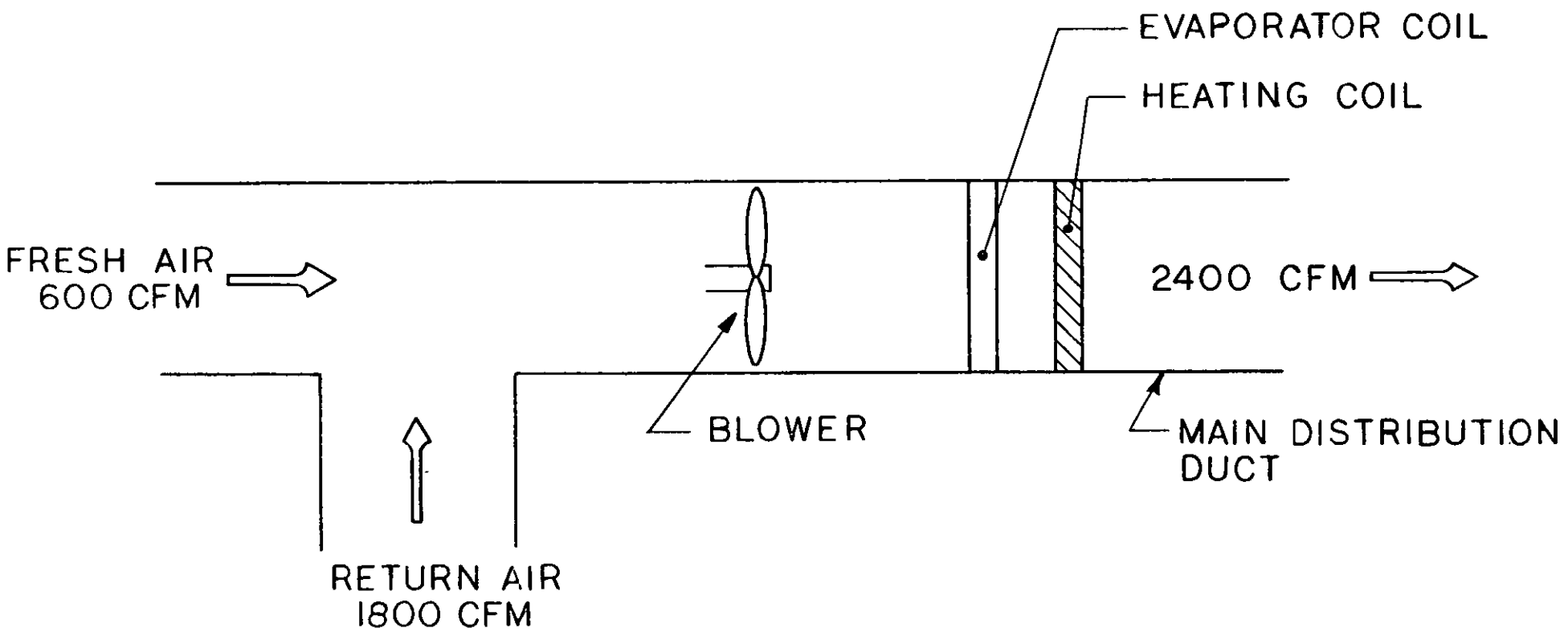
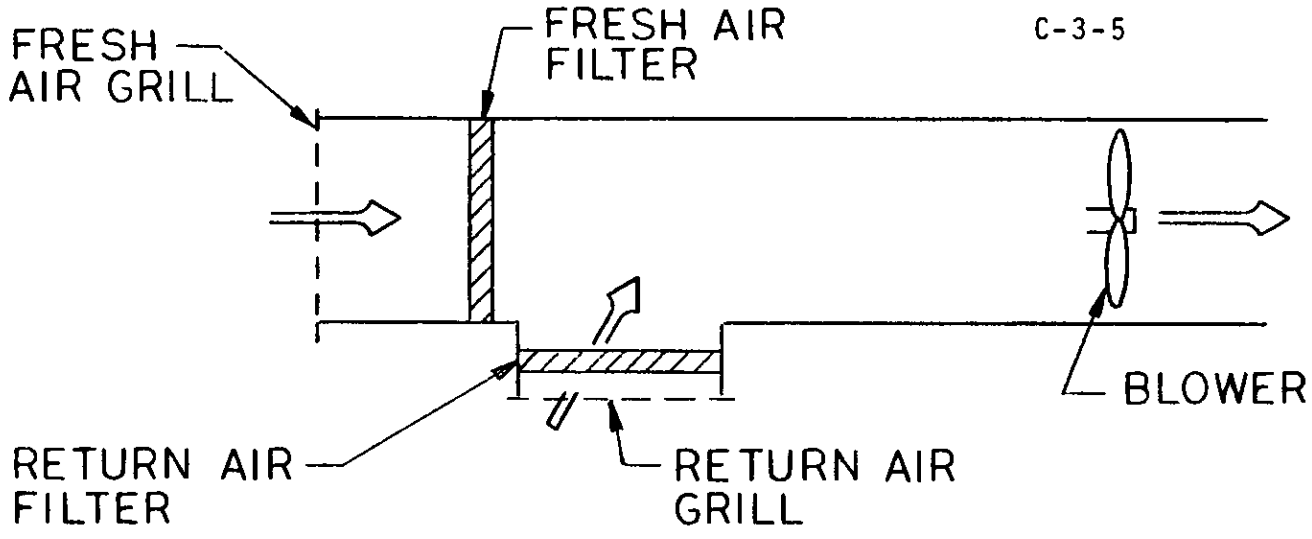


FIGURE 3.1
FRESH AIR / RETURN AIR BALANCE



DUAL FILTER SYSTEM

FIGURE 3.2
AIR FILTER SYSTEM

The car filter frame should indicate correct air flow direction, however it is always:

1. Fresh Air Filter - air flows into the car from this opening.

2. Return air grill - air flows up through this opening.

Temperature control is accomplished through the use of refrigeration or electric heat. Each car has one 8-ton cooling unit located in the ceiling. Heating is accomplished by a combination of overhead and floor heat, independently controlled.

A single temperature control panel controls all aspects of heating, cooling and ventilation.

3.1 Air Conditioning

Each car is equipped with a single Safety Co. 8-Ton air conditioning system. The system uses R-12 and parts are not interchangeable with the freon-22 system of later converted HEP cars.

Evaporator

The push-through evaporator is located almost above the vestibule of the car, along with the direct drive blower fan. The evaporator is split into two stages for 1/2 and full cooling. Included with the overhead assembly are the modulation valve, a moisture/flow indicator and strainer. The unit is also equipped with a two stage overhead heater.

Condenser

The air cooled condenser is located undercar, and consists of the coil itself, the fan and motor, and the modulation pressure switch (on the back).

Compressor

The open-frame compressor and drive motor are located undercar, near the condenser. Included with it are the pressure controls.

Starting Panel

The A/C starter panel is located in the electric locker and includes the A/C logic relays, blower fan, compressor, overhead contactors. Refer to Figure 6-14 for parts.

The A/C logic includes the following safety features:

1. Lockout below 50° outside air temperature.
2. Overload relays for blower fan, condenser fan and compressor motors to protect against overload. Manual reset is required on each.
3. Air Vane Switch & Blower Fan interlock to prevent evaporator freeze-up, should the blower fail to operate.
4. Low pressure shutdown (but not lockout) - self resetting.
5. High pressure shutdown (but not lockout) - self resetting.

Freon Charge

The weight of a full charge of freon 12 is approximately:

40 pounds

Compressor Oil

Until further notice, the following oils may be utilized in both Amtrak air conditioning systems:

	Amtrak #	AMMS #
Sunisco 3GS		
Texaco, Type Capella B*		

* Capella B may be replaced with Texaco WFI32.

Note: Although Sunisco 3GS and Capella B can be safely intermixed, other grades of Sunisco and Texaco (except WFI 32) oils should not be mixed, but should be drained when being replaced with the standard oil.

For a complete description of the A/C system as well as parts list and maintenance instructions, refer to the Safety Co. Manual, Section 3.1.1.

For A/C system tests, refer to test spec. PO-79-1 tests 3.2, 3.3 and 3.6.

DESCRIPTION	MANU.	MANU.	AMT #	AMMS#
Freon - 12	----	----		
Nitrogen (Water pumped) 220 CF CL			47L9001790	
Freon - 11	----	----	47B9003499	
Brazing Alloy ("Silver Solder")	Handy & Harmon	SILFOS		
Acid Test Kit	Safety	T15583	25A4000275	
Silicon Terminal Compound 2 oz tube	Dow-	#3		

Section 3.1.1

Operating Instructions & Service Manual

Safety Co. Component Type

8-Ton Air Conditioning System

Freon 12

Weight of Full Charge

Approx. 40 pounds

Oil:	Sunisic	3GS
	Texaco	Capella B
	Texaco	WFI32

Solenoid Valve Coil Resistance	_____	ohms
Compressor Motor Resistance	_____	ohms
Condenser Fan Motor Resistance	_____	ohms
Evaporator Fan Motor Resistance	_____	ohms

Figure 3.3
A/C EVAPORATOR - SAFETY CO. PART LIST

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
		Refer to Safety Manual for Further Part Lists				
1	--	Evaporator Blower Fan & Motor Unit Complete (Not same as other HEP cars)	Safety	B-1434-15	23X9012879	
2	1	Air Flow Switch	Ogontz	8373-2M	25H9012249	
3	1	Blower Wheel Left	Safety	T-1793-4		
4	1	Blower Wheel Right	Safety	T-1793-3		
5	1	Motor 1 HP 480V 3Ø, 1.5A, 1725 RPM, 182T	Baldor	38N73-287	25N9011513	
6	4	Resilient Mount Set (Frame to Car)	Safety	T-13706-5		
7	2	Shaft Extension Assembly	Safety	T-14037-3		
8	--	Evaporator Unit Complete	Safety	B-1444-17	25T9011509	
9	1	Electric Heater Unit (Not same as other HEP cars)	Safety	B-4319-1	25P9011518	
10	1	Overheat Thermostat "Klixon" 200°	Texas Inst.	C439157442-06A	23P9006951	
11	2	Expansion Valve (ALCO)	Safety	T-3695-1	25L9011519	
12	2	Expansion Valve Power Element	Safety	T-7339-1		
13	2	Expansion Valve Cage	Safety	T-11550		
14	1	Modulation Solenoid Valve	Safety	T-3330-1	25K9011514	
15	2	Solenoid Valve Coil	Safety	T-7820-4	25E9011515	
16	1	Strainer, Liquid	Safety	T-15531	23A4000306	
17	1	Moisture Indicator	Alco	MI-1SS5	23A4000305	
18	1	Flexible Duct - Blower to Evaporator	Safety	B-4409		
19	1	Flexible Duct - Evaporator to Car Duct, "Flexiduct"	Reeves Bros.	2209	23X9007382	
20	AR	Insulation, 2 1/8" ID Foam, 1/2" Wall	Aerotube	--	46N9001208	

Figure 3.4
A/C CONDENSER PART LIST

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
		Refer to Safety Co. Manual for further Details				
1		8 Ton Dry Condenser Unit	Safety	B-2442-14	25K9010511	
2		Condenser Coil	Safety	B-1566		
3		Fan	Safety	M-1890-2		
4		Motor - Condenser Fan, 2HP, 1725 RPM 3.1A	Baldor		25T9011512	
5		Liquid Receiver	Safety	M-1782		
6		Sight Glass, Receiver	Safety	T-12967-2	25A9001569	
7		Resilient Mount Set	Safety	T-13706		
8		Pressure Switch, Modulation	Safety	163748		
9		Filter Drier Assembly, Complete	Safety			
10		Gasket, Outlet Core Retaining Plate	Safety			
11		Gasket, End Plate	Safety			
12		Core, Filter Drier	Safety			
13		Shut Off Valve, Liquid Line at Drier	Safety			
14		Vibration Eliminator, Liquid Line	Safety			
15		Vibration Eliminator, Hot Gas Line	Safety			
16		Sight Glass/Moisture Indicator	Safety			

Figure 3.5
A/C COMPRESSOR AND COMPRESSOR UNIT PART LIST

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
		For Further Details, Refer to Safety Manual	---	---	---	---
1	1	Direct Driven Compressor Unit, 8 Ton	Safety	B-3988-4	25N9010510	
2	1	Compressor (Form 5295) 5F40	Safety	161705		
3	1	Coupling, Thomas	Safety	161685		
4	1	Motor, 15 HP, 1760 RPM, 19-7A, 480/3/60	Baldor		25X9011511	
5	1	Resilient Mount Set	Safety	T-13623-2		
6	1	Refrigeration Controls Assembly, Complete	Safety	B-2899-2		
7	(1)	High Pressure Gauge	Safety	T-16284-1	25A4000064	
8	(1)	Low Pressure Gauge	Safety	T-16283	25A4000065	
9	(1)	Manual Selector Switch	Safety	S-8816-2	25X9011517	
10	(1)	High Pressure Switch 30-270 PSI	Allen Bradley	836 H11 XHCS	25A8000451	
11	(1)	Low Pressure Switch 20" Vacuum - 120 PSI	Allen Bradley	836 AL11 NKCS	25D9006178	
12	(1)	Box Cover	Safety			
13	(1)	Box Seal	Safety	T-2964		
14	(2)	Service Valve	Safety	T-18169		
114	1	Vibration Eliminator, Suction Line	Safety			
115	1	Vibration Eliminator, Discharge Line	Safety			
2	REF	Compressor, 5F40 New Built	Safety	161705		
		Rebuilt	Safety	T-11902-1		
15A	1	Suction Shut Off Valve, 1 5/8" (Mueller)	Safety	162481		
15B	1	Suction Shut Off Valve, 1 5/8" (Henry)	Safety	T-4945		
16A	4	Cap Screw for Item 15A, 20A	Safety	162482		
16B	4	Cap Screw for Item 15B, 20B	Safety	54825		
17	1	Gasket, Cap Screw (Item 15)	Safety	151303		
18	2	Valve Cap (Item 15 and 20)	Safety	T2467		
19	2	Valve Cap Gasket	Safety	T2466		

Figure 3.5
A/C COMPRESSOR AND COMPRESSOR UNIT PART LIST
Page 2

20A	1	Shut Off Valve, Discharge (Mueller)	Safety	162480
20B	1	Shut Off Valve, Discharge (Henry)	Safety	T4924
21	2	Gasket, Suction or Discharge Valve to Crankcase	Safety	162497
22	--	Replacement Gasket Set	Safety	162510
23	(1)	Main Bearing, Seal End	Safety	161978
24	(4)	Dowel Pin, Valve Plate	Safety	T-2464
25	2	Oil Return Check Valve Package	Safety	162126
26	2	Cylinder Head Gasket	Safety	162487
27	1	Suction Strainer Assembly	Safety	162032
28	1	Oil Filter Screen Package	Safety	T2455
29	1	Manifold Cover Gasket	Safety	162486
30	1	Oil Regulating Valve Package	Safety	T2465
31	6	Cap Screw 3/8 - 16 x 1" (Manifold Cover)	Safety	157557
32	28	Cap Screw 3/8 - 16 x 3" (Cylinder Head Suction Manifold)	Safety	162424
33	34	Cap Screw Gasket (3/8)	Safety	151286
34	1	Shaft Seal Package	Safety	T1401
35	8	Cap Screw 3/8 - 16 x 1 - 1/4 (Shaft Seal Cover)	Safety	151375
36	1	Bearing Head and Oil Pump Assembly Includes:	Safety	T2462
37	(1)	Bearing Head Gasket	Safety	162493
38	(1)	Main Bearing, Pump End	Safety	162429
39	(3)	Cap Screw Gasket (5/8")	Safety	T2466
40	(12)	Cap Screw Gasket (3/8") (Bearing Head)	Safety	151286
41	(6)	Hex Head Cap Screw 1/4 - 28 x 3/4 (Oil Pump Cover)	Safety	164363
42	(6)	Cap Screw Gasket (1/4")	Safety	163534
43	(1)	Dowel Pin (Bearing Washer)	Safety	T2463
44	(1)	Oil Pump Package (Matched Parts)	Safety	T13006
45	(1)	Oil Pump Cover Gasket	Safety	T12652
46	(1)	Bearing Head Gasket	Safety	162493

Figure 3.5
A/C COMPRESSOR AND COMPRESSOR UNIT PART LIST
Page 3

47	12	Hex Head Cap Screw (3/8 - 16 x 1-3/4") (Bearing Head Cover)	Safety	T2459
48	1	Woodruff Key #21	Safety	162505
49	1	Retaining Washer (3/8")	Safety	162450
50	1	Lockwasher (3/8")	Safety	4411
51	1	Cap Screw (3/8 - 24 x 7/8")	Safety	162502
52	4	Connecting Rod and Bearing Package	Safety	T2451
53	1	Bearing Washer, Pump end	Safety	162461
54	1	Seal End Thrust Washer (steel)	Safety	162460
55	1	Seal End Bearing Washer (bronze)	Safety	162459
56	4	Piston and Pin Package (Unassembled)	Safety	162462
57	1	Piston Ring Package Includes:	Safety	T7690
58	(8)	Compression Ring	Safety	---
59	(8)	Oil Ring	Safety	---
60	2	Valve Plate Package Includes:	Safety	T2453
61	(1)	Valve Plate	Safety	---
62	(1)	Valve Plate Gasket	Safety	162488
63	(1)	Cylinder Head Gasket	Safety	162487
64	(2)	Suction Valve Disc	Safety	162468
65	(12)	Suction Valve Spring	Safety	162469
66	(6)	Guide Lockwasher	Safety	162476
67	(4)	Suction Valve Clip	Safety	161984
68	(6)	Cap Screw 1/4 - 28 x 1 (Guide to Valve Plate)	Safety	162425
69	(2)	Discharge Valve Guide Assembly Includes:	Safety	T13007
70	(1)	Discharge Valve Guide	Safety	162471
71	(1)	Discharge Valve	Safety	162472
72	(6)	Discharge Valve Spring	Safety	162474

Figure 3.5
A/C COMPRESSOR AND COMPRESSOR UNIT PART LIST
Page 4

73	(1)	Seal Lock Plate	Safety	162475
74	(3)	Cap Screw (1/4 - 28 x 1") (Lock Plate to Guide)	Safety	162425
75	(1)	Dowel Pin - 3/16 x 3/4 (Guide)	Safety	162478
76	(1)	Dowel Pin - 1/4 x 1/2" (Guide)	Safety	163519
77	(4)	Cap Screw 3/8 - 16 x 1 (Valve Plate to Crankcase)	Safety	157557
78	(4)	Cap Screw Gasket (3/8")	Safety	161286
79	1	Handhole Cover and Sight Glass Assy. Includes:	Safety	162426
80	(1)	Sight Glass Package Includes:	Safety	T13004
81	(1)	Sight Glass Assembly	Safety	T12670
82	(1)	Sight Glass Gasket	Safety	T12671
83	1	Handhole Cover and Control Valve Assem. Includes:	Safety	163527
84	(1)	Handhole Cover Gasket	Safety	163532
85	(1)	Hydraulic Relay	Safety	---
86	(2)	Socket Head Cap Screw (5/16 - 24 x 1 - 7/8")	Safety	164358
87	(2)	Cap Screw Gasket (5/16")	Safety	164359
88	(1)	Control Valve Assy. Package Includes:	Safety	164360
89	(1)	Valve Gasket, Inner	Safety	163533
90	(1)	Valve Gasket, Outer	Safety	163531
91	(1)	Control Valve Assembly Includes:	Safety	164361
92	(1)	Spring (7# - for R-12 and R-500)	Safety	163529
93	(1)	External Valve Assembly	Safety	163528
94	(1)	Valve Body with Bellows	Safety	164362
95	24	Cap Screw 3/8 - 16 x 2 - 1/4" (Handhole Cover)	Safety	162423
96	24	Cap Screw Gasket 3/8"	Safety	151286
97	1	Handhole Cover Gasket (Handhole Cover with Sight Glass)	Safety	162490
98	3	Unloader Sleeve	Safety	163535
99	18	Valve Lifter Spring	Safety	163536

Figure 3.5
A/C COMPRESSOR AND COMPRESSOR UNIT PART LIST
Page 5

100	18	Valve Lifter Pin	Safety	163537	
101	3	Unloader Power Element	Safety	163524	
102	(3)	Lockwasher (1/4")	Safety	T9400	
103	(3)	Socket Head Cap Screw 1/4 - 28 x 1 - 3/4"	Safety	---	
104	(1)	Cotter Pin (1/16 x 3/8")	Safety	---	
105	(1)	Plate Washer	Safety	---	
106	(1)	Clevis Pin	Safety	163526	
107	(1)	Unloader Fork	Safety	T2457	
108	3	Unloader Bracket Gasket	Safety	163530	
109	6	Socket Head Cap Screw 1/4 - 28 x 1" (Unloader Assby to Crankcase)	Safety	163521	
110	6	Cap Screw Lockwasher (1/4")	Safety	T9400	
111	1	Dust Seal Package	Safety	T2661	
112		Insulation, Foam 2 1/8" ID Foam, 1/2" Wall	Aerotube	---	46N9001208
113		Oil	Sunisco	3GS	
		OR	Texaco	Capella-B	
			Texaco	WFI32	

FORM 5774 (4/78)

OPERATING INSTRUCTIONS
AND
SERVICE MANUAL
"SAFETY" COMPONENT TYPE
8 TON - REFRIGERANT 12
AIR CONDITIONING SYSTEM

AMTRAK REFURBISHED CARS
ARRANGED FOR OPERATION
AT 460/3/60 POWER SUPPLY
AND 120/1/60 CONTROL VOLTAGE

Safety ELECTRICAL EQUIPMENT CORP.
NEW YORK · CHICAGO · PHILADELPHIA · ST. LOUIS · SAN FRANCISCO · NEW HAVEN · MONTREAL
1187 DIXWELL AVE., NEW HAVEN, CONN. 06514 TEL 203 865 3171

General Terms and Conditions of Warranty

Safety Electrical Equipment Corp. will only be responsible under the warranty conditions made at the time of sale of this equipment, provided the following procedures and conditions are met by the buyer:

(1) All equipment is maintained and serviced properly, as specified in the "Safety" Service and Instruction Manual for the equipment.

(2) Where items are not specifically covered in this manual, accepted good maintenance practice must be adhered to.

(3) All items having a normal wear factor, such as motor brushes, bearings, electrical contacts, etc. do not come under the terms of the warranty conditions.

(4) Safety will not be responsible for any loss of refrigerant.

(5) Safety will not be responsible for any defective equipment unless the parts used for maintenance or repair are furnished or approved by Safety.

(6) Safety will accept no return of equipment unless authorized in writing by the Company or its agent.

Safety ELECTRICAL EQUIPMENT CORP.
NEW YORK · CHICAGO · PHILADELPHIA · ST LOUIS · SAN FRANCISCO · NEW HAVEN · MONTREAL
1187 DIXWELL AVE NEW HAVEN CONN 06514 TEL 203 865 3171

In order to maintain "SAFETY" ELECTRO-MECHANICAL AIR CONDITIONING EQUIPMENT in proper condition, a schedule for servicing and inspection should be established and followed.

Operating conditions will vary on different railroads, so a suitable schedule will have to be based on experience. It is hoped that this manual will serve as a guide to setting up a good maintenance program. . .

Information such as maintenance procedures, wiring diagrams and tools to facilitate disassembly and reassembly, has been included to assist the maintenance forces in proper care of this equipment.

When supplemental information concerning "SAFETY" ELECTRO-MECHANICAL AIR CONDITIONING EQUIPMENT is required, it can be obtained from any of our District Offices. . . .

"SAFETY" COMPONENT TYPE AIR CONDITIONING SYSTEM

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SECTION 1

THE REFRIGERATION CYCLE

The refrigeration cycle is based on the principle that a volatile liquid, in evaporating or changing from a liquid to a vapor, absorbs heat. For example, wetting the hand and blowing upon it will produce a sensation of coolness. The evaporation of the water requires heat which is taken from the hand, causing a lowering of the temperature.

There are many liquids which can be used to produce cooling by causing them to change from a liquid to a vapor, but some are better suited for use in a refrigerating system than others because of their physical and chemical properties. A refrigerant suitable for use in an air conditioning equipment should have the following characteristics:

1. Non-flammable.
2. Non-explosive.
3. Non-toxic
4. Stable.
5. Must not combine with material used in the equipment.
6. Require low or moderate operating pressures.
7. Be readily available.

Refrigerant 12 possesses these qualities and is, therefore, commonly used in air conditioning systems. The temperature pressure relation for this refrigerant is shown in Table on Page I-2.

The flow of refrigerant through the cycle may be traced by reference to Figure 1, Page I-3. Liquid refrigerant flows from the receiver through the expansion valve to the evaporator. The pressure in the receiver is higher than the pressure in the evaporator and the expansion valve automatically regulates the flow as called for by the conditions of pressure and temperature in the evaporator.

In the evaporator the cooling effect takes place upon change of state of the refrigerant from a liquid to a vapor during the heat transfer process between the air to be cooled and the refrigerant. The expansion valve admits sufficient refrigerant such that all liquid has evaporated prior to leaving the coil.

The air circulating through the car is cooled by passing it over the evaporator surface.

The refrigerant vapor formed in the evaporator is removed by the action of the compressor. On the down or suction stroke of the compressor

Temp.	Pressure		Volume		Density	
°F.	Abs. lb./in.²	Gage lb./in.²	Liquid ft.³/lb.	Vapor ft.³/lb.	Liquid lb./ft.³	Vapor lb./ft.³
10	29.35	14.65	0.0112	1.351	89.45	0.7402
12	30.56	15.86	.0112	1.301	89.24	.7687
14	31.80	17.10	.0112	1.253	89.03	.7981
16	33.08	18.38	.0112	1.207	88.81	.8288
18	34.40	19.70	.0113	1.163	88.58	.8598
20	35.75	21.05	0.0113	1.121	88.37	0.8921
22	37.15	22.45	.0113	1.081	88.13	.9251
24	38.58	23.88	.0113	1.043	87.91	.9588
26	40.07	25.37	.0114	1.007	87.68	.9930
28	41.59	26.89	.0114	0.973	87.47	1.028
30	43.16	28.46	0.0115	0.939	87.24	1.065
32	44.77	30.07	.0115	.908	87.02	1.102
34	46.42	31.72	.0115	.877	86.78	1.140
36	48.13	33.43	.0116	.848	86.55	1.180
38	49.88	35.18	.0116	.819	86.33	1.221
40	51.68	36.98	0.0116	0.792	86.10	1.263
42	53.51	38.81	.0116	.767	85.88	1.304
44	55.40	40.70	.0117	.742	85.66	1.349
46	57.35	42.65	.0117	.718	85.43	1.393
48	59.35	44.65	.0117	.695	85.19	1.438
50	61.39	46.69	0.0118	0.673	84.94	1.485
52	63.49	48.79	.0118	.652	84.71	1.534
54	65.63	50.93	.0118	.632	84.50	1.583
56	67.84	53.14	.0119	.612	84.28	1.633
58	70.10	55.40	.0119	.593	84.04	1.686
60	72.41	57.71	0.0119	0.575	83.78	1.740
62	74.77	60.07	.0120	.557	83.57	1.795
64	77.20	62.50	.0120	.540	83.34	1.851
66	79.67	64.97	.0120	.524	83.10	1.909
68	82.24	67.54	.0121	.508	82.86	1.968
70	84.82	70.12	0.0121	0.493	82.60	2.028
72	87.50	72.80	.0121	.479	82.37	2.090
74	90.20	75.50	.0122	.464	82.12	2.158
76	93.00	78.30	.0122	.451	81.87	2.218
78	95.85	81.15	.0123	.438	81.62	2.284
80	98.76	84.06	0.0123	0.425	81.39	2.353
82	101.7	87.00	.0123	.413	81.12	2.423
84	104.8	90.1	.0124	.401	80.87	2.495
86	107.9	93.2	.0124	.389	80.63	2.569
88	111.1	96.4	.0124	.378	80.37	2.645
90	114.3	99.6	0.0125	0.368	80.11	2.721
92	117.7	103.0	.0125	.357	79.86	2.799
94	121.0	106.3	.0126	.347	79.60	2.880
96	124.5	109.8	.0126	.338	79.32	2.963
98	128.0	113.3	.0126	.328	79.06	3.048
100	131.6	116.9	0.0127	0.319	78.80	3.135
102	135.3	120.6	.0127	.310	78.54	3.224
104	139.0	124.3	.0128	.302	78.27	3.316
106	142.8	128.1	.0128	.293	78.00	3.411
108	146.8	132.1	.0129	.285	77.73	3.509
110	150.7	136.0	0.0129	0.277	77.46	3.610
112	154.8	140.1	.0130	.269	77.18	3.714
114	158.9	144.2	.0130	.262	76.89	3.823
116	163.1	148.4	.0131	.254	76.60	3.934
118	167.4	152.7	.0131	.247	76.32	4.049
120	171.8	157.1	0.0132	0.240	76.02	4.167
122	176.2	161.5	.0132	.233	75.72	4.288
124	180.8	166.1	.0133	.227	75.40	4.413
126	185.4	170.7	.0133	.220	75.10	4.541
128	190.1	175.4	.0134	.214	74.78	4.673
130	194.9	180.2	0.0134	0.208	74.46	4.808
132	199.8	185.1	.0135	.202	74.13	4.948
134	204.8	190.1	.0135	.196	73.81	5.094
136	209.9	195.2	.0136	.191	73.46	5.247
138	215.0	200.3	.0137	.185	73.10	5.405
140	220.2	205.5	0.0138	0.180	72.73	5.571

TABLE I-1 PHYSICAL PROPERTIES OF REFRIGERANT 12

piston, the cylinder is filled with vapor and on the up or discharge stroke, this vapor is compressed and discharged into the condenser. As the pressure is increased, the temperature likewise is raised due to the work done on vapor by the compressor.

The process which takes place in the condenser is the reverse of that in the evaporator. In the latter, heat is ADDED to the liquid, causing it to vaporize. In the condenser, heat is ABSTRACTED from the vapor causing it to condense to the liquid state. This heat is removed by passing outside air over the condenser surface.

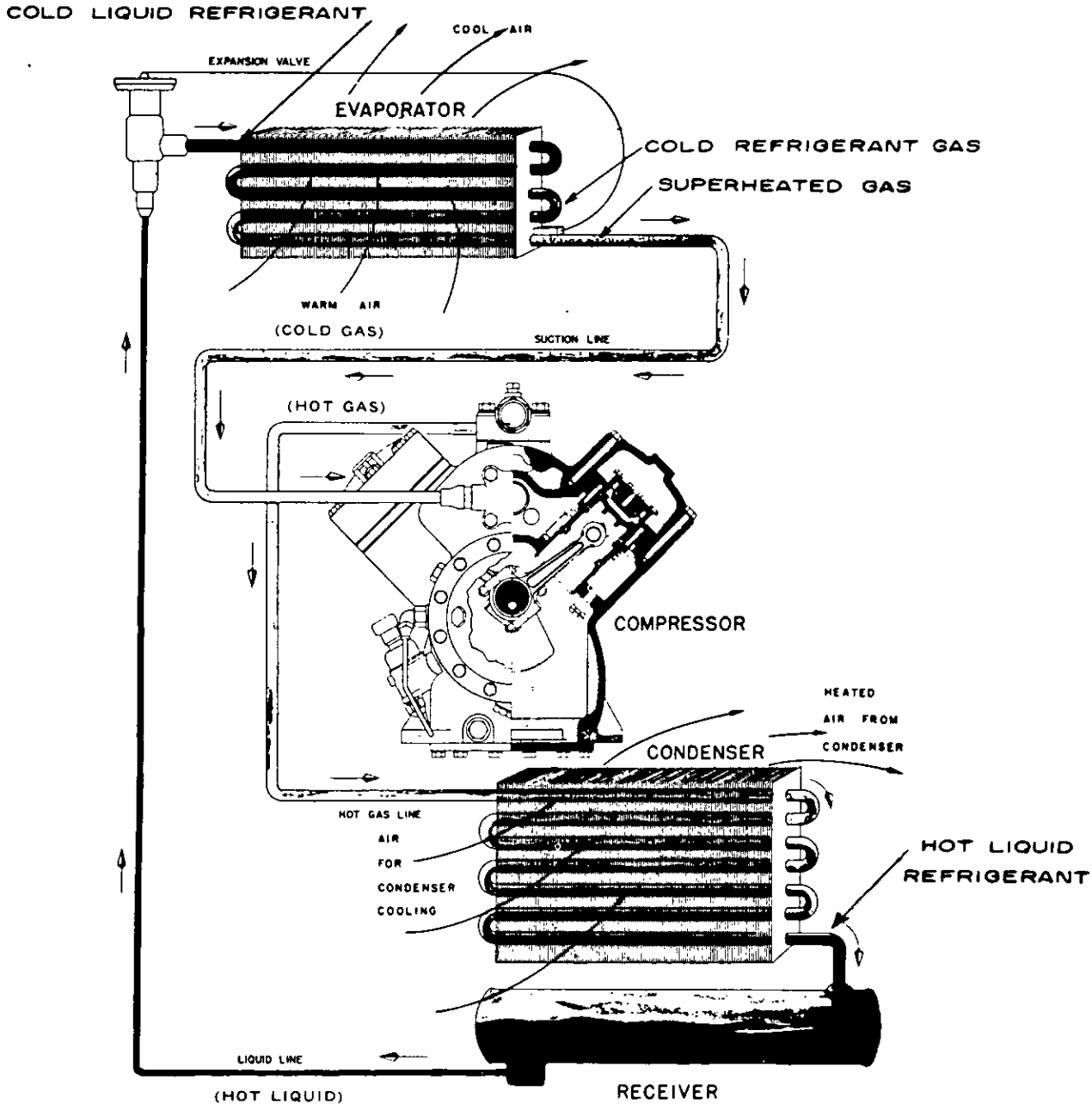


FIGURE I-1 DIAGRAM OF REFRIGERATION CYCLE

SECTION 2

DESCRIPTION OF EQUIPMENT

1. GENERAL

The "Safety" component type 8-ton (Refrigerant 12) electromechanical system consists of a separately mounted Motor-Compressor Unit, and a Condenser Unit applied underframe, together with an Evaporator and Blower Assembly which is mounted above the ceiling area at one end of the car. The motors are arranged for operation on 460/3/60 power supply and a control voltage of 120/1/60 hz.

MAIN COMPONENTS	CAT. NO.
1. Motor Compressor Unit	B-3988-4
2. Air Cooled Condenser Unit	B-2247-10
3. Evaporator and Blower Assembly	B-1444-17
4. Motor Control Panel	B-4290-1

2. DESCRIPTION OF OPERATION

To deliver conditioned air to the interior of the car body, a mixture of recirculated air, (returned from the car body) and outside air is filtered, passed through the evaporator and electric heat surfaces by the blower fans and discharged into the overhead centerline air distribution duct. By absorbing heat taken from the air, the liquid refrigerant from the receiver is vaporized in the evaporator. This cools and conditions the leaving air which is then ducted into the car body.

The refrigerant vapor leaving the evaporator is returned to the compressor where it is forced to higher temperature and pressure levels and discharged into the condenser. This compressed vapor is then liquified in the condenser by drawing outside air through the coil surface. The liquid refrigerant returns to the receiver and the cycle is repeated.

3. DESCRIPTION OF COMPONENTS

MAIN COMPONENTS

A. Motor-Compressor Unit - Cat. No. B-3988-4

Included in this unit are an adapter frame, compressor, motor, flexible coupling, refrigeration controls, and supporting bracket. The motor is flanged mounted to the bracket which holds the compressor to form a rigid unit as shown in Figure II-1. The assembly is isolated from the underframe support members by resilient mounts.

1. Adapter Frame - Cat. No. M-5999-3

The adapter frame is a rugged steel weldment which is secured to the undercar support members to provide the mounting structure for the resiliently mounted motor and compressor assembly.

2. Compressor - Cat. No. 161705

The compressor is a Carrier manufactured four cylinder, air cooled, open, "Vee-type", with forced feed lubrication and is powered by an external driving motor.

To match the requirements of the system, variations in capacity are obtained by the operation of a built-in cylinder control mechanism. Power for this control unit to load or unload three cylinders in sequence is obtained hydraulically from the forced feed lubrication system in response to changes in the suction pressure.

The principles of operation and maintenance procedures for the compressor equipped with capacity control mechanism are included in the Appendix, Form 5297.

3. Compressor Motor - Cat. No. T-18554

The compressor motor operates on 460/3/60 hz power, is a NEMA D-flange type, totally enclosed fan cooled, frame size 254T, and is rated 15 horsepower at 1760 RPM. Class "B" insulation is used and the design full load power is approximately 13 HP.

4. Flexible Coupling - Cat. No. 161685

Torque is transmitted to the compressor through a flexible coupling designed for high speed operation and heavy duty service. The stainless steel laminated disc assembly is torsionally rigid to prevent damage due to backlash and also provides for free end float of both connecting shafts.

5. Refrigeration Controls - Cat. No. B-2899-2

The refrigeration controls are installed in a weatherproof box attached to the support frame. These controls include a dual pressurestat having high and low pressure control switches, discharge and suction pressure gauges, and a three position selector switch for MANUAL-OFF-AUTOMATIC operation of the equipment. Gauge lines are equipped with shut off valves which should be opened only to determine operating pressure in the system. In the MANUAL position, the temperature control circuit is by-passed. This permits the operation of the equipment for test purposes at intervals when the thermostatic controls are satisfied. For normal operation, the AUTOMATIC setting should be used. When the cover of the control box is closed, the selector switch is positioned to the AUTOMATIC position.

6. Support Bracket - Cat. No. B-1023

The compressor bracket support is designed for the severe impact and shock loads experienced in railroad service. This unit is of all welded steel construction with a removable strut member to provide greater accessibility to service the compressor.

B. Air Cooled Condenser - Cat. No. B-2247-10

The air cooled condenser shown in Figure II-2 consists of a condenser coil mounted in an all welded support frame, liquid receiver, integrally mounted motor with direct connected axial flow fan, and a pressure modulation control switch. The assembly is resiliently hung underframe from the car support members.

1. Condenser Coil - Cat. No. B-1566

The coil is arranged for counterflow of refrigerant and the cooling medium. A heavy duty all steel six blade axial flow fan which operates in a venturi for high efficiency draws the air through the coil surface.

An expanded metal guard protects the coil inlet face from flying road ballast, and a removable hot dipped galvanized fan guard is provided at the fan discharge.

Superheated refrigerant vapor from the compressor enters near the top of the coil and the liquified subcooled refrigerant flows to the receiver.

2. Liquid Receiver - Cat. No. M-1782

The liquid receiver is mounted vertically on the supporting frame and consists of a welded steel shell with two dished heads, two sight glasses, liquid inlet and outlet shut off valves (5/8" OD flare), and purge valve (1/4" OD flare). This is also used as a test valve to insure that liquid is not stored above this point when both inlet and outlet valves are closed.

A 1/4" OD flare connection is provided as an integral part of the receiver outlet valve for charging the system with liquid refrigerant. This is a backseating type valve and, in the fully open position, the charging port is closed.

3. Condenser Fan and Motor

The condenser fan, Cat. No. M-1890-2, is driven by a 2 HP, 1725 RPM, totally enclosed, 145T frame size motor arranged for 460/3/60 hz power supply. The design load for this motor, Cat. No. T-16822, is approximately 1.3 HP.

The compressor and condenser fan motor must start and stop simultaneously.

C. Evaporator and Blower Assembly - Cat. No. B-1444-17

To deliver conditioned air to the overhead centerline distribution duct, the evaporator and blower assembly includes the following components:

(1) 20 KW Electric Heat Assembly

(2) Evaporator Coil Assembly with Associated Piping

(3) Drain Pan

(4) Flexible Plenum

(5) Blower and Motor Assembly

1. Electric Heat Assembly - Cat. No. B-4319-1

The overhead electric heat assembly is mounted down stream of the evaporator coil assembly. It is an open design type (corrosion-proof bare wire elements with ceramic insulators.)

(a) The overhead heat is arranged for two stage operation of 10 KW each at 460/3/60 hz power supply. Each stage is spread out over the entire air path. The heater elements will not be damaged by sustained operation at ± 10% rated voltage swings.

(b) To provide protection against excessive heat build up, loss of air, etc., a single pole, single throw N.C. thermoswitch (set to open at 200°F and with an automatic reset of 185°) is mounted at the top of the casing. The switch, Cat. No. T-14045, has a silicone rubber overmold, is preset, non-adjustable, and not field serviceable. This thermoswitch operates a shunt trip circuit breaker. The N.O. contacts are in series with a shunt coil which is physically a part of the circuit breaker feeding the overhead heat assembly. With a rising temperature caused by loss of air and, should the heat contactor remain closed for any reason, the thermoswitch contacts will close as the internal temperature passes the set point. This then energizes the shunt coil in the circuit breaker which causes an immediate trip, thus shutting down power to the overhead electric heat assembly. To reestablish power to the heater assembly, the circuit breaker must be reset.

2. Evaporator Coil Assembly - Cat. No. M-4142-1

The evaporator coil, Cat. No. B-2488-1, is a six row 3/8" OD copper tube coil with extended surface of .010" copper plate fins spaced eight to the inch.

(a) The coil is divided horizontally into two halves for modulated control when other than full cooling is required. Each section is multi-circuited and fed by an expansion valve which consists of a power assembly cage, and valve body. The valve power assembly is equipped with a thermal bulb which is securely attached to the suction line header fed by the valve.

(b) Expansion Valves - Cat. No. T-3695-1

The two expansion valves are located at the side of the evaporator assembly. They feed liquid refrigerant to the two multi-circuited sections of the evaporator coil. See Parts List 5775 in the Appendix. Each expansion valve has a liquid distributor, 1/4" SAE external equalizer connection, and an external superheat adjusting stem.

NOTE: In service, the equalizer line must always be connected to the suction header fed by the valve to sense the suction pressure leaving the coil, otherwise, the valve may flood, starve, or regulate the flow of refrigerant erratically.

The expansion valves are operated by the pressure differential between the suction pressure in the evaporator and the pressure in the thermostatic charge of the thermal bulb. Since the thermal (feeler) bulb is in thermal contact with the suction line, the pressure in the bulb is a function of the suction line temperature. Since the valve operates on a pressure differential, it cannot be set to produce a fixed evaporator pressure.

After the evaporation of the liquid refrigerant in the evaporator, the suction vapor is superheated and its temperature will increase. However, the evaporator pressure, neglecting the pressure drop, is unchanged, The warmer vapor flowing through the suction line increases the bulb temperature. Since the thermal bulb contains both a liquid and vapor charge, the temperature and pressure will increase. The higher bulb pressure causes the valve to open and admit more refrigerant to the evaporator. Conversely, if the valve feeds too much refrigerant, the bulb temperature is decreased, or the evaporator pressure is increased, to cause the valve to close and adjust to the new load condition.

(c) Modulation Control Solenoid Valve - Cat. No. T-3330-11

For capacity reduction, the admission of refrigerant to the top evaporator circuit is controlled by a normally closed solenoid valve (with 120/1/60 coil, Cat. No. T-7820-4) which responds to the temperature modulation thermostat.

To open the valve manually in the event of failure of the coil, a side adjusting stem opens a by-pass for liquid refrigerant. To open the valve manually, the stem must be turned a maximum of one-half revolution counter-clockwise. Under normal service conditions, the manual opening stem is positioned to the closed setting.

3. Drain Pan - Cat. No. M-1485-1

A stainless steel drain pan extends under the evaporator coil and electric heat assemblies to collect condensate which is formed on the evaporator coil surface. The pan is pitched to drain to the back edge where two copper tube lines are connected.

The exterior of the pan is insulated to prevent condensation of the cold surface. A premolded vinyl plastic insulation with a minimum thickness of 1/4" is applied to the outside surface. Baffles and splash angles are provided within the pan to prevent condensate from spilling over on grades or during periods of acceleration or deceleration.

4. Flexible Plenum - Cat. No. B-4409

A fire resistant and water-proof flexible duct of neoprene covered glass fiber is provided between the fan and motor assembly and the evaporator. This duct may be detached easily to permit access to the coil surface for cleaning and inspection.

5. Blower and Motor Assembly - Cat. No. B-1434-15

The blower motor assembly is resisiently mounted to overhead car support members. The assembly is rated 2400 CFM at 1.25" wg TSP and includes: two forward curved, double width, double inlet (DWDI) centrifugal blower wheels which are flange mounted to shaft extensions on a 182T frame size, one horsepower motor.

The motor, Cat. No. T-16807-1, is open, drip-proof, equipped with sealed bearings for normal service life and will operate at 1725 RPM on a 460/3/60 hz power supply.

After uncoupling the mating flanges for the shaft extensions to which the blower wheels are applied, the motor may be lowered by removing four mounting bolts.

D. Motor Start and Control Panel Assembly - Cat. No. B-4290-1

The motor control panel contains the components for starting the compressor motor, condenser fan motor, blower fan motor and electric heat assembly and the essential overload protective devices.

The panel is arranged so that any component subject to wear or deterioration may be serviced or replaced from the front without removing the panel from the electrical locker.

SYSTEM AUXILIARIES (Optional)

The Refrigerant Flow Diagram, MSK-2396, Figure 1 in the Appendix lists schematically the various system optional auxiliaries which are piped in the liquid refrigerant lines.

a. Moisture and Liquid Indicator, Cat. No. T-15521-2.

This assembly is installed in the liquid line to the evaporator section immediately ahead of the expansion valves. This indicator shows the adequacy of the refrigerant charge as well as the quality or relative dryness of the liquid in the system. The indicator element is highly sensitive to moisture and will gradually change color in direct relation to an increase or decrease in the moisture content of the system. The dry-caution-wet system operating conditions are then easily determined by matching the element color with the four colors displayed on the reference label. Colors vary as often as the moisture content in the system changes. An unsafe (wet) indication would call for replacement of filter-drier cores.

The indicator element before installation will indicate an unsafe condition. This is normal and simply reflects the room humidity condition. Also, LIQUID refrigerant must be in contact with the indicator element, with the system in operation, to insure a positive and true color reading.

The fused glass eyepiece in the indicator provides a clear wide angle view of the liquid refrigerant flow so that bubbles or flash gas may be easily seen. This condition indicates an insufficient system charge, low discharge (head) pressure, insufficient liquid subcooling or some form of restriction in the liquid line. Low discharge pressure will occur when reduced cooling load demands prevail or low outside ambient conditions prevent the build up of the high side pressure in the condenser.

Thus the discharge pressure must be at least 180 psig and 37 psig suction before the determination of low charge of refrigerant is made. Following installation of the moisture and liquid indicator or filter-drier cores, the system should be allowed to reach equilibrium after a minimum of twelve (12) hours operation before attempting to determine safely the moisture content in the system. If a caution or unsafe condition is still indicated following this period, the filter-drier core assembly must be replaced. This practice should be continued until the system is dry and a safe condition is indicated.

b. Line Solenoid Valve - Cat. No. T-3330-11

A normally closed solenoid valve is located in the main liquid line to the evaporator and also in the coil modulation (top) circuit. These valves are also equipped with a manual opening stem which serves as a liquid by-pass so that the system may continue to operate in the event of failure of the coil. To open the valve manually, the stem must be turned counterclockwise a maximum of one-half revolution. For normal system operation, the valve must be operated with the manual stem in the closed position.

The system does not require pump down operation but since the quantity and location of the refrigerant within the system piping cannot be definitely controlled, the main line solenoid, along with the check valve in the compressor discharge line, will stop the migration of refrigerant after shut down. In this way oil dilution and carry off from the compressor are avoided.

In service, the line solenoid valve opens ten (10) seconds in advance of compressor start up.

Refer to Form 5453-A in the Appendix for the list of replacement parts and service instructions.

c. Liquid Line Strainer Assembly - Cat. No. T-15531

A cleanable "Y" type forged brass strainer with 5/8" ODF solder end connections contains a replaceable monel screen #80 mesh size with a screw clean out plug. A 44 micron (#325) mesh "cleanup" screen is installed in the liquid line strainer for use during the first 6 - 10 hours of operational tests to collect and remove any foreign contaminants from the system piping. However, the standard #80 mesh screen, Cat. No. T-15532-1, is applied prior to the release of the car to service operation.

Shutoff valves are provided at the inlet and outlet connections to isolate the refrigerant charge when the monel screen is cleaned or replaced.

To clean or replace the screen, isolate the refrigerant charge by pumping down the system. Close the inlet valve at the assembly and operate the compressor until the suction pressure is approximately 2 psig. Close the outlet valve. Set the selector switch to the OFF position. Loosen the strainer screw plug slowly to relieve residual line pressure. USE CAUTION TO PREVENT INJURY TO THE EYES, FACE, AND HANDS. Unscrew the plug and remove the screen nested within the recess. Wash the screen in a clean solvent. (Do not use carbon tetrachloride.) Dry the screen thoroughly and insert the non-reinforced end within the recess in the plug. Replace the plug loosely and open the inlet valve at the assembly momentarily to purge the line. Tighten the cap and test for leaks. Open the inlet and outlet valves.

d. Check Valve - Cat. No. T-14691-1

A check valve is installed in the discharge line between the compressor and condenser coil. This is to insure that refrigerant entrained in the high side of the system is not permitted to return to the compressor during periods of shut down.

e. Liquid Line Filter Drier - Cat. No. 163088

A filter-drier of the replaceable core type is mounted in the liquid line at the outlet of the receiver. Its purpose is to filter out particles in the piping system (copper, solder, dirt) and to retain any moisture left in the system at installation or introduced while servicing.

Valves are provided at the inlet and outlet of the assembly so that the two cores, Cat. No. 163089, may be replaced without opening the entire system.

The procedure for renewing the core assembly and the list of replacement parts is described on Form 5287-A in the Appendix.

f. Flexible Line Connectors

The refrigerant liquid, suction, and discharge lines at the resilient mounted condenser and compressor assemblies are equipped with neoprene jacketed flexible tube connectors. These are a mechanical bellows type with neoprene coverings over the flexible seamless bronze hose and bronze wire braid to provide resistance to abrasion, and to prevent condensation and moisture from freezing behind the ferrules.

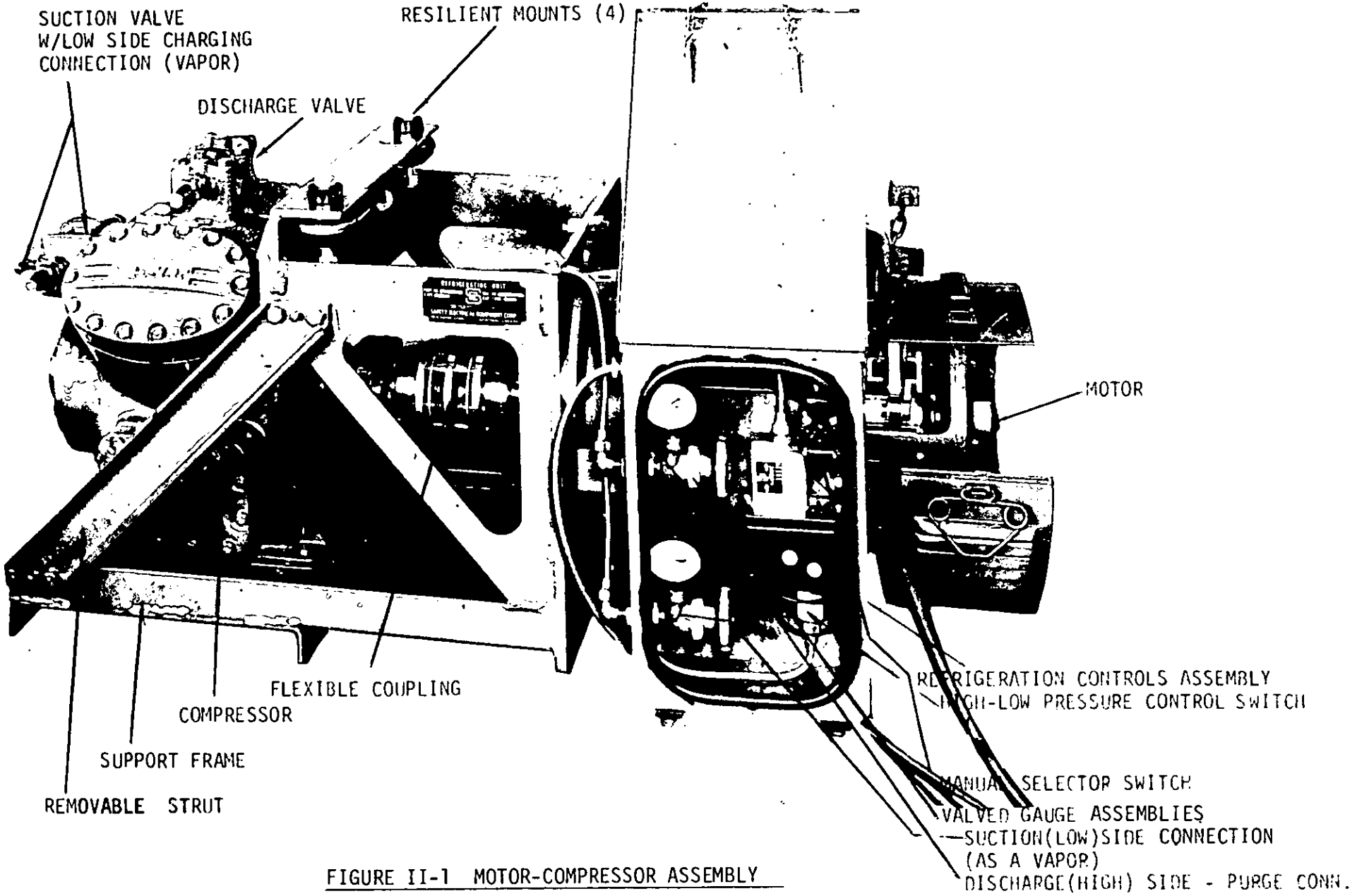


FIGURE II-1 MOTOR-COMPRESSOR ASSEMBLY

Type B-3988 Less Unit Adapter and Undercar Mounting Support Frame

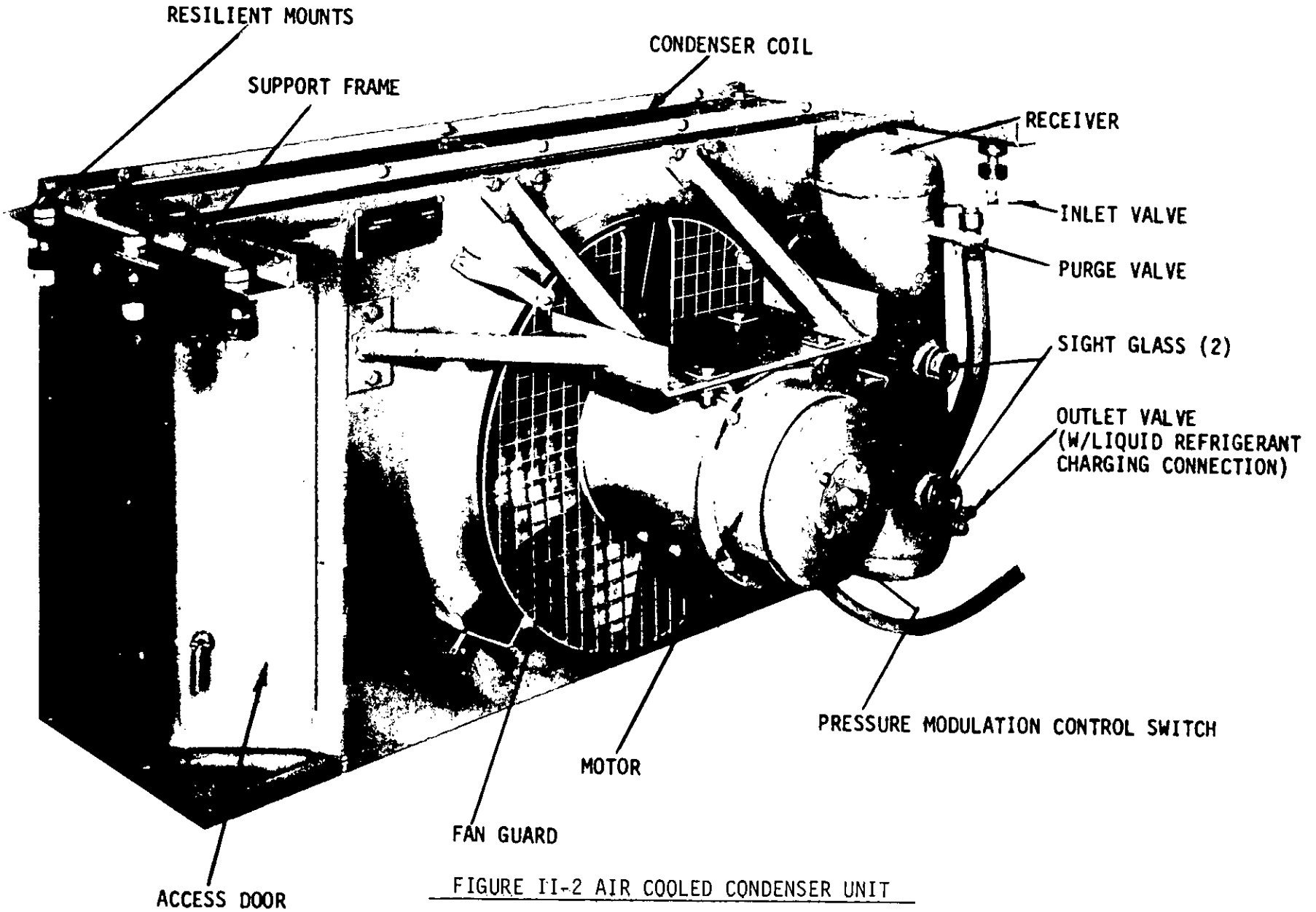


FIGURE II-2 AIR COOLED CONDENSER UNIT

TYPE B-2447 LESS UNIT ADAPTER AND UNDERCAR MOUNTING SUPPORT FRAME

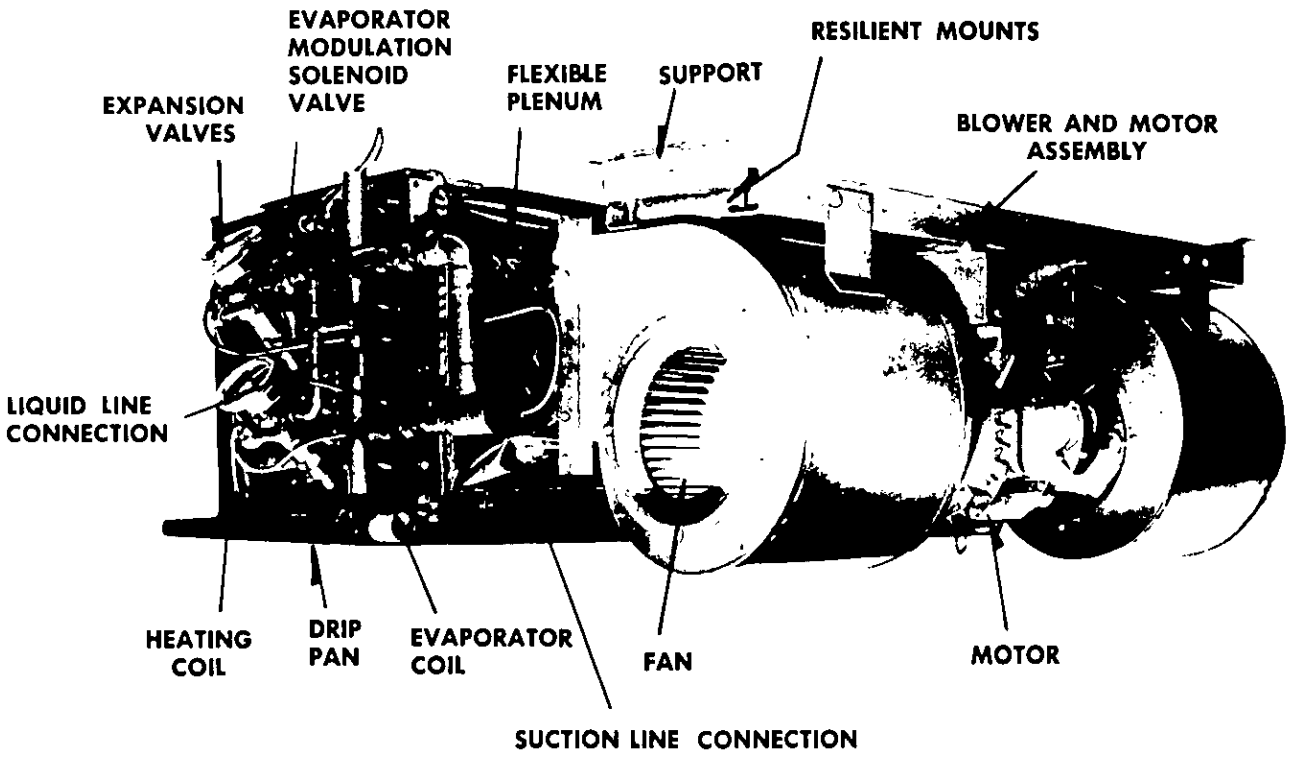


FIGURE II-3 EVAPORATOR AND BLOWER UNIT
TYPE B-1444

SECTION 3

OPERATION

With all circuit breakers arranged in the "ON" position, switches closed, and the compressor motor control switch in the AUTOMATIC setting, the control circuit is energized. This permits current flowing to the evaporator blower motor circuit to operate the air circulating fans in the overhead unit. The system is now capable of automatic functioning in either the full or modulated cooling cycles to satisfy the given load conditions. The operation of the controls is described in Section 7 and also illustrated schematically in the wiring diagram, Figure 2 in the Appendix.

If the car body temperature is above the high thermostat setting and calls for full cooling, the compressor motor and condenser fan motor will start. The system then operates at rated capacity, that is, with all cylinders of the compressor loaded and pumping and both sections of the evaporator coil in use.

Also, the:

1. Evaporator Blower Motor is operating.
2. Compressor Motor and Condenser Fan Motor run.
3. Evaporator modulating solenoid valve is energized (open).

This mode of operation continues until the car body temperature is reduced to the setting of the high thermostat. The controls then function to reduce the cooling capacity. During this modulated operation as the evaporator solenoid valve closes the compressor automatically unloads in response to the lowering of the suction pressure. The functioning of the unloading compressor with pressure type capacity control mechanism is contained in the Appendix, Form 5297.

If the car temperature continues to fall to the setting of the low thermostat, the controls function to stop operation. The condition of the equipment then is:

1. Evaporator Blower Fan Motor is operating.
2. Compressor Motor and Condenser Fan Motor are stopped.
3. Evaporator modulation solenoid valve is closed.

This arrangement provides for the automatic adjusting of the system capacity to approximate the cooling load requirements.

It should be noted that the conditions under which the equipment is called upon to operate are not constant. Together with changes in the outside temperature, the internal cooling load varies with the temperature and the number of passengers. This combination of variables affects the operating performance. Under light cooling loads or low outside temperatures, the suction and discharge pressures will also be lower than conditions of heavy loads when a build-up in operating pressures will be noted.

When the system is not operating, the suction and discharge pressures will tend to equalize. The final pressure depends upon the car temperature and the outside temperature.

OPERATING INSTRUCTIONS

Initial Starting Check:

1. Check oil level in compressor sight glass. This level should be 1/2 sight glass.

2. Check all electrical circuits for tight connections.

3. Refrigerant lines should be checked for tightness using a Halide leak detector torch.

4. Open and backseat the compressor discharge and suction shut off valves.

5. Open the inlet and outlet valves at the receiver.

Starting Instructions:

1. Arrange the circuit breakers at the temperature control panel to the "ON" position and close the cooling switch to set the evaporator blower motor in operation.

2. To operate the cooling cycle, the compressor motor control switch should be set to the "Automatic" position. The equipment will then operate at rated capacity if the high thermostat setting is exceeded or at reduced capacity if the low thermostat is in control. For test purposes where by-passing the control thermostats is necessary for operation of the system, the compressor motor selector switch should be set to the "Manual" position.

3. It is essential that the condenser fan be arranged for proper rotation. (Draw through operation). Since the compressor is equipped with a gear type positive displacement oil pump, the directional arrow on the top of the cover plate must be checked. If the arrow does not point in the direction of rotation, the oil pump must be reversed by following the procedure outlined in Form 5297.

4. Trouble diagnosis charts are given in Section 5 and, in the Appendix, Form 5297.

5. The nominal settings for the high and low pressure controls and the pressure modulation control switch are provided in the following table:

Pressure Control Switch Type	Cut-Out (Open)	Cut-In (Closed)
High Pressure Control	275	225
Low Pressure Control	2-5	12-15
Modulation Pressure Control	235	205

TABLE III-1 PRESSURE CONTROL SWITCH SETTINGS (Nominal)

NOMINAL OPERATING DATA - 8 TON SYSTEM (REFRIGERANT R-12)

460/3/60 hz. POWER SUPPLY AND 120/1/60 CONTROL VOLTAGE

Evaporator Cooling Load	96000 BTU/HR
Air Volume	2400 cfm @ 1.25° wg TSP
Air to Condenser	95°F DB
Suction Pressure (at Compressor)	32 psig
Discharge Pressure (at Compressor)	195 psig
Compressor Motor, 15 HP	460/3/60 hz power
Speed (approximately)	1760 RPM
Current, (FL) approximately	17 amps
Power (FL) approximately	13 HP
Condenser Fan Motor, 2 HP	460/3/60 hz power
Speed (approximately)	1725 RPM
Current (FL) approximately	3.0 amps
Blower Fan Motor, 1 HP	460/3/60 hz power
Speed (approximately)	1725 RPM
Current (approximately)	1.6 amps
Control Voltage	
Nominal	120/1/60
Compressor	
Discharge Line Temperature	Hot
Suction Line Temperature	Cool - No Frost
Oil Charge	12 pints (U.S.)
Oil Level In Crankcase	
When Operating (approximately)	Half Level in Sight Glass
When Not Operating	1/3 - 2/3 Sight Glass Level
Refrigerant Level in Receiver(*)	Half Level in Lower Sight Glass

(*)at 180 psig Discharge Pressure and 37 psig Suction Pressure

TABLE III-2 - TABLE OF OPERATING DATA (Nominal)

SECTION 4

ROUTINE SERVICE INSTRUCTIONS

More satisfactory operation with fewer failures will be obtained if the equipment is put in first class condition during prescribed car shopping periods, by adhering to preventive maintenance schedules, and implementing systematic service procedures.

Weekly:

1. Clean air filters, grilles, and screens.
2. Check evaporator blowers and condenser fan for tightness on shafts.
3. Check motor and compressor mounting bolts for tightness.
4. Check motor compressor coupling for tightness.
5. Clean surface of condenser coil.
6. Check operation of control panel.
7. Operate unit to check oil and refrigerant levels under steady operating conditions. Note any signs of leakage which will be indicated by oil at the point of leakage. See Service Instructions for adding oil and refrigerant.
8. Inspect motor brushes and commutators.

Monthly:

1. Clean the surface of the evaporator coil.
2. Flush the drip pan under the evaporator coil.
3. Clean drain lines to provide for free drainage.
4. Inspect and, if necessary, clean contacts on motor control panel.
5. Follow all steps outlined for weekly servicing.

Annually:

1. The equipment should be given a thorough inspection and a complete check of the controls made prior to seasonal changeovers.
2. All steps listed for weekly and monthly servicing should be followed.
3. Inspect all motors.
4. Thoroughly clean all coil surfaces.
5. Blow dirt from interior of casing.

CAUTION

Where established maintenance schedules require the pumping down of the system and the isolation of the refrigerant charge in the receiver, care should be taken to insure that the top of the liquid level is visible in the upper sight glass to allow for expansion.

PREPARATIONS FOR WINTER

Although no special precautions are required during the winter heating season, the refrigerant circuit should be inspected for leaks. Necessary repairs should be effected in order that positive pressure will be maintained within the system during the winter shut down period.

SECTION 5

TROUBLE DIAGNOSIS CHART

Faulty operation of the system is indicated by very definite symptoms. These symptoms may be caused by one or more incorrect conditions which must be eliminated in a step by step process of corrective measures. The following chart of symptoms, their causes and corrections, will be of assistance in quickly and efficiently locating faults.

The procedures to be followed in making repairs are given in Section 6.

HIGH HEAD PRESSURE

May be due to:	Correction:
a. Air or non-condensable gases in system.	a. Purge from the receiver.
b. Insufficient condenser air.	b. Clean air screen and the condenser surface.
c. Dirty condenser.	c. Clean the condenser surface.
d. Too much liquid in the receiver.	d. Draw off some of the liquid.
e. Discharge valve closed.	e. Open the valve.

LOW HEAD PRESSURE

a. Liquid refrigerant flooding back from the evaporator.	a. Examine fastening of feeler bulbs to suction lines.
b. Leaky compressor discharge valve.	b. Test; if leaking, replace.
c. Suction valve closed.	c. Open the valve.
d. Liquid valve on the receiver closed.	d. Open the valve.

HIGH SUCTION PRESSURE

a. Overfeeding of the expansion valves.	a. Check the bulb attachments.
b. Leaky compressor suction valves.	b. Pump down, remove the cylinder head, examine the valve discs or rings; replace if worn.
c. Excessive cooling load on system.	c. When pre-cooling car in hot weather the suction pressure will be high, but should gradually decrease as the car is cooled.

LOW SUCTION PRESSURE

May be due to:	Correction:
*a. Insufficient refrigerant in system.	*a. Check the liquid level in the lower receiver sight glass; add refrigerant if necessary.
b. Too much oil circulating in system.	b. Check for too much oil; remove some if necessary.
c. Suction valve closed.	c. Open the valve.
d. Liquid valve at the receiver is closed.	d. Open the valve.
e. Little or no cooling load on the evaporator coil	e. This will occur if the air circulating fan is not operating.
f. Clogged liquid filter-drier.	f. Pump down and apply new filter-drier core.
g. Evaporator coil is dirty.	g. Clean the coil.
h. Faulty unloader mechanism.	h. Apply new unloader control unit.

FREQUENT CYCLING

a. High pressure cut-out switch incorrectly set.	a. Check setting of switch.
b. Low pressure cut-out switch incorrectly set.	b. Check setting of switch.
c. Air circulating fans not running.	c. Check the fan motor, protective overload devices and connections.
d. Thermal bulb on the expansion valve has lost charge.	d. Detach the bulb from the suction line and hold in the palm of one hand. With the other hand grip the suction line. If flooding through is observed, the bulb has not lost its charge. If no flooding is noticed, replace valve power element.
*e. Insufficient refrigerant in system.	*e. Add refrigerant.
f. Suction valve or liquid valve closed.	f. Open the valves.

NOISES

a. Fan striking housing.	a. Align the motor with housings.
b. Ticking or rattling,loose bolts	b. Tighten.
c. Hissing - at expansion valves.	c. Check the refrigerant flow and level in lower receiver sight glass.
d. Bearing noise - worn motor bearings.	d. Replace bearings.
e. Rattle - inadequately supported piping, loose unit covers.	e. Tighten.

COMPRESSOR IS NOISY

May be due to:	Correction:
a. Vibration.	a. Tighten the compressor mounting bolts. Check coupling.
b. Too much oil in circulation.	b. Check the oil level in the crankcase and for oil in the refrigerant.
c. Slugging due to the expansion valves feeding too much refrigerant.	c. Check to see if the thermal bulbs are securely clamped and make good contact with the suction lines.
d. Wear of parts, such as pistons, pins, bearings, etc.	d. Determine the location of cause. Repair or replace the compressor.

COMPRESSOR WILL NOT START

a. Thermostat set too low.	a. Equipment will operate only on manual setting of compressor control switch if car temperature is below thermostat setting.
b. Overload protective device tripped. Switches open.	b. Reset overload protective device and close switches.
c. High-pressure cut-out switch open.	c. Check the setting of the switch and adjust if necessary.
d. Low-pressure cut-out switch open.	d. Check the setting of the switch and adjust if necessary.
e. Dirty contacts.	e. Check and clean the contacts on all switches.
f. Cooling control switch OFF.	f. Turn to the ON position.
h. Low-pressure cut-out switch open (after pump down).	h. "Jump" terminals to close contacts. This,then,permits flow of refrigerant and pressure buildup to reset.

CYLINDERS AND CRANKCASE SWEATING

a. Too much oil in circulation.	a. Make oil test. Remove, if necessary, to maintain oil level at 1/2 sight glass.
b. Too much refrigerant in circulation.	b. Check setting of expansion valves and contact between the thermal bulbs and the suction lines.

FAILURE TO COOL	
May be due to:	Correction:
a. Air circulating fans not running.	a. Check the motor, overload protective devices, contacts.
b. Compressor not operating.	b. Check the thermostat, overload protective devices, contacts, etc.
*c. Insufficient refrigerant in system.	*c. Check the level in the lower sight glass of receiver.
d. Air filters dirty.	d. Clean the filters.
e. Compressor speed too low.	e. Check the voltage and the motor.
f. Evaporator modulation solenoid valve closed.	f. Check operation of coil.

AIR CIRCULATING FAN NOT OPERATING	
a. Fan switch is in OFF position.	a. Make oil test. Remove, if necessary, to maintain oil level at 1/2 sight glass.
b. Too much refrigerant in circulation.	b. Check setting of expansion valves and the contact between the thermal bulbs and the suction lines.

*Note: To prevent overcharging the system, the determination of low charge should be made when the discharge (high side) pressure is not less than 180 psig.

SECTION 6

MAINTENANCE AND SERVICE INSTRUCTIONS

This section provides procedures for establishing preventive maintenance and systematic servicing schedules which are the keys to successful operation.

1. GENERAL

a. Safety:

When any work is to be done on the components of the air conditioning system, always make sure that the equipment cannot be started automatically or accidentally. If valves are closed and/or circuits interrupted during service procedures, the control switches should be suitably tagged with such notations.

(1) Importance of Dehydration:

Too much emphasis cannot be placed on the importance of maintaining the system free of moisture. Slight amounts of water in the system will inevitably lead to trouble in the following forms:

a. Corrosion of steel parts.
b. Intercrystalline corrosion of the bellows.
c. Copper plating of the shaft and bearings.
d. Sludging or gumming of the oil.
e. Plugging of the strainers.
f. Freezing and plugging of expansion valves.

Whenever it is necessary to open the system for any reason, always take precautions to prevent the entrance of air into the system, as air always contains some water vapor. Isolate as much of the system as possible from the portion to be opened by closing suitable valves and tightly plugging the open pipe ends. Purge the opened section immediately prior to reclosing.

(2) Use of Alcohol:

The introduction of alcohol or other similar commercial preparations for the purpose of overcoming freezing trouble at the expansion valves due to moisture in the system is not recommended. The cure leads to trouble worse than the cause.

(3) Grease Solvents:

Many grease and oil solvents can be used without harmful effects. When washing compressor parts or cleaning new components use naphtha, gasoline (non-leaded) or benzine. Thoroughly dry the parts before placing them in use. Carbon tetrachloride SHOULD NOT be used.

(4) Soldered Connections:

The use of "EASY-FLO" silver solder, or equivalent, is recommended in the refrigerant system piping.

Prior to disturbing any connections, the type solder originally used should first be verified and then continued. By taking this precaution, the contamination of the joint will be avoided.

(5) Opening the System

Whenever it is necessary to open a charged or functioning system to make repairs or replacements, it is necessary to evacuate the refrigerant from that part of the refrigerant circuit. The final evacuation should be to a slight positive pressure before the system is opened. If the final evacuation is reduced to less than atmospheric, sufficient refrigerant should be bled into the evacuated part of the system to raise the pressure to approximately 2 psig. Connections may then be broken and the necessary repairs made. One connection should be made first so the air in that part may be swept out through the free end by purging with refrigerant gas bled from the charge in the system. The other connection or connections should then be promptly made. If, after breaking connections, more than a few minutes must elapse, the free ends of the system should be capped. Extreme care must always be taken to prevent the entrance of moisture and dirt into the system.

It is essential when soldered joints are to be unsweated that the residual pressure in the line be vented to the atmosphere prior to the application of heat.

(6) Evacuating Air from the System

PRECAUTIONS

Do not use the compressor as a vacuum pump nor as an air compressor. It was not designed to handle air and will not pull down to as low a vacuum as a pump designed for that service. Similarly, if used to compress air, serious overheating and consequent damage may result.

Connect a pump capable of drawing a vacuum of .2" mercury absolute or higher to that part of the system which has been opened. Continue until all air and moisture have been removed.

To evacuate the air from the system it is essential that the normally closed liquid line solenoid valves located at the Evaporator Assembly be open. See Figure 2 in the Appendix. This is accomplished by energizing the coils or manually turning the lifting stem located at the side of the valves approximately one-quarter to one-half turn counterclockwise.

The final evacuation may be accelerated, however, by manifolding the connections to the vacuum pump and evacuating simultaneously the high and low sides of the system. The vacuum should be broken by introducing refrigerant.

(7) Testing for Leaks:

The preferred method for finding leaks is to use a Halide Leak Detector Torch. Testing with soap suds at joints will reveal only the larger leaks and is, therefore, ineffective in determining the tightness of a system. Much time will be saved by the use of the detector. Several types are available. Some are small units burning alcohol while others are arranged for attaching to small acetylene cylinders. Study and follow carefully the directions which are furnished with the detector.

In checking for leaks, slowly pass the end of the exploring tube over joints or other points where leakage might occur and note the color of the detector flame. Small leaks will give a greenish tint to the flame while large leaks color the flame a vivid blue.

(8) To Add Refrigerant to the System:

It is important to have the correct amount of Refrigerant 22 in the system. If there is too little, the expansion valves will pass vapor and reduce the capacity of the evaporator. Too much refrigerant will result in higher head pressures and oil dilution. It is equally important to ascertain that the receiver is level before charging the system or adding refrigerant. If it is not level, a false reading will be indicated in the sight glass. Under steady operating conditons of 275 psig discharge pressure and 70 psig suction pressure, the liquid refrigerant level should be approximately at the center of the lower sight glass.

NOTE: Build-up the high side pressure to at least 180 psig before making a determination of the refrigerant level. This can be done by partially blocking the inlet air to the condenser.

Whether the refrigerant charge is added in the vapor or the liquid state, it is important initially to purge the air from the transfer tube. Also, a greater pressure must be maintained at all times in the refrigerant cylinder or the charging operation stopped.

(a.) Low Side Charging as a Vapor

NOTE: When adding refrigerant vapor to the low side of the system, always charge with the refrigerant cylinder in the upright position; that is, with the service valve up so as to avoid the slugging of liquid to the compressor. During this operation, the cylinder will become cold and the pressure will drop accordingly. The transfer of refrigerant can be accelerated, however, by gently applying heat to the cylinder.

A 1/4" SAE charging connection is provided at the low (suction) pressure gauge shut off valve in the Refrigeration Control Unit.

To charge the system at the suction pressure gauge valve port, proceed as follows:

1. With one end of the transfer tube connected to a refrigerant service cylinder, attach the other end loosely to the charging port. Purge the charging line for a few seconds by cracking the cylinder to allow gas to escape and sweep air through the loose connection.

2. Tighten the flare connection, open the cylinder valve to admit refrigerant vapor only, and the suction pressure gauge valve.

3. Use the cylinder valve to control the flow of refrigerant vapor, being careful to avoid any sudden rise in pressure.

4. Under steady operation conditions, observe the liquid level in the receiver. When this has risen to approximately one-half in the lower sight glass close the service cylinder and suction pressure gauge valve.

5. Remove the transfer tube and replace the seal cap at the charging port.

(b.) Charging as a Liquid

To add refrigerant to the system through the high side, it is necessary to charge as a liquid. The refrigerant cylinder must be inverted or inclined to insure liquid refrigerant will be drawn into the liquid line. A 1/4" SAE charging port connection is incorporated in the outlet valve of the receiver for this purpose.

NOTE:

Some new style refrigerant service cylinders are equipped with dip tubes. This allows the liquid refrigerant to be drawn off with the tank in the upright position.

1. Backseat the liquid outlet valve at the receiver by turning the valve stem counter-clockwise to the fully open position. This closes the port.

2. With a refrigerant service cylinder inverted, attach the transfer tube loosely to the charging port. Purge air from the line and tighten the flare connection.

3. Frontseat the receiver outlet valve by turning in the valve stem clockwise to the closed position. This opens the port and permits the flow of refrigerant into the system.

4. With the equipment operating, observe the rise of the level in the lower sight glass of the receiver.

5. Backseat the valve to close the charging port. Under steady operating conditions and the discharge pressure not less than 180 psi, the refrigerant level should be at half the lower sight glass in the receiver.

6. Remove the transfer tube and replace the seal cap at the charging port.

CAUTION: To prevent overcharging the system it may be necessary to repeat steps 3, 4 and 5 during the charging cycle with small amounts added at intervals.

9. Removal of Non-Condensable Gases:

Air and non-condensable gases in any system collect in the receiver above the liquid. These can be removed by purging at the valve provided for this purpose at the top of the receiver. To purge, open the valve for a few seconds. Note any decided difference from the initial pressure when the valve is again closed. Repeat the operation until the pressure is approximately equal to the refrigerant vapor pressure corresponding to the temperature of the receiver. (See TABLE I-1, Section 1).

10. Adding or Removing Oil

a. Compressor Lubrication

To insure proper lubrication of the compressor and functioning of the unloader mechanism, the level of oil in the crankcase should be approximately 1/3 bull's-eye during steady operating conditions. Prior to adding oil, however, it is important that the amount of oil in the system be checked. This should be determined only if the head pressure is above 180 psig and the system has been in operation at least 30 minutes. The procedure to add or remove excess oil is given in the Appendix. (See Section I, Form 5297).

2. SERVICING THE COMPRESSOR-MOTOR ASSEMBLY

As illustrated in Figure II-1, the components of the Compressor-Motor Assembly are carried on a common supporting base which is resiliently hung from the underframe of the car.

Under shop conditions or where space and equipment factors are favorable, the assembly may be removed and replaced as a unit using a fork lift truck.

The following procedures outline the steps to remove the individual components:

a. To Remove the Motor:

1. Set the control switch to the "off" position. Disconnect and tag the motor leads.

2. Remove the bolts which secure the control box assembly to the compressor base, and support it from the car frame to prevent damage to gauge lines. (Close compressor shut off valves if control assembly is removed).

3. Remove the short bolts from the flange of the coupling which is mounted on the motor shaft.

4. Block up under the motor.

5. Remove four bolts which secure the motor to the compressor support base.

6. Remove two bolts mounting motor feet to the support channel.

7. Slide motor to the right and remove.

b. To Remove the Compressor:

Note: It is not necessary to unsolder the refrigerant lines nor move the compressor motor.

1. Pump down the system to remove the refrigerant from the compressor. Close (front seat) the suction valve at the compressor by advancing the valve stem in a clockwise direction.

2. Operate the compressor until the suction pressure does not rise above 2 psi. Allow the compressor to cycle 2-3 times at low pressure.

3. Set the control switch to the "off" position.

4. Close (front seat) the discharge valve and disconnect the 1/4" flare discharge pressure gauge connection at the compressor body to bleed off residual pressure in the compressor.

5. Remove the cap screws which secure the compressor shut-off valves.

6. Remove short bolts of the flexible coupling which extend through the flange on the compressor shaft.

7. Loosen the jack screws used for horizontal alignment, and remove the compressor hold-down bolts. Slide the compressor assembly through the end of the support frame.

c. To Replace the Compressor:

After it is in position.

1. Attach the discharge and suction valves and make up loosely the gauge connections to the compressor. Open the discharge and suction shut-off valve momentarily to purge the compressor through the gauge connections.

2. Tighten the gauge connections.

3. Replace the bolts in the coupling flange and align it as described under "Flexible Coupling."

4. Open all valves and test for leaks.

Note: It is recommended that new gaskets be used when re-applying the suction and discharge valves. Insure that the direction of rotation of the oil pump is the same as that of the motor.

d. Compressor:

The general description, principles of operation, and maintenance procedures are contained in the Appendix, Form 5297.

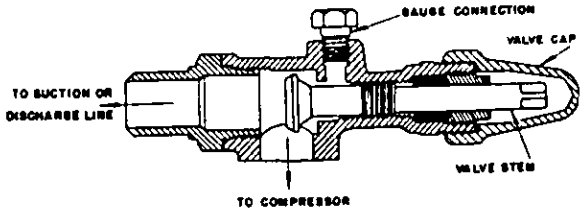
e. Compressor Service Valves:

The compressor discharge and suction stop valves are provided with a double seat and gauge tapping as shown in Figure VI-1. Turning the valve stem all the way to the right (forward) closes the outlet of the valve and in this position the gauge connection is open to the pressure in the compressor.

Turning the valve stem all the way out backseats the valve, and closes off the gauge connection. Therefore, when attaching a gauge or charging line to gauge opening, the valve must be backseated to prevent escape of refrigerant from gauge tapping.

Excessive use of force should be avoided when the valve stem is turned all the way in or all the way out. Always use a square ratchet wrench or box end wrench when operating or closing a valve. Never use an adjustable wrench or pliers since their use will soon round the valve stems making it impossible to close the valve tightly. If the

valve stem turns hard it may be necessary to loosen the packing nut slightly while adjusting. See Figure VI-1.



COMPRESSOR SERVICE VALVE

FIGURE VI-1

f. FLEXIBLE COUPLING ALIGNMENT

1. Caliper and Straight Edge Method

The coupling is a flexible type in which the torque is transmitted by an assembly of thin stainless steel discs. To operate satisfactorily, the elements of the coupling must be aligned within certain limits. Whenever the compressor or motor has been moved, it will be necessary to check the alignment of the coupling. See Figure VI-3.

For vertical alignment, shims must be placed under the compressor feet. To obtain horizontal alignment, use the jackscrews on the compressor base for lateral adjustment. The following procedure - if executed with care - will establish the desired alignment. Tools required are:

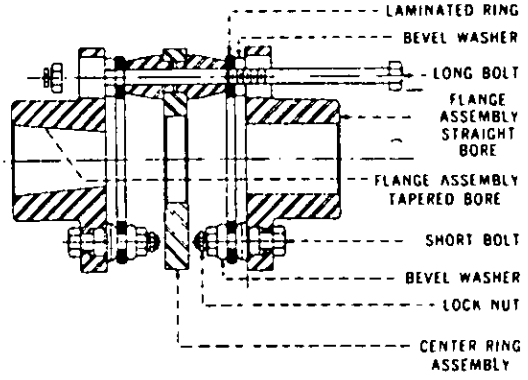


FIGURE VI-2 FLEXIBLE COUPLING

1. Straight edge (6")
2. Inside calipers
3. Steel rule (graduated in 64ths)
4. Two 7/16" socket wrenches
5. One 7/16" open end wrench
6. Allen screw wrench

Clean the compressor and motor shafts and inspect for burrs. Fit the compressor flange to the compressor shaft. Note that this flange has a tapered bore. Do not use the shaft center hex screw and washer to draw the flange into place. After it is in place, tighten hex screw securely.

Next fit the motor flange to the motor shaft. Note that this flange has a straight bore and is keyed to the shaft. All parts should fit together snugly, but easily. DO NOT FORCE.

Views 1 and 2 Figure VI-3 illustrates the coupling with correct alignment. With the motor bolted to the supporting frame, it is then necessary to align the compressor frame with the motor frame.

During initial alignment, the hold-down bolts should be loose enough to permit movement of the compressor.

1. Place a straight edge on the rims at the top and sides. When the coupling is in alignment, the straight edge should rest in full contact.

2. With the coupling completely assembled on the shafts, check dimension "E" (the distance between flanges) at several points around the circumference. This dimension should be exactly 2-7/16" at all points. Secure the motor flange to the motor shaft with the two set screws provided.

3. Referring to View 2, if the coupling is in correct alignment, dimensions "A", "B", "C", AND "D" are equal within 1/64" at all points around the circumference.

4. Tighten the compressor hold-down bolts and recheck dimensions "A", "B", "C", AND "D". If these dimensions are now not equal within the tolerance of 1/64", either angular and/or parallel misalignment exists. Note that all measurements are made to the outside edges of the flanges.

5. View 3 illustrates angular misalignment which should be corrected first.

6. To correct this condition, move and/or shim the compressor as required, until dimensions "A" and "B" are equal to "C" and "D" within 1/64".

7. View 4 illustrates parallel misalignment. Note that dimensions "A" and "D" are not equal to "B" and "C". Approximate parallel misalignment can be checked by lining up flanges with a straight edge placed across the two flanges at four points equally spaced around the circumference as shown in View 1.

8. To correct this condition, move and/or shim the compressor as required until dimensions "A" and "D" are equal to "B" and "C" within 1/64"

All final checks must be made with the compressor hold-down bolts tight. After this initial alignment, run the unit long enough to let the motor and compressor warm up, then make the final check for alignment and tightness. When operating at full speed, both laminated ring assemblies should have a distinct and clearly defined appearance - not blurred when viewed from the top or side.

2. DIAL INDICATOR METHOD

An alternate procedure for aligning the coupling is the Indicator Method. For details, contact the nearest "Safety" office.

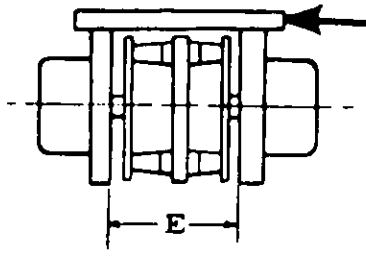
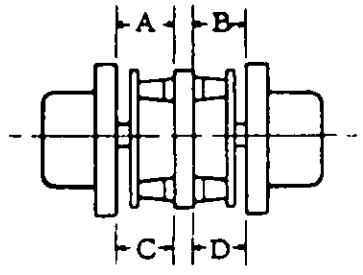
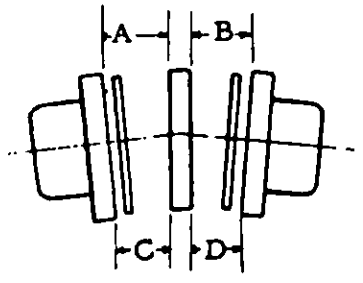
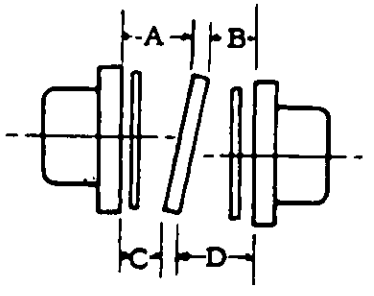
FLEXIBLE COUPLING		FLEXIBLE COUPLING ALIGNMENT
 VIEW 1		Use straight edge to secure initial alignment at all points of circumference. Dimension E equals 2-7/16".
 VIEW 2	CORRECT ALIGNMENT	Check dimensions A, B, C, and D with inside calipers. If dimensions A, B, C and D are the same within 1/64", the alignment is satisfactory. Be sure dimension E is correct. PULL ALL BOLTS UP TIGHT
 VIEW 3	ANGULAR MISALIGNMENT	A and B are not equal to C and D as shown at left. Move and/or shim compressor until correct alignment is secured.
 VIEW 4	PARALLEL MISALIGNMENT	A and D are not equal to B and C as shown at left. Move and/or shim compressor until correct alignment is secured.

FIGURE VI-3 FLEXIBLE COUPLING ALIGNMENT (Caliper and Straight Edge

3. ALIGNMENT GAUGE METHOD

The use of the gauge illustrated in Figure VI-4 will be found very convenient. It may be obtained from the Safety Company as Catalog No. 161983.

With the coupling on the shafts and completely assembled, place the gauge between the faces of the flanges at the top of the coupling as shown in Figure VI-4. Loosen set screw in flange on the motor shaft and move the flange to right or left so that gauge can be applied without play.

Place a mark at the point where the gauge was applied and by turning the shaft bring this mark to the bottom and apply gauge at the mark. If it cannot be inserted, the outboard end of the compressor must be shimmed up; if there is clearance, shimming is required at the shaft end of the compressor. After adding shims it will be necessary to readjust position of the flange on the motor shaft.

Continue shimming until the gauge will just pass between the flanges at the mark, with the mark at the top and at the bottom.

Next, make a mark on the front of the coupling and apply gauge at this point. If gauge will not enter, move the outboard end of the compressor toward the rear by means of the jack screws at the compressor base. If toomuch clearance, move the compressor to the front.

Now turn the motor shaft to bring the mark at the back of the coupling and apply the gauge at that point. When adjustments have been made so that the gauge will just pass between the flanges at all points and with the coupling turned at various positions, the shafts will be parallel. A further operation must be made to bring them in line.

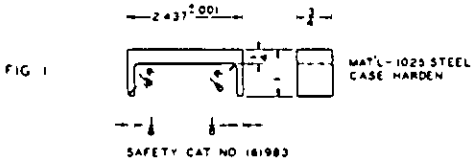


FIG 1

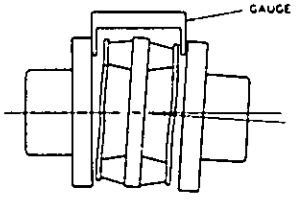


FIG 2

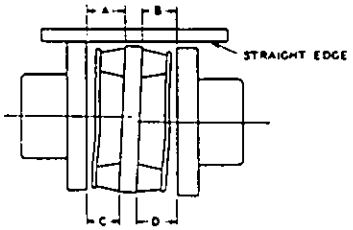


FIG 3

FIGURE VI-4

For this, apply a straight edge to the rims of the flanges as shown in Figure VI-4. Shim compressor up or down and move it sidewise until the flanges are in line with the straight edge applied at the top, bottom, front and back. When shimming, equal thickness must be added or removed from both sides of the compressor and the two jack screws on a side must be screwed in or out the same amount so as to maintain parallelism.

After compressor mounting bolts and coupling set screw have been tightened the coupling should be re-checked as follows:

1. With straight edge on rims of flanges.
2. With gauge between flanges.
3. With inside calipers check dimensions A, B, C, and D.

These dimensions should be equal.

This flexible coupling requires no lubrication nor adjustment after alignment.

FLEXIBLE COUPLING ALIGNMENT
(Alignment Gauge)

g. Refrigeration Controls Assembly

1. The refrigeration controls are installed in a weatherproof enclosure adjacent to the compressor motor. These controls include a three position manual selector switch, high and low pressure gauge and shutoff valve assemblies, and a dual pressurestat having high and low pressure control switches.

The evaporator coil pressure modulation control switch is mounted on the air cooled condenser casing.

(a) Selector Switch

The operation of the compressor and condenser fan motor is controlled by the three-position selector switch.

The selector switch is a heavy duty, three-position, snap action, rotary type which is operated by a pistol grip handle to position to the MANUAL-OFF-AUTOMATIC modes of operation. In the MANUAL position, the temperature control circuit is by-passed. This permits the operation of the system for test purposes at intervals when the thermostatic controls are satisfied. For normal operation, however, the AUTOMATIC setting is used. Stops are positioned on the interior of the cover to prevent the closing and latching of the cover unless the switch is position to the AUTOMATIC setting.

(b) Gauge and Valve Assemblies

The valved gauge assemblies are used to determine the operating pressures within the system and during the evacuating or purging procedures. The gauge to the upper left indicates the discharge (high side) pressure a' the lower gauge, the suction (low side) pressure. The valves are a pack-less type with 1/4" MPT x 1/4 FPT and a 1/4" SAE flare connection. The valve must be kept closed and the flare connection capped unless the pressure is being checked. Master gauges or a service test manifold similar to SAFETY Cat. No. T-12497 (Form 5285 in the Appendix) may be applied during these operations or to calibrate the existing gauges.

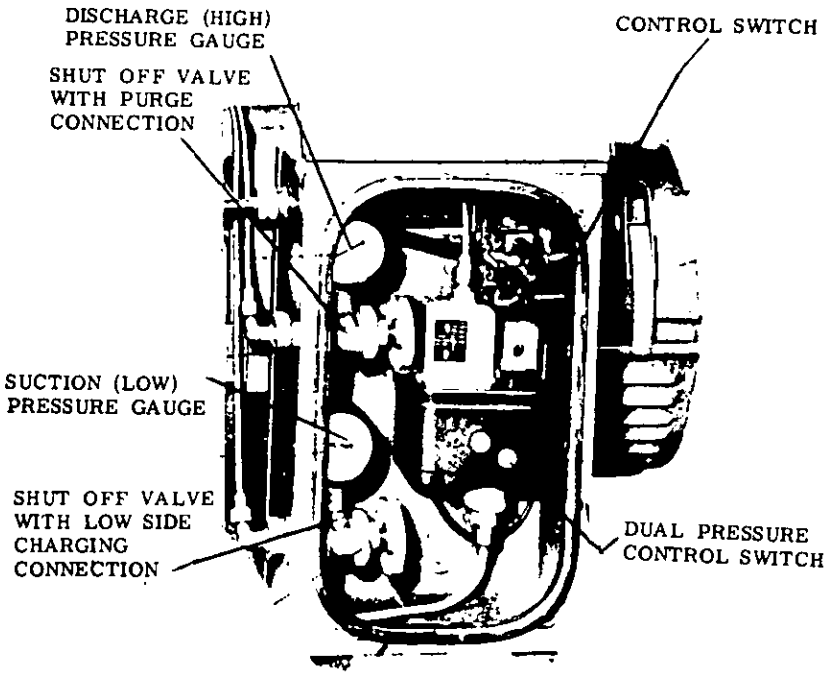


FIGURE VI-5 - REFRIGERATION CONTROLS - CAT. NO. B-2899 TYPE

(c) Dual-Pressure Control

NOTE: A non-adjustable dual pressure control switch assembly is being used in some applications and may be substituted for the adjustable dual pressure control type. The adjustable dual pressure control is a protective device which incorporates two independently actuated bellows and microswitch assemblies, one for each circuit. The functioning of one switch does not affect the operation of the other.

(1) The high pressure switch acts to stop operation whenever the discharge pressure becomes abnormally high. The low pressure switch stops operation when the suction pressure falls too low for safe operation. The high pressure switch should be set to open at 275 psig and the low pressure switch no lower than 2 psig.

(2) The high side pressure control switch is actuated by the refrigerant pressure which expands the bellows against the force of a spring. This then gives straight line motion to an operating pin which throws the precision snap action switch to its opposite position when the setting is reached. The switch is restored to its normal setting when the pressure in the bellows drops enough to allow the force of the main spring to compress the bellows. The straight line motion eliminates friction and wear and assures continuous accuracy and reliability.

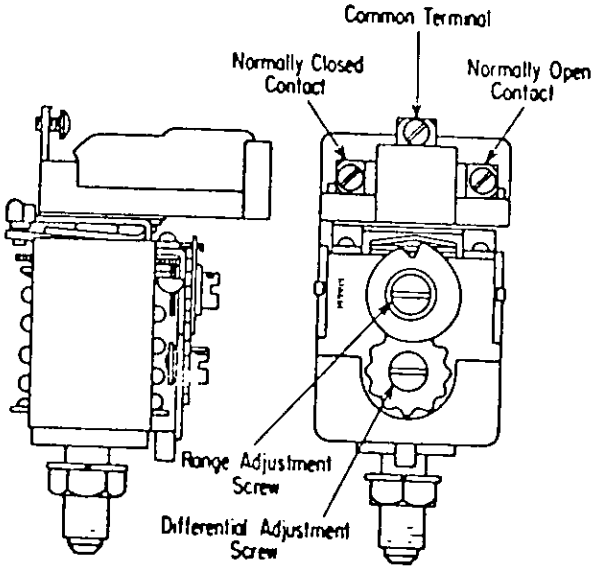


FIGURE VI-6

RANGE AND DIFFERENTIAL ADJUSTMENT PRESSURE CONTROL SWITCH -- ALLEN BRADLEY TYPE

(1) Adjustments:

(a) When the range adjustment screw on the front plate of the control is turned clockwise, both the cut-in and cut-out pressures are raised equally. Turning the range adjustment screw counterclockwise will lower the cut-in and cut-out settings an equal amount.

(b) When the differential adjustment screw is turned clockwise, the differential of the switch is reduced by raising the lower setting only. The top setting remains unchanged. Turning the screw counterclockwise widens the differential by lowering only the lower setting with the top setting unchanged.

(c) On the high pressure side, the upper setting is the cut-out point (control opens) and the lower setting the cut-in point. While on the low pressure side of the system, the upper setting is the cut-in point, and the lower setting the cut-out (control opens).

(d) At the high side, the cut-out should be set first using the range adjustment screw, and the cut-in point is set by changing the differential until the proper cut-in of approximately 275 psig is achieved.

(e) For the low side, the cut-in (upper setting) of 12 psig is first established using the range adjustment screw and the cut-out of 2 psig is then set using the differential screw.

(f) Do not force any adjustments. If an adjustment screw suddenly becomes very hard to turn, the limit of adjustment has been reached. Forced turning beyond this point can damage the control.

NOTE: With the time delay provided in the compressor motor start circuit, the pressure at which the switch resets during the time delay interval can be very different from the pressures existing in the system when the compressor motor starts to run. The correct reset pressures are when the switches close, not when the compressor motor starts to run. Listen for the audible click as the contacts of the control switches close.

The pressure modulation control switch (MPS) should also be removed from the circuit while the high pressure switch is being checked. This will allow the pressure to build up quickly without the unit going into modulation before the high pressure safety switch trips.

(1) High Pressure Switch

Operate the equipment and reduce the flow of air to the condenser by covering the inlet screen with cardboard. Observe the high pressure gauge as the switch opens. This should be approximately 275 psig as the compressor and condenser fan motors cycle. Note the cut-in point when the contacts of the switch reset. This setting is approximately 225 psig.

CAUTION: Do not permit the pressure to exceed 285 psig.

(2) Low Pressure Switch

Remove the cardboard from the condenser air inlet and operate the system. Slowly close the compressor suction valve and note the pressure at which the switch opens. This should be not lower than 2 psig. Do not permit the pressure to go below zero. With the compressor stopped, allow the pressure to rise to the desired cut-in point of approximately 12 psig.

Should further range or differential adjustments for the high or low side setting be required, refer to Figure VI-6. Recycle the equipment to insure proper functioning of the control.

The wiring diagram for the refrigeration controls assembly is shown in Fig. VI-7.

(3) Repairs

There are no field replaceable parts. Accordingly, any defective switches should be returned to SAFETY ELECTRICAL EQUIPMENT CORP. for repairs or service.

h. PRESSURE MODULATION CONTROL SWITCH (MPS)

The Pressure Modulation Control Switch is designed to operate at 235 psig cut-out with automatic reset at 205 psig.

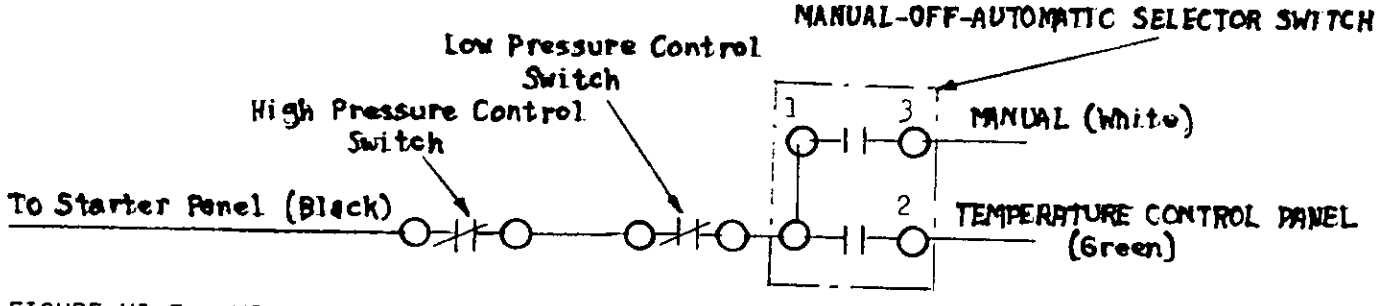


FIGURE VI-7 - WIRING DIAGRAM - REFRIGERATION CONTROLS ASSEMBLY - CAT. NO. B-2899 TYPE

h. Pressure Modulation Control Switch (MPS) - Cat. No. 163748 (Continued)

The type pressure switch used to control the functioning of pressure modulation of the upper circuit of the evaporator coil is shown in Figure VI-8

Adjustment

Should it be necessary to reset this type control, proceed as follows:

The Range Adjusting Screw "A" raises or lowers the cut-out point (this also raises the cut-in point by a like amount). Set the cut-out point first with the Adjusting Screw "A". The cut-in (differential) Adjusting Screw "B" changes the cut-in point only.

Pressure Switch Application	Cat. No.	Setting (PSIG)	
		Cut-Out	Reset
Evaporator Coil Modulation	163748	235	205

TABLE VI-1 PRESSURE SWITCH SETTING (NOMINAL)

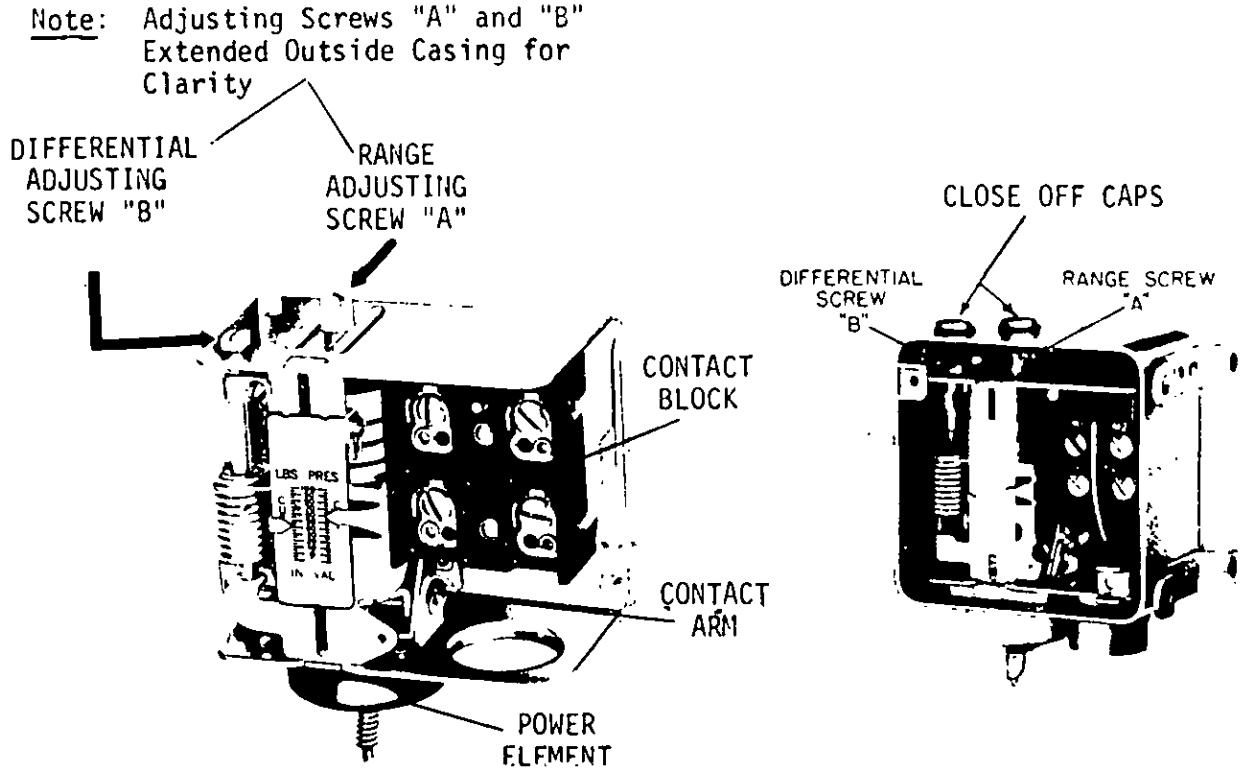


FIGURE VI-8 - PRESSURE MODULATION CONTROL SWITCH (MPS) RANGE AND DIFFERENTIAL ADJUSTMENT

3. SERVICING THE COMPONENTS OF THE AIR COOLED CONDENSER ASSEMBLY

a. Condenser Coil Maintenance

Normal maintenance of the condenser consists of cleaning the finned coil surface. The frequency with which the coil must be cleaned will be determined by the operating service and the condition of the road bed.

If dirt is allowed to accumulate, the condenser capacity will be decreased. This may also result in short cycling (on high pressure cut out) and failure of the equipment as excessive operating pressures are encountered.

Examination of the condenser surface after a short period of time in service will indicate the proper cleaning schedule.

(1) To Clean the Condenser Coil

(a) Using an air jet, blow back and forth over the face of the coil from both sides until all areas are covered. Continue until the leaving air is clean. Exercise care to insure that no damage is done to the fan nor fins on the coil surface.

(b) Blow dirt from the casing.

NOTE: In "dirty" locations, the condenser may require periodic removal of lint or leaves. Use either a long bristle brush, washing with a hose, or compressed air where the pressure does not exceed 50 psig.

(2) To Remove the Condenser Coil from the Unit

Should it become necessary to remove the condenser coil for repairs or for more extensive cleaning:

(a) Set the compressor motor control selector switch (MANUAL-OFF-AUTOMATIC) and circuit breaker to the OFF position to remove power. Remove the side close off sheets at the ends of the Condenser Coil section. Close the Receiver outlet valve and the Compressor discharge valve.

(b) Should recovery of refrigerant not be required, move to step 3. To recover refrigerant, transfer the charge to the receiver. Apply moderate heat to the Condenser coil surface using steam or hot water while cooling the receiver with cold water or ice bath. This will cause the refrigerant to pass over to the receiver. Continue for approximately 15 minutes. Close the Receiver inlet valve.

(c) Loosen the 5/8" SAE flare connection at the Receiver inlet valve to relieve the residual pressure in the condenser coil. Remove the clamp which secures the discharge line near the check valve to the support member.

(d) Apply heat to the 1-1/8" OD copper tube joint at the condenser discharge header connection (top joint). The brazing material used is "Easy Flo #45" silver solder with a melting point of 1125°F. and a flow point of 1145°F. Use the flexible tube connector in the discharge line as a hinge point to remove the tube from the solder cup.

(2) To Remove the Condenser Coil from the Unit (continued)

(e) Prior to applying heat to the 5/8" OD copper tube liquid line, force back the insulation covering to approximately 5" from the solder joint. Wrap a wet cloth around the copper tube to protect the insulation covering from damage caused by torch. Unsweat the joint by forcing the tube from the solder cup at the condenser liquid header.

(f) Support the condenser using blocking on a hydraulic lift table. Remove the mounting bolts to the coil flanges. Lower the hydraulic lift table sufficiently to clear the condenser coil, with protective screen, from the unit. Seal the open tube ends to prevent entrance of moisture and foreign matter into the system piping.

(g) Remove the condenser coil to the service area where repairs or service may be effected.

(3) To Replace the Condenser Coil

(a) Apply the protective screen to the coil flange at the entering air side of the coil.

(b) Position the coil on a hydraulic lift table. Elevate to position within the unit. Insure that no damage is done to the coil surface, headers, nor return bends. When positioned, secure with mounting bolts.

(c) Make up the silver soldered joints with "Easy Flo #45", or equivalent. At the liquid line, pull back the insulation covering to approximately 5 inches from the joint. Wrap the tube and covering with a wet cloth to protect from damage during brazing.

NOTE: (1) If the entire refrigerant charge has been removed, evacuate the condenser and receiver circuit by connecting a vacuum pump to the purge valve of the receiver and follow the procedures outlined on page VI-2.

(2) If a residual refrigerant charge has been retained, open the compressor and receiver shutoff valves. Operate the system. Purge at the receiver to remove air and non-condensable gases after 30 minutes of operation.

(3) Observe the refrigerant and oil levels after steady operating conditions are reached. Replace as necessary as outlined on pages VI-3 and VI-6.

b. CONDENSER FAN MOTOR - CAT. NO. T-16822

This totally enclosed fan cooled motor is equipped with sealed-for-life ball bearings which require no relubrication under normal service conditions. The motor is designed to operate satisfactorily with line voltages which are within 10% of name plate values.

(1) Maintenance

NOTE:

(a) Contact with operating voltage may be fatal. Observe all safety precautions. Always make sure that the electrical power is OFF while making electrical connections and while working on the motor during maintenance or repair. Keep fingers and tools away from the ventilation openings on motors and from rotating parts when operating the equipment.

(b) Motor operating under rated load and ambient conditions may feel hot to the touch. This is normal and should not be cause for concern.

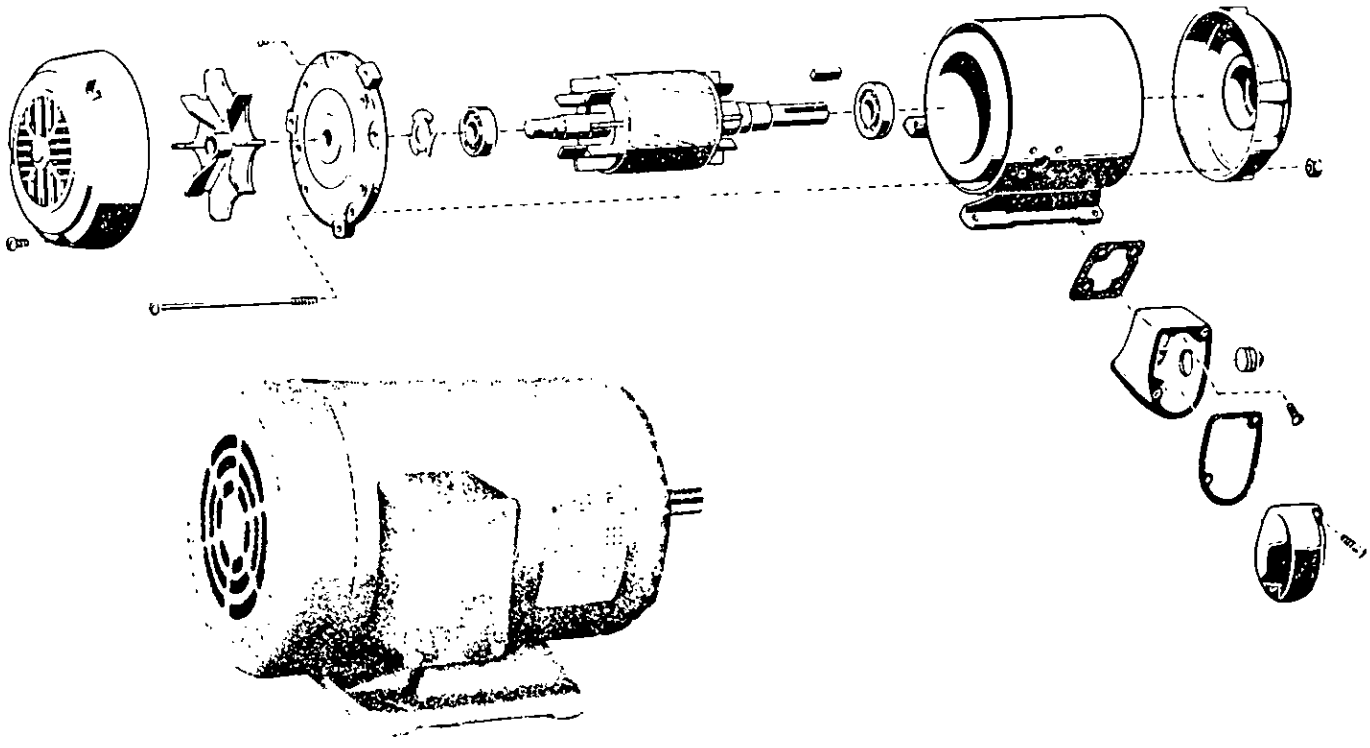


FIGURE VI-9 - CONDENSER FAN MOTOR - CAT. NO. T-16822
2 HP, 1725 RPM, 460/3/60 hz, TEFC, Frame Size 145T

(1) Maintenance (Continued)

(c) Inspect the motor on a monthly basis for excessive dirt, friction, vibration, unusual noises or abnormal temperatures. Dust may be blown from inaccessible locations using a compressed air jet not in excess of 50 psig. Be sure that the drain holes are kept open. Inspect the motor mountings. Damaging vibrations may be caused by loose retaining bolts.

(2) To Remove the Motor

(a) Set the compressor motor control switch (MANUAL-OFF-AUTOMATIC) and the circuit breaker to the OFF position to remove power. Disconnect leads at the junction box. Mark or tag for proper phase sequence when reconnecting.

(b) Remove four hex head cap screws which secure the upper fan guard for accessibility to the two 5/16-18 x5/8" square head set screws in the fan hub. Remove the fan.

(c) Remove four hex head mounting bolts and lift the motor from the base.

(3) To Assemble, Reverse the Sequence

(a) Locate the motor on the base and make up mounting bolts finger tight. Apply "Never Seez", SAFETY Spec. MI-1000 or equivalent, to the motor shaft.

(b) Apply the fan to the motor shaft and align the fan within the orifice ring. Tighten the motor holddown bolts. Set the trailing edge of the fan blade 13/16" beyond the venturi. Torque the two square head knurled cup set screws in the fan hub to 10 lb. ft. Apply upper fan guard. Reconnect the motor leads.

(c) Operate the motor to insure proper fan rotation. Note: Facing the motor end bell, the rotation is clockwise.

c. LIQUID RECEIVER, COMPLETE - CAT. NO., M-1782

The liquid receiver is mounted vertically to the support frame and is located adjacent to the condenser coil. This tank provides the storage capacity for the charge of liquid refrigerant when the system is pumped down for servicing. The receiver consists of a welded steel shell with two dished heads. Two sight glasses are provided at different heights in order to gauge the liquid refrigerant level in the tank. Two shut off valves with 5/8" SAE flare connections are provided at the inlet and outlet connections. A purge valve with 1/4" SAE flare connection is located near the top of the receiver tank. This valve is used during service operations, such as: purging (the release of non-condensable gases which may collect above the liquid refrigerant level in the receiver when the system is in operation), or evacuating the receiver-condenser circuit (by connecting a vacuum pump to this port). This valve also serves as a test cock to insure that liquid refrigerant is never stored above the upper sight glass level when both the inlet and outlet valves are closed.

NOTE: An increased pressure caused by a rise in temperature may result in the rupturing of the tank under conditions of excessive liquid charge in the receiver when both inlet and outlet valves are closed.

A 1/4" SAE flare connection is provided as an integral part of the receiver outlet valve. During operation, liquid refrigerant may be charged through this port. The valve is a backseating type and in the fully open position (stem turned counterclockwise to the backstop) the charging port is closed. This is the normal mode during system operation. Refer to Page VI-4 for guidance in adding liquid refrigerant to the system.

(1) To Transfer the Refrigerant to the Receiver (Pump down)

(a) Close the receiver outlet valve.

(b) Open the suction pressure gauge valve at the Refrigeration Controls Assembly. Operate the compressor to pump down the system until the suction pressure does not exceed 2 psig.

(c) Set the motor control selector switch (MANUAL-OFF-AUTOMATIC) to the OFF position and circuit breaker to remove power. Close the compressor shutoff service valves.

(d) Apply moderate heat to the condenser coil using steam or hot water and, at the same time, cool the receiver with cold water. Continue for approximately 15 minutes. This will transfer the refrigerant from the condenser to the receiver.

(e) Close the receiver inlet valve. The liquid level should be visible in the upper sight glass. If it is above the upper sight glass, check the refrigerant level in the receiver by opening the purge valve momentarily to lower to this level.

CAUTION: Do not fill the receiver beyond 80% of its capacity. Remove the excess liquid refrigerant through the purge valve until the level appears in the upper receiver sight glass.

(2.) To Remove Refrigerant From the Receiver:

After the charge has been transferred to the receiver by pumping down the system, the refrigerant should then be stored in a service cylinder with sufficient volume and strength to accomodate the charge safely.

(a) For the Maximum Recovery of Refrigerant. (Refer to Figure 1 in the Appendix - Refrigerant Flow Diagram).

(1) Close the line shut off valve at the inlet to the filter-drier assembly. Open the receiver outlet valve to the backseated position to close the charging port. Apply a transfer tube to connect the charging port to a standard Refrigerant 12 service cylinder. Purge the line and then tighten the flare nut at the service cylinder. Close the receiver outlet valve approximately two full turns in (to open the charging port and permit the flow of refrigerant). The receiver valve is a backseating type and in the closed or front seated position, the charging port is open.

(2) Apply heat gently to the receiver using steam or hot water, and at the same time, cool the cylinder in an ice bath or with cold water. This will raise the pressure in the receiver and lower the pressure in the cylinder to accelerate the rate of removal. When all the liquid has been transferred from the receiver, close the cylinder valve and backseat the receiver outlet valve to close the charging port. Disconnect the transfer tube. Replace the seal cap.

(3) A potential hazard in salvaging refrigerants from a system is overfilling the cylinder used to collect the refrigerant. The hazard is due to the increase in pressure with temperature should the storage cylinder become liquid filled. For example, the increase in pressure with R-12 is about 25 psi per degree rise in temperature. The bursting pressure of the container may be exceeded with a relatively small rise in temperature -- with hazardous results.

(3) To Remove the Receiver

Should it become necessary to remove the receiver, proceed as follows:

(a) For Maximum Recovery of Refrigerant

(1) Close the receiver outlet valve and pump down the system until the suction pressure does not rise above 2 psig. Set the compressor motor control switch and circuit breaker to the OFF position to remove power. Close the compressor service shut off valves. Heat the condenser coil with steam or hot water, and at the same time, cool the receiver with cold water. This will cause the refrigerant in the condenser to pass over to the receiver. Continue for approximately 15 minutes. Then close the receiver inlet valve and the line inlet and outlet shut off valves at the filter drier assembly. Open the receiver outlet valve to close the charging port. Connect a transfer tube from the charging port at the receiver outlet valve to a standard Refrigerant 12 service cylinder. Purge the line and then tighten the flare nut at the service cylinder.

(2) Following the same procedure to heat the receiver with steam or hot water and cool the cylinder in an ice bath or with cold water, transfer the refrigerant into a refrigerant 12 service cylinder. When the transfer is completed, close the valves, remove the transfer tube and apply the seal caps.

(3) Loosen the two 5/8" SAE flare connections at the inlet and outlet receiver shut off valves slowly to release any residual pressure within the system piping. Disconnect the flare connections.

(4) Support the receiver from below and remove four hex head mounting bolts. Lift the receiver outward from the side of the unit. Seal the tube ends and connections with protective caps to prevent entrance of foreign matter and moisture.

(5) The removal of refrigerant from a system and the storage must be done by experienced and knowledgeable personnel. An understanding of potential hazards in overfilling cylinders, the reuse of contaminated refrigerant which may result in premature failure of equipment in later years, and the mixing of refrigerants in the same cylinder will increase the problems of storage and reuse.

(a) Loosen the 5/8" SAE flare connections at the receiver to release any residual pressure within the condenser and receiver. Disconnect the flare connections.

(b) Support the receiver from below and remove four hex head mounting bolts. Lift the receiver outward from the side of the unit. Seal the tube ends and connections with protective caps.

(4) To Replace the Receiver

(a) Position the receiver within the unit and secure with the mounting bolts. Apply the liquid lines to the inlet and outlet connections.

(1) If a residual charge of refrigerant remains within the system, open the receiver inlet valve and evacuate the receiver and condenser coil circuit by connecting a vacuum pump to the purge valve at the receiver. Evacuate this circuit to at least 29.7" Hg to remove air and moisture. Break the vacuum by adding approximately ten (10) pounds of liquid refrigerant through the purge valve of the receiver. Open all valves which had been closed, and operate the system for approximately one-half hour. Raise the discharge pressure to 180 psig and the suction pressure to 37 psig to check the refrigerant and oil levels. The refrigerant should be at half level in the lower receiver sight glass during operation, and the oil level at approximately half level in the compressor crankcase sight glass at shut down. If either level is low, add to the specified level.

(2) If no refrigerant charge remains within the system, evacuate the entire system by connecting a vacuum pump to the high and low sides of the system. When the vacuum has been lowered to 29.7" Hg, pump for approximately four (4) additional hours. Charge the system with approximately thirty (30) pounds of Refrigerant 12 to break the vacuum.

(4) Servicing the Components of the Evaporator and Blower Assembly - Cat. No. B-1444-17

Figure II-3 shows the arrangement of components which include: an evaporator coil assembly, an electric heat assembly, evaporator and blower assembly, a drain pan, and a flexible plenum.

(a) The Evaporator Coil Assembly, Cat. No. M-4142-1, includes: an evaporator coil with two liquid distributors, two expansion valves, and a modulation solenoid valve feeding the top circuit.

(1) Evaporator

For efficient heat transfer, the finned surfaces of the evaporator must be cleaned periodically to remove any accumulations of dirt and lint. The application of a high pressure air jet (approximately 50 psig) blowing back and forth over the face of the coil from both sides should be continued until the leaving air is clean. Use caution to insure that no damage is done to the finned surfaces of the evaporator coil nor elements of the electric heat assembly.

Remove dirt from the casing after the cleaning operation. Flush the drip pan and clear any obstructions in the drain lines.

If it becomes necessary to remove the evaporator coil, the system must be pumped down and the refrigerant charge stored in the receiver.

(a) To remove the Evaporator Coil Assembly

Close the liquid outlet valve at the receiver. Operate the compressor until the suction pressure does not exceed 2 psig, then close the compressor suction shutoff valve. Remove the suction line insulation tape, SAFETY Spec. N-302, from the piping at the evaporator. Loosen a 1/4" SAE flare connection at an equalizer line to an expansion valve to remove any residual pressure within the coil. Remove the thermal bulbs from the suction lines to protect against the effects of the open flame or heat from the torch as the 5/8" OD liquid and the 1-3/8" OD copper tube suction lines are unsweated.

(1) Disconnect the flexible duct at the evaporator face by loosening the #10-32 wing nuts which secure the duct clip fasteners at the entering air side of the coil.

(2) Remove the flexible connections at the drain lines to the drip pan.

(3) Detach flexible duct at the outlet of the electric heat assembly.

(4) Remove the drain pan.

(5) Support the evaporator coil from below. Remove mounting bolts which secure the coil assembly to the car support members.

(6) Disconnect electrical connections to the electric heat assembly. Tag for guidance when reassembling.

(7) Lower the evaporator and electric heat assemblies as a unit through the access opening in the ceiling.

(8) Effect the necessary repairs or service.

(9) Apply the coil sections in reverse sequence.

(2) Expansion Valves - Cat. No. T-3695-1

The two expansion valves which feed liquid refrigerant to the two multi-circuited sections of the evaporator are located at the side of the evaporator coil assembly.

Each valve has a liquid distributor 1/4" SAE external equalizer connection, and an external superheat adjusting stem.

The thermo expansion valve has three component parts: Power assembly, cage assembly, and body flange. There are no working parts in the body flange. It is not necessary to break the solder connections to service the valve.

To inspect, clean, or replace parts, remove two cap screws. Lift off the power assembly and remove the cage assembly. Be sure gaskets are properly replaced when reassembling valve and that the two (2) lugs on the cage assembly fit into the grooves provided for them in the power assembly. DO NOT FORCE VALVE TOGETHER, INSURE THAT THE CAGE ASSEMBLY IS PROPERLY APPLIED BEFORE TIGHTENING BODY FLANGE.

Expansion valves are accurately tested and preset at the factory for 6 - 10°F. superheat. Accordingly, no adjustments should be made in the field unless absolutely necessary.

To adjust, remove seal cap at the side of the valve and turn the superheat adjusting stem. Turning the stem to the right decreases flow and raises superheat. Turning stem to the left increases flow and lowers superheat. Adjust valve two turns (1°F.) at a time.

Adjust each valve separately and wait between each adjustment to observe results. Always tighten any loosened connections and replace seal cap after adjusting.

The sensitivity and response of the valve is largely dependent upon proper installation and application of the feeler bulb. The bulb should always be firmly clamped to the suction line fed by the valve. It should be applied to the suction line close to the evaporator and on the evaporator side of the equalizer connection, 45° down from the horizontal centerline.

Important

Before replacing or otherwise attempting to service the expansion valves, make sure that the trouble is not in some other part of the system. Also, check initially the application of the valve bulb to the suction line.

On new installations, some valve trouble may be caused by dirt left in the lines when the piping was installed. Trouble from this source will disappear after a short period of service and the liquid line filter-drier or strainer will likewise take care of dirt which may enter the system thereafter.

If investigation of faulty operation of the system indicates the trouble is in an expansion valve, proceed as follows:

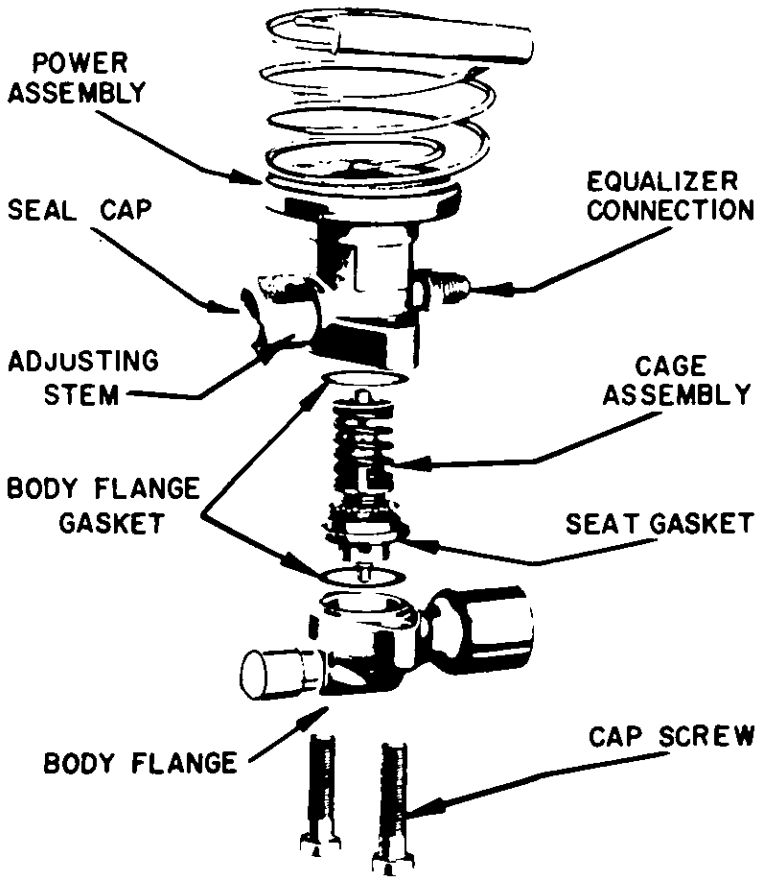


FIGURE VI-10 - EXPANSION VALVE - CAT. NO. T-3695-1

(WITH EXTERNAL SUPERHEAT ADJUSTMENT)

1. Close the liquid outlet valve at the receiver.

2. Operate the compressor until the suction or low side pressure cutout point of approximately 2 psig is reached.

   The pressure will build up again. Repeat this operation until the pressure does not rise above 2 pounds. (If, by chance, the pressure is lowered below zero and it does not rise to one or two pounds, open the liquid valve momentarily to build up to a slight positive pressure.)

3. Close the compressor suction valve.

4. If a replacement power element or cage assembly is to be applied, unclamp the remote bulb from suction line. Disconnect the flare connection at the equalizer line. Remove two flange bolts. The power element and cage assembly may then be removed. Remove any foreign material (solder, dirt, chips, etc.) from the valve body. Insert the replacement valve components without undue force and position the gaskets properly. Clamp the remote bulb securely to the suction line on a 45° plane below the horizontal centerline.

Reconnect the equalizer line loosely.

5. Purge through the equalizer line. Tighten and test for leaks, wrap the suction line and remote bulb with insulation tape, SAFETY Spec. N-302.

CAUTION: Do not apply heat near the location of the remote (feeler) bulb of the expansion valve without first removing the bulb.

(3) Evaporator Coil Modulating Solenoid Valve - Cat. No. T-3330 Type

The solenoid valve is equipped with a manual opening stem which permits the main port to be opened without energizing the coil, or for use in the event of the failure of the coil. Since the movement of the plunger is audible, it is only necessary to energize the control circuit to determine the functioning of the coil.

Refer to Parts List 5453, Solenoid Valve, for the list of replacement parts and service instructions.

(4) Motor - Cat. No. T-16807-1

The blower motor is designed for long service life. It is necessary, however, to keep it clean and dry for prolonged trouble-free operation. Stator troubles usually may be traced to one of the following caused: worn bearings, moisture, overloading, operating single phase, or insulation faults. Dust and dirt are normal contributing factors.

(a) Maintenance

Inspect the motor on a monthly basis for excessive dirt, friction, vibration, unusual noises, or abnormal temperatures. Dust may be blown from inaccessible locations by using a compressed air jet (approximately 50 psig). Be sure that the drain holes in the motor are kept open. Inspect the motor mountings since damaging vibrations may result from loose mounting bolts. Motor troubles may also be traced to low voltage conditions, loose connections, or lack of maintenance.

(b) To Remove the Motor

(1) Set the control switch and circuit breaker to the OFF position. Disconnect the leads. Mark or tag for phase sequence and proper rotation when reconnecting.

(2) Support the motor to position while removing the mounting bolts.

(3) Lower from the unit.

(4) Replace in reverse order, operate to check for proper rotation.

(c) To Remove the Blower Wheels

(1) Proceed as above. Remove the inboard (motor side) housing inlet rings and withdraw the blower wheels through the opening.

(2) Reassemble in reverse sequence. It is important, however, that the blowers which are forward curved in design be properly applied.

5. Repairing Leaks

CAUTION: Prior to attempting any repairs, it is essential that the residual pressure in the lines be relieved before disassembling connections or unsweating soldered joints.

A. To Repair Leaks in . . .

a. The liquid line from the receiver to the evaporator and blower unit.

b. The evaporator coil, connections, and expansion valves.

c. The suction line from the evaporator coil to the compressor.

1. Close the liquid outlet valve at the receiver and open the suction gauge valve.

2. Operate the compressor and pump down until the pressure does not rise above two pounds. Avoid reducing the pressure below zero psig.

3. Close the compressor suction valve.

NOTE: The solenoid valves piped in the liquid line and at the evaporator are normally closed when de-energized. To open the valve, turn the manual opening stem a maximum of 1/4 to 1/2 turn counterclockwise.

4. Relieve the residual pressure in the circuit by loosening either flare connection at an equalizer line to the expansion valves.

5. Make the required repairs.

6. Purge. Tighten any connections which may have been loosened.

7. Crack the liquid outlet valve at the receiver to build up pressure in the circuit, then close the valve.

8. Test repairs for leaks.

9. If tight, evacuate air and moisture from the lines.

10. Open the compressor suction valve and the liquid valves at the receiver and filter-drier assembly. Close the liquid line solenoid valve by turning the manual opening stem ¼ to ½ turn clockwise. Build up pressure in the low side of the system to reset contacts of the low pressure control switch, if necessary.

11. Operate the equipment and purge. See "Removal of Non Condensable Gases".

12. After steady operating conditions are obtained, observe the levels of refrigerant in the receiver and the oil in the compressor sight glass. Add, if necessary.

B. To Repair Leaks in . . .

a. The line between the compressor and condenser.
b. The condenser.
c. The line between the condenser and receiver.

1. Turn the compressor motor control switch to the "OFF" position.

2. Close the liquid outlet valve at the receiver and the compressor discharge valve.

3. Apply moderate heat to the condenser using steam or hot water. At the same time, cool the receiver with cold water or ice bath. This will cause the refrigerant to pass over into the receiver. Continue this for about fifteen minutes.

4. Close the receiver inlet valve.

NOTE: The check valve in the discharge line will remain in the closed position when the system is not operating. To vent the pressure remaining in the discharge line and condenser, loosen the 5/8" OD flare connection at the inlet valve to the receiver.

5. Make the required repairs. Tighten any connections which may have been loosened.

6. Crack the receiver inlet valve slightly to build up pressure. Then purge.

7. Test the repairs for leaks. Open the compressor discharge valve.

8. Operate the equipment and purge. See "Removal of Non-Condensable Gases".

9. After steady operation of the system, observe the refrigerant level at the receiver and the rate of oil return to the compressor. Add, if necessary.

C. To Repair Leaks at the Receiver Sight Glass

If a leak is detected at a sight glass assembly, it is necessary to renew the sealant used at the threaded joint.

1. With the minimum level of refrigerant in the receiver, close the inlet and outlet valves. For maximum recovery of refrigerant, follow Steps 2, 3, and 4.

2. Connect a service cylinder to the purge valve with a transfer tube.

3. Open the purge and cylinder valves. Transfer the refrigerant to the cylinder by warming the receiver and cooling the service cylinder as outlined above.

4. Close the cylinder and purge valves. Disconnect the transfer tube from the purge valve and open the purge valve to bleed off the residual pressure.

5. Remove the sight glass assembly (normally the bonded parts can be disassembled with ordinary hand tools. If the holding power is too great, however, gently heat the joint to approximately 450°F. to weaken the sealant. Disassemble while hot.)

Note: Bonded parts cannot be loosened with solvents.

6. To reassemble, remove powder accumulation from the threads. Apply sealant Primer and Catalyst, "Safety" Catalog No. T-13624, and allow five minutes drying time.

7. Apply thread sealant, "Safety" Catalog No. T-13625, and reassemble sight glass.

Note: Only the sealant down in the threads will harden. Wipe off any accumulation on the outside of the sight glass.

The cure time for the sealant is a function of the temperature--approximately two hours at 72°F. and up to 48 hours at 40°F.

8. Close the purge valve and open the inlet valve on the receiver to build up pressure. Purge and then test repairs for leaks.

9. Evacuate air and moisture from the receiver.

10. Open the outlet valve at the receiver and return the refrigerant previously removed to the system as outlined under

To Add Refrigerant to the System

Operate the equipment and purge. See "Removal of Non-Condensable Gases." Observe the refrigerant level in the receiver and the rate of oil return to the compressor after steady operation is obtained.

6. SAFETY PRECAUTIONS IN HANDLING REFRIGERANT 12

1. FROSTBITE

If Refrigerant 12 in the liquid phase comes in contact with the skin, the rapid evaporation may cause freezing. The presence of fluorocarbon vapors in the air surrounding the point of contact does not affect the skin nor frozen area. Treatment is the same as for frostbite from any other source.

The following treatment is suggested:

a. If treatment is begun within 20-30 minutes after exposure, soak the exposed area in lukewarm water.

   CAUTION: DO NOT SOAK IN ICE COLD WATER NOR IN HOT WATER.

b. If treatment is begun more than 30 minutes after exposure, eliminate the preliminary soaking.

c. Apply a very light coating of any bland ointment, such as petroleum jelly.

d. Apply a light bandage if the exposure is at a location where the presence of the ointment would be awkward.

e. If the frostbite is severe and the frozen area large, administration of an anticoagulant or vasodilator should be considered by a physician to avoid the development of gangrene.

2. Effects on the Eyes

a. The vapors have little effect on the eyes. Exposure to Refrigerant 12 in the liquid phase or to solutions of fluorocarbons dissolved in oil may produce temporary redness. (No permanent damage was found in tests with rabbits).

b. If Refrigerant 12 liquid contacts the eye, serious damage from freezing may occur. Eye protection should be worn at all times. Get medical attention immediately. Flush eyes for several minutes with running water.

3. Effects on the Skin

Refrigerant 12 liquids will dissolve and extract the natural oils present in the skin. If contact is prolonged, the skin may become dry and perhaps cracked. Neoprene gloves are recommended, if exposure to the liquid refrigerant is possible, to avoid irritation to dry, sensitive skin.

NOTE: There is very little evidence of the absorption of Refrigerant 12 through the skin or effect on internal organs similar to that found with some chlorinated compounds, such as carbon tetrachloride.

Refrigerant 12 vapor is 4 to 5 times heavier than air. High concentrations may tend to accumulate in lower areas.

A well accepted authoritative source for first aid procedures should be used for training all service personnel, and the physician on call at your facility will best be able to provide recommendations to suit the AMTRAK operating conditions. The fourth edition of the American Red Cross First Aid Handbook, for example, provides fifteen pages on a description of artificial respiration and three pages on treating frostbite.

After contact with liquid refrigerant, any contaminated clothing should be removed at once and not worn again until completely dry. All affected body areas should be washed with soap and water. After washing, a lanolin-based ointment should be applied to help replace the natural skin oils. If persistent signs of skin irritation appear, consult a physician.

4. Environmental Considerations in Handling R-12 and the Ozone Depletion Theory

Do not deliberately discharge R-12 Refrigerant to the atmosphere.

Recent environmental studies have shown that there may be a link between R-12 refrigerant in the atmosphere and a possible increase in skin cancer caused by a reduction in atmospheric ozone.

SECTION 7

AIR CONDITIONING STARTER PANEL

The panel is arranged so that any component subject to wear or deterioration can be easily removed from the front without disturbing the remaining components or wiring. All nuts for mounting components are welded to the back of the panel so that the panel does not have to be removed for replacement of individual components.

The following components are mounted on the air conditioning starter panel:

Refrigerant Compressor Motor Starter	RCMS
Condenser Fan Motor Overload Relay	OL3
Heat Contactor No. 1	HC1
Heat Contactor No. 2	HC2
Blower Fan Motor Starter	BFMS
Terminal Board	TB1

The refrigerant compressor motor starter and the contactors for applying both stages of electric heat are interlocked by means of auxiliary contacts on the blower fan motor starter. Therefore, whether heat or cooling is called for, the blower fans must be on.

The condenser fan motor uses the same contactor as the compressor motor, except that it has its own overload relay (OL3). The overload relay that the compressor motor uses is OL2. The condenser fan motor, therefore, starts at the same time as the compressor motor.

In addition to the requirement that the blower fan motor be on, the compressor motor is further interlocked with the compressor motor overload relay (OL2), the condenser fan motor overload relay (OL3), the high pressure switch, and the low pressure switch.

The two stages of heat are initiated by the two heat contactors (HC1 and HC2). In addition to the requirement that the blower fan motor be on, the heat contactors are interlocked with a heat protective thermostat (PT) which will open the circuit at 200°F.

The heat or cooling is initiated by signals from an external temperature control which is not supplied by "SAFETY". The cooling function can be initiated by "overriding" the temperature control with the "MANUAL-AUTOMATIC" switch located on the compressor motor control box. By turning this switch to "MANUAL" (the cover must be opened first), the compressor motor will start, even though the temperature control is not calling for cooling. This switch can then be considered a "test switch" for checking out the cooling function.

The control circuit operates on 120 volts, 60 hz, single phase power, while the motors and heating elements operate on 460 volts, 60 hz, 3 phase power.

TROUBLESHOOTING

In order to isolate the problem if the air conditioning starter box is not functioning properly, the external wires that terminate on TB-1 should be removed and a power source of 120 volts, 60 hz, single phase be made available to power the control box.

Apply 120 volts across TB1-1 and TB1-7. The blower fan motor starter should energize. If not, then either OL1 has been tripped or the starter coil is defective.

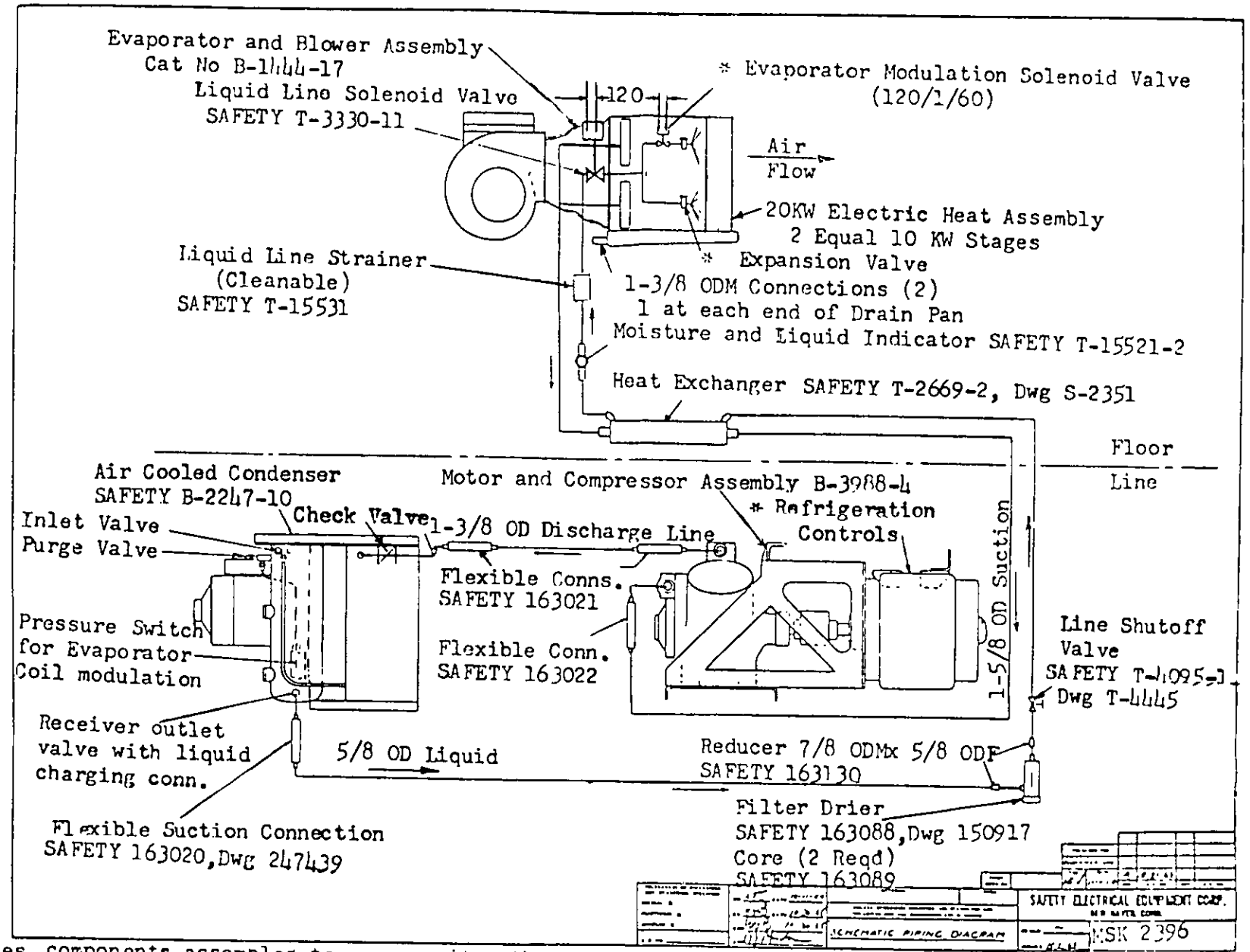
With power applied as above, jumper TB1-2 to TB1-4, and TB1-7 to TB1-6. HC2 contactor should energize. If not, then either the auxiliary contact on the blower fan motor starter is defective or the contactor coil is defective.

Change jumper from TB1-7 to TB1-6 to TB1-7 to TB1-5. HC1 contactor should energize. If not, then the contactor coil is defective.

Remove jumpers between TB1-7 to TB1-5 and TB1-2 to TB1-4.

Add jumper from TB1-7 to TB1-3. The refrigerant compressor motor starter should energize. If not, then the faulty component is either the auxiliary contact on the blower fan motor starter or the coil of the compressor motor starter, or OL2 or OL3 has been tripped.

Of course, in addition to the actual closing of the contactors, it must be ascertained that there is continuity through the contacts and overload heaters when that particular contact or starter closes. That is, when RCMS closes there should be continuity from L1 to 2T1 and 3T1; L2 to 2T2 and 3T2, etc.



REFRIGERANT FLOW DIAGRAM, MSK 2395

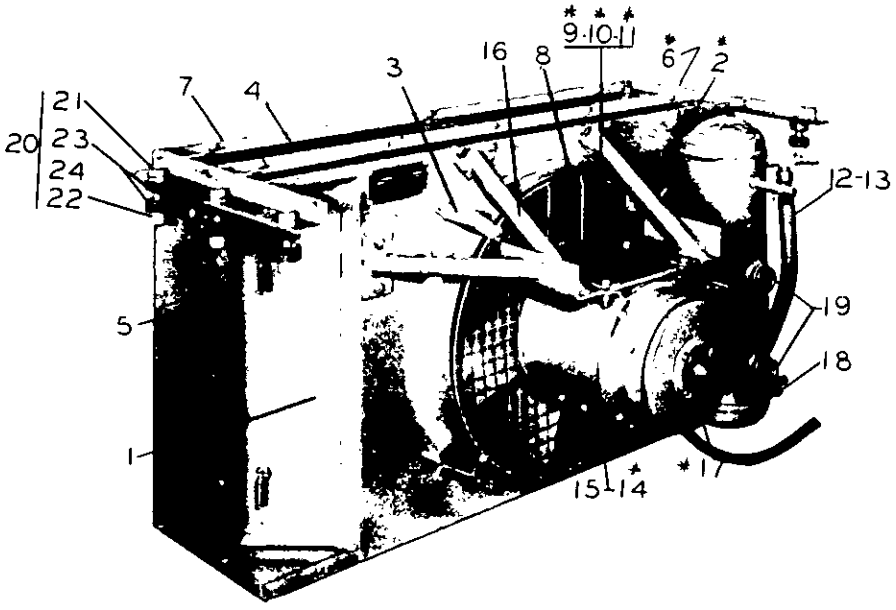
FIGURE 1

Notes: * Indicates components assembled to major unit, others are furnished separately as accessories to the system.

Main Power Supply 460/3/60, Control Voltage 120/1/60

AIR COOLED CONDENSER

CAT. NO.	CAPACITY	REFRIGERANT	VOLTAGE
B-2442-10	8-Ton	R-12	460/3/60hz



NOTE: Undercar Mounting Support Frame Adapter - Cat. No. M-4113, Not Shown

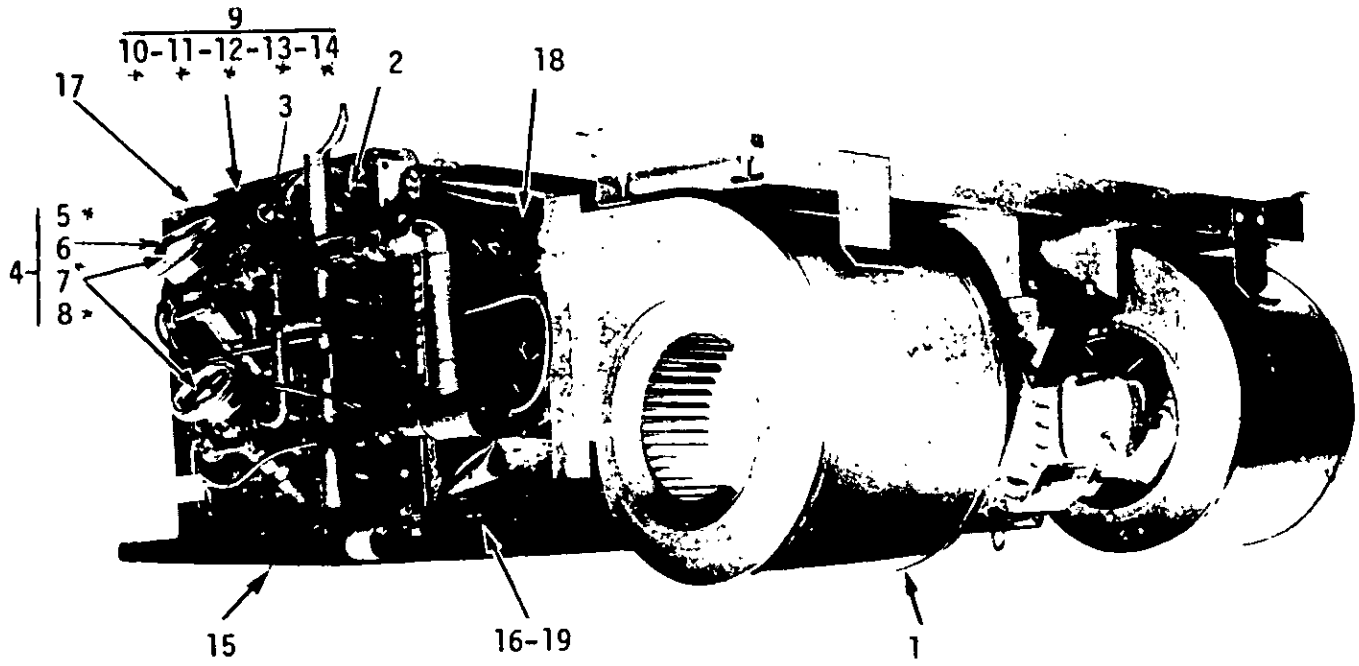
Item No.	Description	Cat. No.	No. Req'd.
1	Access Door Complete (Left Side)	S-2213-2	1
2	*Access Door Complete (Right Side)	S-2213-1	1
3	Bracket, Complete (Fan Guard)	T-3605	2
4	Condenser Coil	B-1566	1
5	Cover, Coil End (Left Side)	S-2179-1	1
6	*Cover, Coil End (Right Side)	S-2179-2	1
7	Guard, Screen (Condenser Air Inlet)	S-2178	1
8	Fan, Complete	M-1890-2	1
9	*Fan Guard (Rectangular)	S-2281	1
10	*Fan Guard (Circular)	M-1831	1
12	Inlet Piping (Condenser to Receiver)	T-3597	1
13	Insulation (Covering for Item 12)	T-7222-1	1
14	*Key, Motor Shaft (1/4 x 1/4 x 1-1/32)	304760	1
15	Motor, Complete (P/L	T-16807-1	1
16	Motor Mount, Complete	S-6071-2	1
17	*Pressure Control Switch (Modulation)	163748	1
18	**Receiver, Complete	M-1782	1
19	Sight Glass	T-12967-2	(2)
20	Resilient Mount Set	T-13706	6
21	Bolt	S-2199-1	(1)
22	Nut	T-4435	(1)
23	Rebound Cushion	T-3367-4	(2)
24	Washer	500202	(1)

* Not Shown

** Note: Receiver - Item 18. Use Pipe Thread Joint Seal Primer "Safety" Cat. No. T-13624 and Sealant, Cat. No. T-13625 when assembling one piece(threaded) sight glass, Cat. No. T-12967-1 (Item 19).

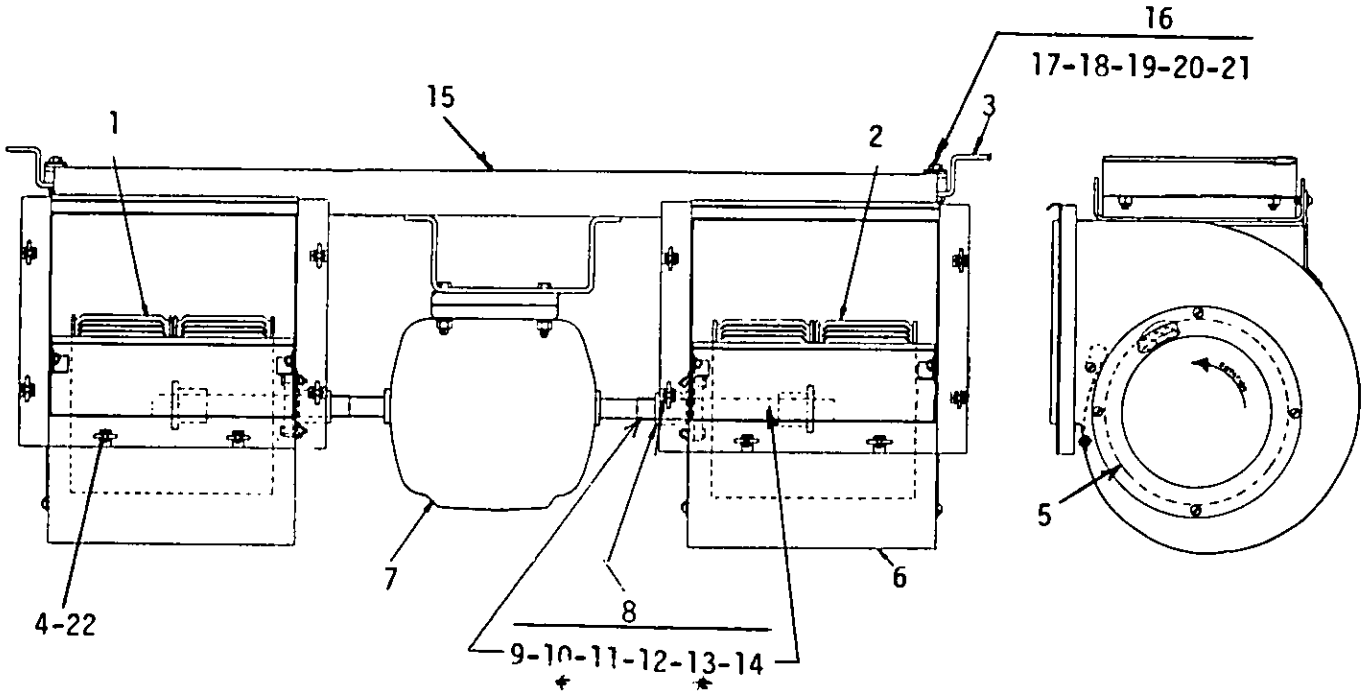
EVAPORATOR AND BLOWER ASSEMBLY
CAT. NO. B-1444-17

CAPACITY	REFRIGERANT	VOLTAGE (NOM.)	CONTROL VOLTAGE
8-Ton	R12	460/3/60	120/1/60



Item No.	Description	Cat. No.	No. Req'd.
1	Blower Fan and Motor Assembly (Page 2)	B-1434-15	1
2	Evaporator Coil Assembly	M-4142-1	1
3	***Evaporator Coil (w/o distributors)	B-2488-1	(1)
4	Expansion Valve (Alco)	T-3695-1	(2)
5	*Cage Assembly	T-11550	(1)
6	**Power Element	T-7339-1	(1)
7	*Gasket (Body Flange)	T-7823	(2)
8	*Gasket (Seat)	T-7824	(1)
9	Solenoid Valve	T-3330-1	(1)
10	*Coil	T-7820-4	(1)
11	*Gasket, Body "O" Ring	T-7822	(1)
12	*Gasket, Seal Cap	T-15061-2	(1)
13	*Seal Cap	T-15061-1	(1)
14	*Diaphragm	T-7821	(1)
15	Drain Pan	M-1485-1	1
16	Duct Clip	T-7784	18
17	Heating Coil	B-4319-1	1
18	Plenum	B-4409	1
19	Wing Nut	154458	18

* Not Shown
** Includes two (2) Body Gaskets, one (1) Seat Gasket and two (2) Remote Bulb Clamps.
*** When reordering item, specify "Evaporator Coil to be furnished with distributors, Cat. No. T-3696-7, arranged for R.H. piping application."



EVAPORATOR BLOWER FAN AND MOTOR, CATALOG NO. B-1434-15

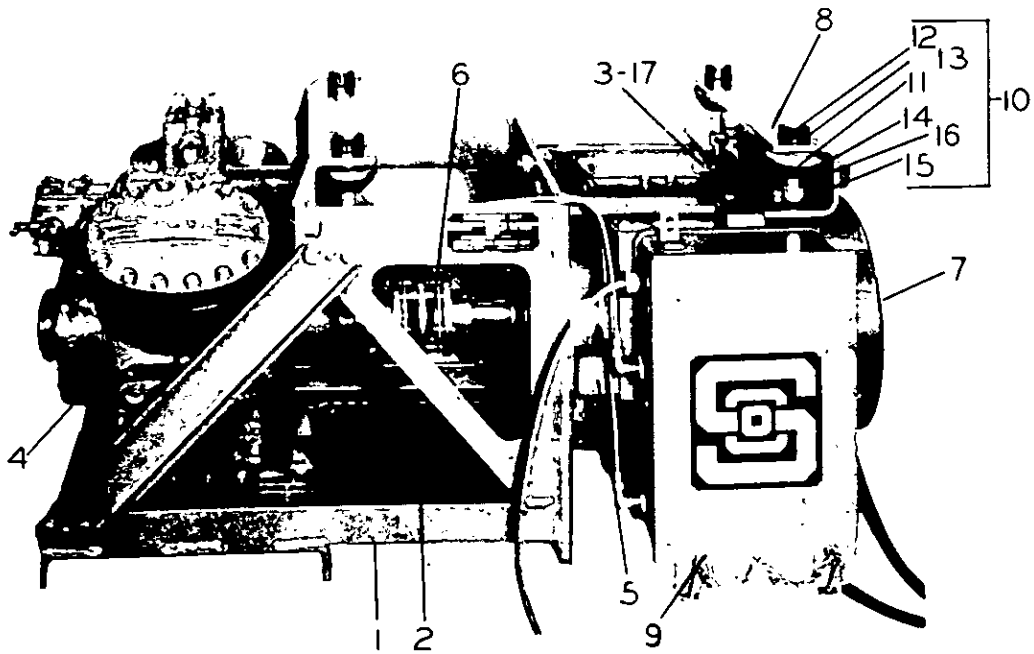
Item No.	Description	Cat. No.	No. Req'd.
1	Blower Fan	T-1793-3	1
2	Blower Fan	T-1793-4	1
3	Bracket, Mounting	S-1801-1	2
4	Duct Clip	T-7784	12
5	Entrance Ring (Venturi Plate)	S-1802	4
6	Housing	M-1542	2
7	Motor (Parts List 5784)	T-16807-1	1
8	Shaft Extension Assembly	T-14037-3	2
9	Extension Hub	S-7187-3	(1)
10	* Key (1/4 x 1/4 x 1-7/16)	T-1603-3	(1)
11	Nut	T-4435-3	(3)
12	Screw	22099	(3)
13	* Set Screw	59107	(1)
14	Shaft Extension, Complete	S-7188-3	(1)
15	Support Mount	M-6426-1	1
16	Resilient Mount Set	T-13706-5	4
17	Bolt	51327	(1)
18	Nut	T-4435-2	(1)
19	Resilient Bushing	163770	(1)
20	Washer (Rubber)	163771	(1)
21	Washer (Steel)	163782	(1)
22	Wing Nut	154458	12

* Not Shown

DIRECT DRIVEN MOTOR COMPRESSOR UNIT
TYPE-PRESSURE OPERATED CAPACITY CONTROL

PARTS LIST 5776 (4/78)

CAT. NO.	CAPACITY	REFRIGERANT	VOLTAGE
B-3988-4	8-Ton	R-12	460/3/60 hz



NOTE: Undercar Mounting Support Bracket, - Cat. No. M-5999-3, Not Shown

Item No.	Description	Cat. No.	No. Req'd.
1	Bracket, Complete	B-1023	1
2	Screen	162156	(1)
3	Chain	164188	2
4	Compressor (Form 5295)	161705	1
6	Flexible Coupling (page 2)	161685	1
7	Motor, Complete (P/L Form	T-18554	1
8	Motor Support	B-2002-1	1
9	Refrigeration Controls Assembly	B-2899-2	1
	* Gauge, High Pressure	T-16284-1	(1)
	* Gauge, Low Pressure	T-16283	(1)
	* Manual Selector Switch	S-8816-2	(1)
	* Pressure Control (High-Low)	T-14059	(1)
10	Resilient Mount Set	T-13623-2	4
11	Bearing Cup	307505	(1)
12	Bolt	59390	(1)
13	Rebound Cushion	307504	(1)
14	Resilient Bushing	159167	(1)
15	Nut	T-4435	(1)
16	Washer	500202	(1)
17	Shackle	163139	4

* NOT SHOWN

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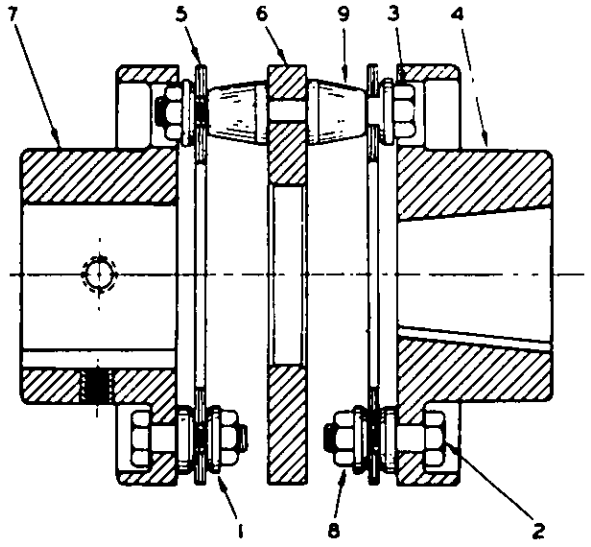
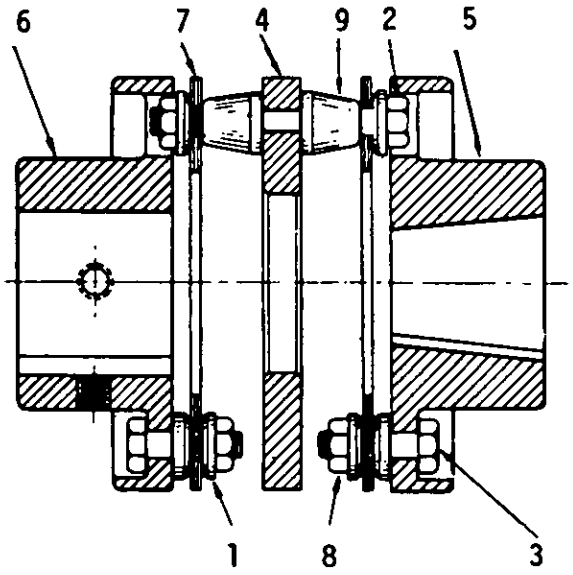
FLEXIBLE COUPLING . . . Catalog No. 161685



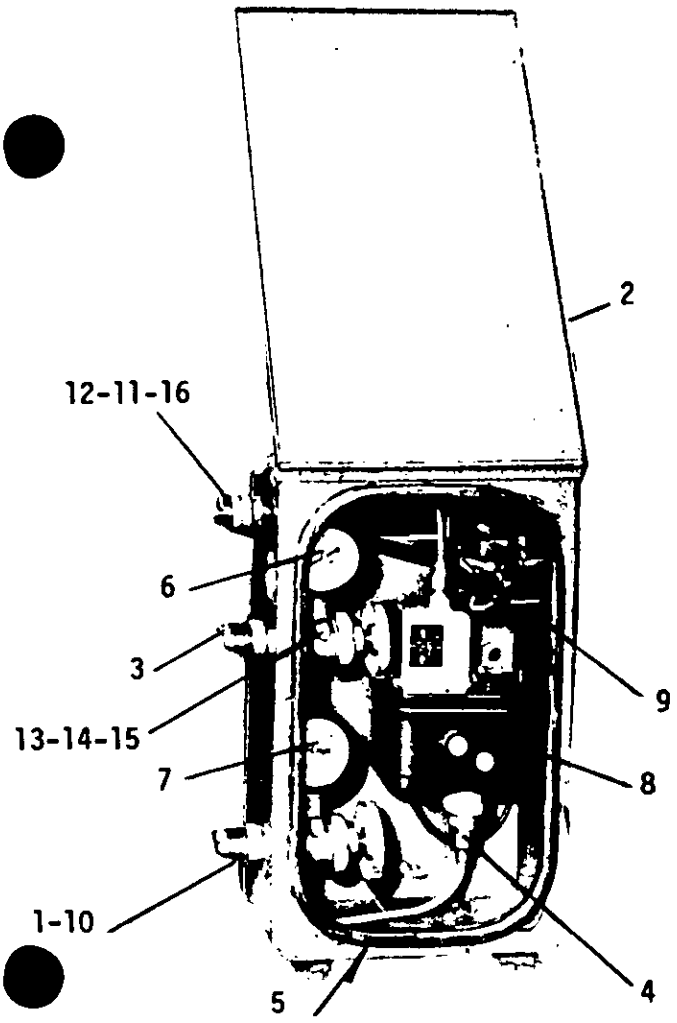
Item No.	Description	Cat. No.	No. Req'd.
1	Beveled Washer	161555	18
2	Bolt (Short)	161556	6
3	Bolt (Long)	161557	3
4	Compressor Flange Complete	161712	1
5	Laminated Disc Assembly	161713	2
6	Center Ring	161714	1
7	Motor Flange Complete	161715	1
8	Locknut	161563	9
9	Spacer	164077	6

1. Flexible Coupling, Cat. No. 161685
2. Refrigeration Controls Assembly, Type B-2899



FLEXIBLE COUPLING-CATALOG NO. 161685

Item No.	Description	Cat. No.	No. Req'd.
1	Beveled Washer	161555	18
2	Bolt (Long)	161557	3
3	Bolt (Short)	161556	6
4	Center Ring	161714	1
5	Flange Complete, (Compressor End)	161712	1
6	Flange Complete, (Motor End)	161715	1
7	Laminated Disc Assy.	161713	2
8	Locknut	161563	9
9	Spacer	164077	6



REFRIGERATION CONTROLS ASSEMBLY
CAT. NO. B-2899-2

Item No.	Description	Cat. No.	No. Req'd.
1	Block	T-2961	2
2	Control Box	B-1489-2	1
3	Elbow, Half Union	155966	2
4	Flare Nut	151693	2
5	Gasket	T-2964	1
6	Gauge, High Pressure	T16284-1	1
7	Gauge, Low Pressure	T-16283	1
8	High-Low Pressure Control Switch	T-14059	1
9	Manual Selector Switch	S-8816-2	1
10	Nut	55770	2
11	* Nut	158057	1
12	Strain Relief Bushing	305756	1
13	Valves Complete	T-18169	2
14	* Flare Gasket	163820	(1)
15	Seal Cap	151439	(1)
16	* Washer	24948	1

* Not Shown

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COMPRESSOR CAT. NO. 161705

Open Type - With Pressure Operated Capacity Control Mechanism

SERVICE INSTRUCTIONS AND PARTS LIST

TABLE OF CONTENTS

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SECTION 1

SERVICING THE COMPRESSOR

1. Compressor Lubrication

To insure proper lubrication of the compressor, the level of the oil in the crankcase must be maintained between certain limits. Too much oil in the system is just as harmful as too little. Recommended levels are:

Initial charge at factory	- 12 pints
Level when operating	- 1/3 bull's eye
Minimum level after standing 15 minutes	- 1/2 bull's eye

These levels are average, and some variation is permissible, particularly a lower level when operating. The oil level may be safely at or slightly below the bottom of the sight glass when the compressor is running. If a good quantity of oil is observed falling in the crankcase, the oil charge is adequate; it is only when little or no oil can be seen dropping that oil must be added.

Prior to adding oil, however, it is important that the amount of oil in the system be properly checked. This should be determined only if the head pressure is above 180 psig and the system has been in operation for at least thirty minutes.

Should oil be added to a unit which already has an excess of oil in the system, paradoxically, it will tend to lower the oil level in the crankcase rather than to raise it. This is due to the fact that when oil returns to the compressor it always contains some refrigerant which, when it enters the warm crankcase, causes foaming. Thus with an excess of oil in circulation, more foaming will result, which thereby increases loss from the crankcase.

The refrigerant released from the excess oil raises the crankcase pressure slightly above the suction pressure which, in turn, results in the closing of the oil return check valve. Thus, it will be seen that, if there is no balance between the release of gas from the oil returning to the crankcase and the speed at which this gas is released from the crankcase through the vents in the check valves, the latter will always remain closed.

The temperature of the crankcase should be warm to the touch. While the crankcase may be cool for a short period after starting up, it should warm up in about a half hour.

Under some conditions, it may run hotter than 105° F, but it should not run colder. A crankcase which is running colder than normal is an indication of one or both of the following conditions:

1. The expansion valves are adjusted to pass too much liquid.

2. There is excessive oil in the system. If the crankcase is running cool, the oil level will always be lower than it would be if the crankcase were at normal temperature. The reason for this is that the refrigerant which is evaporating from the oil in the crankcase is cooling and causing the oil to foam, thus carrying it out into the system. At the same time, pressure is maintained in the crankcase in excess of the suction pressure which prevents the return of oil at the proper rate.

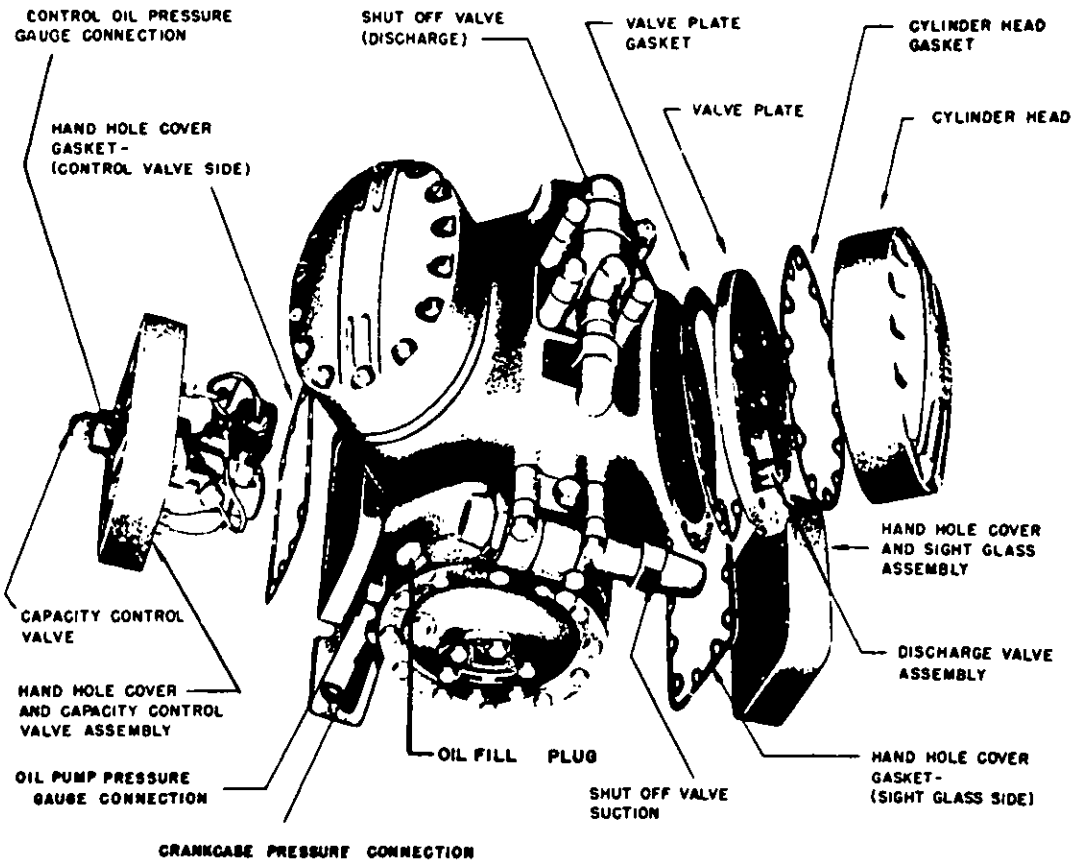


FIGURE I-1 COMPRESSOR, PUMP END VIEW

Test for excessive oil in system:

This test is made at the liquid line charging valve. Hold a piece of clean white paper close to the valve and crack slightly to permit a small quantity of the refrigerant to spray on the paper. If a proper amount of oil is in circulation, the oily residue left after the evaporation of the refrigerant should not be more than enough to produce a stain of no greater intensity than to make the paper appear water-marked.

Removing excess oil:

The best way to remove the excess oil is to loosen (do not remove) the oil drain plug in the crankcase and allow the oil to bleed out slowly while the compressor is running. The rate of removal should be about one quart per hour. As oil is drained from the crankcase, it will be replaced by oil dropping out of circulation. As the amount of excess oil is gradually reduced, there will be a noticeable rise in the crankcase level in spite of the fact that oil is being removed from the crankcase. Continue this process until there is no more than a slight trace of excess oil in the system.

By following this procedure slowly enough to allow ample time for the oil to return to the crankcase, the oil should rise to a normal level at about the time that all excess has been removed. If it has not done so, it may be assumed that the level will be as high as can be satisfactorily maintained.

It should be noted that, at start up, the compressor will lose considerable oil; sometimes to the point where splash in the crankcase almost ceases. It may be from 20 minutes to an hour before the oil will begin to return, depending on how much refrigerant has been absorbed. This is normal.

Adding Oil:

To add oil, the compressor must first be emptied of refrigerant by pumping-down as follows:

1. Close compressor suction valve.
2. Pump down by operating the compressor until the suction gauge pressure does not rise above two pounds.
3. Close the compressor discharge valve.

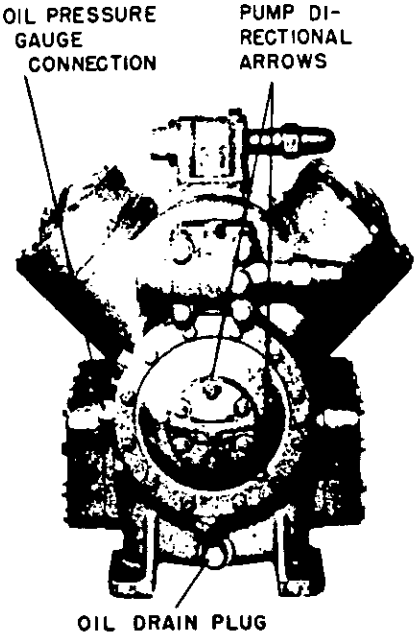


FIGURE I-2 PUMP END OF COMPRESSOR

4. Unscrew the oil fill plug on the compressor slowly to permit the residual pressure to bleed off.
5. Pour oil through this opening to bring oil level to the middle of the sight glass.
6. Replace the plug loosely, crack suction valve to purge, tighten plug, open the compressor discharge and suction valves.
7. Operate to ascertain oil level under stabilized conditions.

NOTE: Always keep compressor oil stored in sealed containers. Oil exposed to the atmosphere will absorb moisture which can cause trouble when introduced into the system.

Use only dehydrated wax free grades of oil which are suitable and recommended for Refrigerant 12 compressor lubrication and which have been specially processed so as to have the necessary low moisture content.

The physical properties of the recommended compressor crankcase oil are listed below. Oil should be ordered in containers small enough so that it will be used up when the containers are opened.

Compressor Oil	"Safety" Cat. No.
Requirement	T-9387 (24 Quart Case) T-9387-1 (5 Gallon) T-9387-2 (Quart Can)
Viscosity at 100°F. SSU	300 ± 20
Viscosity at 210°F. SSU	45 - 50
Viscosity Index	
Dual Inhibited Suniso 4G	0
Capella DI	25
Dielectric, Minimum	25 KV
Floc Point	-50°F.
Pour Point, Maximum	-25°F.

Physical Properties of Compressor Crankcase Oil

Also suitable oils are:

Vendor	Designation
Sun Oil Co.	Dual Inhibited Suniso 4G
Texas Oil Co.	Capella DI

2. Oil Pump

The compressor is equipped with a gear type positive displacement oil pump. This pump is located in the pump end bearing head opposite the shaft extension and is direct driven from the crankshaft. Direction arrows cast on the cover plate show the correct rotation when viewed from the top. Upon starting the compressor for the first time, this should be checked. If it need be reversed, this can be done manually by rotating the cover plate 180°.

To reverse the pump, proceed as follows:

1. Close suction valve.
2. Pump down. Set the motor control switch to the "OFF" position. Close discharge valve.
3. Vent the pressure from the crankcase by loosening the oil fill plug.

4. Remove the six cap screws from the pump cover and, in removing the cover, take care that no damage is done to the gasket.

5. Rotate the cover one-half revolution and re-apply so that the bottom arrow is now on top and agrees with the rotation of the motor.

6. Open compressor suction valve to purge crankcase. Tighten oil fill plug.

7. Open discharge valve and operate to check the oil pressure.

CAUTION If the special gasket between the cover plate and pump is damaged, replace it only with one obtained from the factory. The thickness of the gasket affects the pump clearance. Refer to page I-15, OIL PUMP CLEARANCES.

Correct oil pressure is important in maintaining adequate lubrication and satisfactory unloader operation. The correct oil pressure should be 45-55 psig above the suction pressure after steady operating conditions have been established. The pressure may be checked by applying a gauge to the tapping provided in the pump end bearing head. See Figure I-2. It will be necessary to pump down before removing the plug to apply the gauge and again to remove the gauge.

To determine the oil pressure, note the pressures indicated by the oil gauge and the suction pressure gauge. The difference will be the actual oil pressure. A lower pressure may be caused by the oil screen in the crankcase being clogged or by wear in the pump. It is well to check the oil pressure when a new equipment is put into service and also when a replacement compressor is installed.

The oil pressure regulator is located on the side of the crankcase adjacent to the seal housing. This is a cartridge type pressure relief valve which requires no adjustment. See Detail "A", Figure I-3.

Complete assemblies of worn or defective oil pumps may be returned to the factory in exchange for new assemblies. The complete assembly of the bearing head and pump must be returned. Individual pump parts are not furnished separately.

When removing the pump end bearing head and pump assembly, the crankshaft should be blocked to prevent the seal end spacer from dropping down on the shaft and being pinched when the bearing head is replaced. Block the shaft in position by wedging a wood block between the coupling flange and the seal housing.

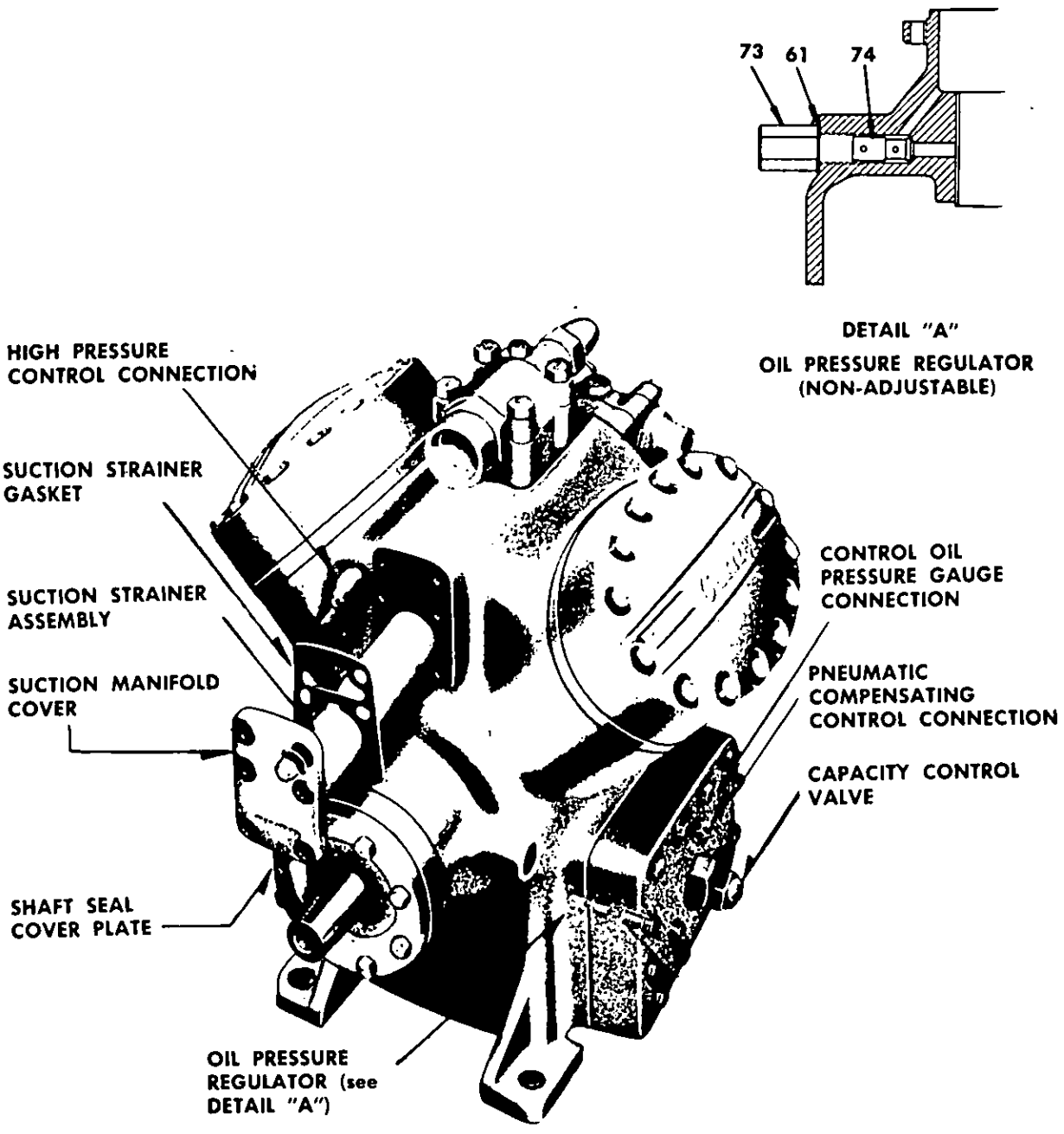


FIGURE I-3 COMPRESSOR - SEAL END

3. Shaft Seal

If the shaft seal fails, fresh oil will be evident on the seal cover plate. However, a slight oil film at this point may not necessarily mean that the seal has failed. A small seepage of oil between the sealing surfaces is necessary for lubrication. It is well to keep the cover plate and compressor body surfaces wiped clean so that the presence of fresh oil in unusually large amounts can be detected.

Generally a Halide torch leak detector is sensitive enough to determine excessive refrigerant losses at the seal. Electronic detectors normally will pick up the small traces of refrigerant in the seepage oil. This may give a false indication of a shaft seal failure.

Removing the Shaft Seal: (It is not necessary to move the compressor nor motor to effect changeout).

Should leakage make repairs necessary, it is recommended that a new seal assembly be applied rather than trying to relap the old one. To remove the seal, proceed as follows:

1. Operate the compressor and gradually close the suction shut off valve until the suction pressure is reduced and does not rise above two pounds.

2. Stop the compressor and set the control switch to the "OFF" position. Close the discharge shut off valve.

3. Unscrew the oil fill plug to relieve the residual pressure in the compressor.

4. Remove the short bolts from the flexible coupling. Remove the laminated disc assembly as a unit. Loosen the set screws in the flange on the motor shaft and slide the flange toward the motor head. Remove the flange from the compressor shaft, and also the dust seal and shaft seal cover plate.

5. Remove the seal parts.

Installing the Rotary Shaft Seal - Integral Seat Type

The contents of the shaft seal assembly are illustrated in Figure I-4.

1. Spring Guide
2. Spring, Sleeve and Driving Band Assembly
3. Neoprene Bellows
4. Flange Retainer
5. Retainer Shell
6. Carbon Seal Washer
7. Seal Seat and Cover Plate
8. Cover Plate Gasket
9. Instruction Sheet, 5H40-1915

Handle the seal with care at all times as it is a precision product.

PREPARATION

1. Polish the crankshaft with fine crocus cloth.

2. Remove all sharp edges from the crankshaft keyway to prevent damage to the Neoprene bellows.

3. Clean the seal cavity thoroughly.

INSTALLATION

1. Use refrigerant oil to lubricate the crankshaft and the surface of the Neoprene bellows which comes into contact with the shaft.

   CAUTION: Do not allow oil to get between the bellows and the driving band.

2. Slide the seal assembly onto the crankshaft until the Neoprene just starts to grasp the shaft.

3. Holding the spring and sleeve assembly, pull forward on the seal nose assembly at the same time, turning it so that the lugs on the driving band are out of the slots in the retainer shell and rest on the surface of the retainer shell (See View 2).

   NOTE: Views 2, 3 and 4 show the seal installed on a crankshaft which has been removed from the compressor in order that parts of the seal may be seen more readily.

4. Using the seal cover plate, push the seal assembly into its proper location on the crankshaft. The spring guide should be tight against the side of the bearing surface as shown by the pencil in View 3.

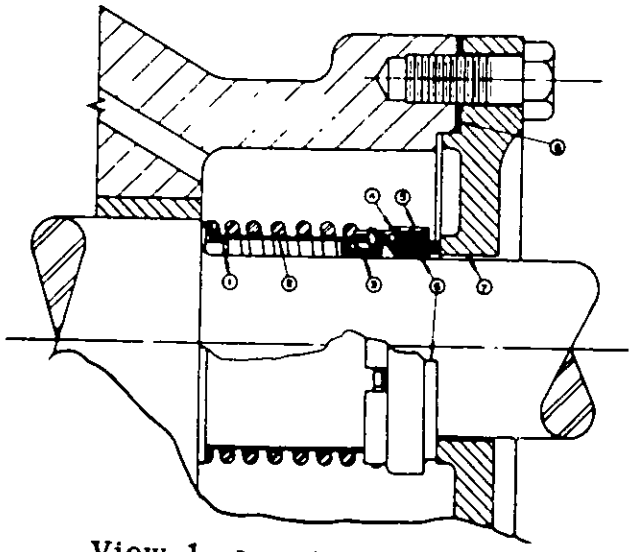
5. Remove the cover plate, being careful not to allow the carbon seal washer to become damaged.

6. Grasp the seal nose assembly and turn it until the lugs on the driving band drop back into the slots in the retainer shell. View 4 shows the lugs of the driving band properly positioned in the center of the slots in the seal retainer shell.

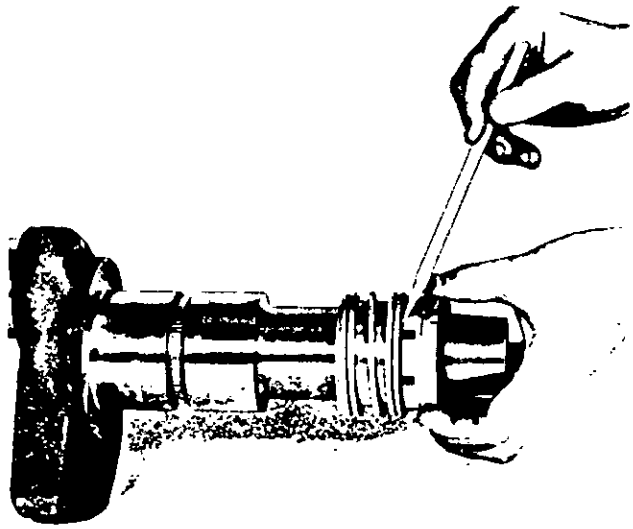
7. Lubricate the carbon seal washer and seal seat.

8. Reinstall the seal cover plate and the dust seal. Draw the bolts down evenly to prevent damage to the carbon seal washer.

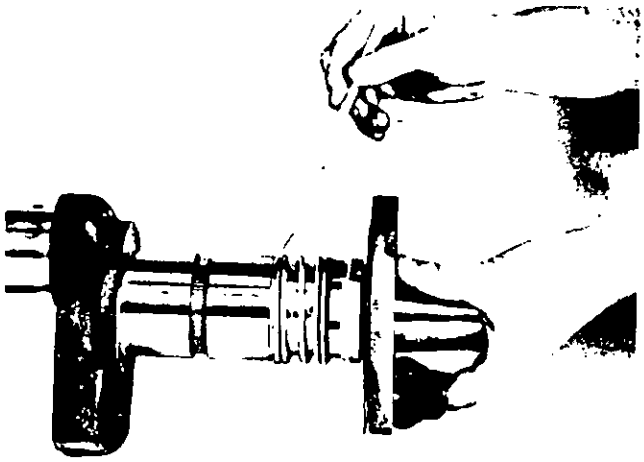
The seal may show slight leakage immediately after installation, but a short period of operation should correct this condition



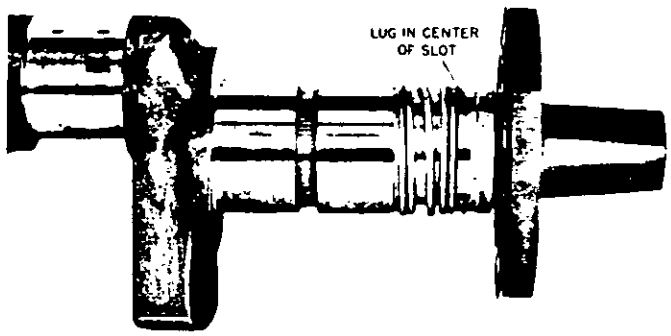
View 1 – *Rotary Seal (Sleeve Type) Service Replacement*



View 2 – *Driving Band Lugs Out of Slots in Seal Retainer Shell*



View 3 – *Spring Retainer Tight Against Shaft Shoulder*



View 4 – *Driving Band Lugs in Center of Retainer Slots*

FIGURE I-4 ROTARY SHAFT SEAL - Integral Seat Type

SECTION 2

CAPACITY CONTROL FOR UNLOADING COMPRESSORS

In order to analyze troubles and service the control system it is important to become thoroughly familiar with the manner in which it operates, as well as its construction.

The capacity control is of the step type in which variation in capacity is obtained by unloading the compressor cylinders in sequence. This is accomplished by holding the suction valve open continuously. The gas drawn into the cylinder during the suction stroke is thus forced back through the suction valve to the suction manifold instead of being compressed and discharged through the discharge valve. As a result, cylinder capacity is reduced to zero with the minimum use of power. Three of the four cylinders can be unloaded providing 100%, 75%, 50% and 25% of full capacity.

Capacity control is automatically obtained in response to suction pressure change. The lubrication oil supply is used to furnish the power to operate the mechanism which is so arranged that in the absence of oil pressure, the cylinder suction valves are held open. This automatically provides for starting the compressor without load.

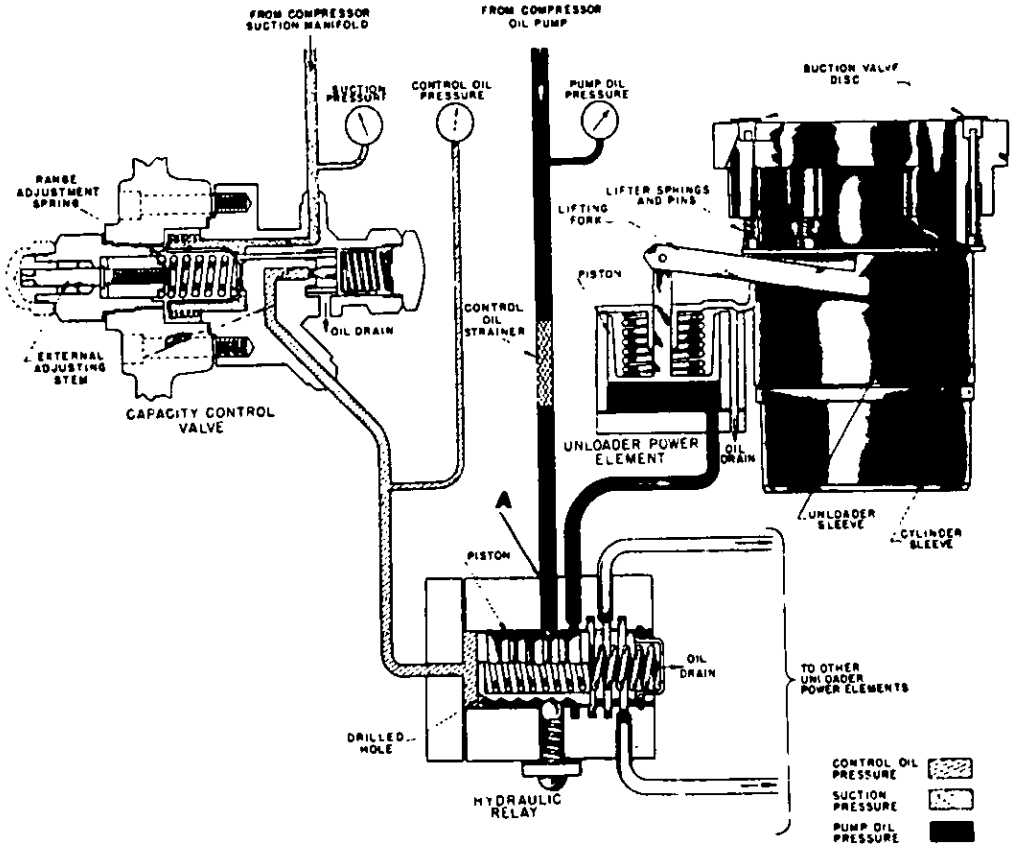


FIGURE II-1 CAPACITY CONTROL SYSTEM

Fig. II-1 shows the control system diagrammatically and how it operates.

It consists of four major elements:

1. The Capacity Control Valve.
2. The Hydraulic Relay.
3. The Power Element (one for each of three cylinders).
4. The Valve Lifting Mechanism (one for each of three cylinders).

1. The capacity control valve is pressure actuated. The suction pressure acts upon the inside of its bellows while the outside is under atmospheric pressure and the force of the range adjustment spring. The movement of the bellows, with variation of suction pressure, is transmitted by means of three closely fitted push rods to the control valve. The valve opens with a decrease in suction pressure. Oil passes through the valve seat and then drains into the crankcase. Turning the range adjustment stem changes the loading of the range adjustment spring so as to vary the value of the suction pressure at which the valve will open.

2. The hydraulic relay is an oil pressure actuated, multiple port, snap action, piston valve. Full oil pressure from the oil pump enters the relay assembly at "A" (Fig. II-1) and fills the annular space around the piston. The drilled hole in the piston permits oil to flow into the control oil pressure chamber at the end of the cylinder and thence to the capacity control valve. Depending upon the position of the piston in the cylinder, the outlet ports at the right end of the cylinder are supplied with full oil pressure from the annular groove in the piston or are vented to the crankcase, in which the relay is located.

The position of the piston is determined by the oil pressure in the control oil pressure chamber working in opposition to the piston spring. The oil pressure at this point is determined by the position of the capacity control valve. The snap action ball, working in connection with the grooves in the piston, prevents the piston from moving gradually as the oil pressure changes. The piston can make only abrupt steps equal to the spacing of the grooves, since the outlet ports have the same spacings, piston movement provides either sudden unrestricted application of the full oil pressure to the power elements or venting to the crankcase.

3. The power element consists of a cylinder, spring loaded piston and a forked lever. Oil pressure supplied by the hydraulic relay and applied under the piston, forces the piston up and the forked end of the lever acting on the flange of the unloader sleeve lowers it. In the absence of oil pressure, as when the compressor is not running or when the relay has cut off the supply, the spring returns the piston to the bottom of the cylinder. Oil leaking past

the piston is returned to the crankcase. There are three power elements located in the suction manifold and adjacent to the cylinders which they unload.

4. The valve lifting mechanism consists of the unloader sleeve, which slides on the outside of the cylinder sleeve, the lifter pins and springs. For normal operation (the cylinder working), the parts are in the position shown in Figure II-1. The oil pressure holds the piston of the power element at the upper end of its stroke; the end of the lifting fork is in its lower position, the lifter springs have pushed the unloader sleeve down, so that the lifter pins are retracted to allow the suction valve to operate normally. When the oil pressure is removed from the power element by action of the relay, the power piston moves downward. This raises the unloader sleeve which in turn pushes the lifter pins upward to hold the suction valve off its seat.

The following features of the operation of the control system should be kept in mind:

1. Individual cylinders are unloaded by holding the suction valve off its seat.

2. The suction valve is lifted off its seat by the power element.

3. The power element is operated by oil pressure. When full oil pump pressure is supplied to the power element, the lifting fork drops and allows the suction valve to operate normally.

4. Oil pump pressure is supplied to individual power elements according to the position of the piston in the hydraulic relay.

5. The position of the piston in the hydraulic relay is determined by the capacity control valve which varies the control oil pressure on the relay piston.

6. The capacity control valve varies the control oil pressure in accordance with the suction pressure and the setting of the external adjusting stem.

7. When the capacity control valve is closed, control oil pressure (full pump pressure) is applied to the relay piston, forcing it to the right. In this way, full pressure is admitted to all the power elements allowing controlled cylinders to operate normally (fully loaded).

8. When the capacity control valve is wide open, the pressure on the relay piston is relieved and the spring moves the piston to the left. This removes oil pressure from the power elements causing them to unseat the suction valves on all the controlled cylinders.

Note that the oil pressure is required to load a cylinder. As a result of this arrangement, the compressor is unloaded (except for the one uncontrolled cylinder) on starting until oil pressure is established by the oil pump.

SERVICING THE CAPACITY CONTROL SYSTEM

There are three important points to remember:

1. The control tries to balance the compressor capacity with the evaporator load.

2. The cylinder unloading mechanism is powered by the compressor forced feed oil system.

3. The suction pressure is the determining force which causes the compressor to unload, but the oil pressure actually does the work.

The air conditioning equipment is designed to produce its rated capacity when operating at a suction pressure of 36 psig. However, to improve dehumidification at less than full load conditions, cylinder unloading is delayed until the suction pressure falls to 32 psig.

For a routine check of the capacity control, it is only necessary to observe the suction pressure as indicated by the pressure gauge in the compressor control box. Operate the equipment with the full evaporator working and when steady conditions have been established, observe the suction pressure.

The pressure should not vary more than about four pounds above or below 32 pounds. If the pressure is within this range, it may be assumed, in the absence of other indications, that the control is functioning properly.

A way to check the control is to close the compressor suction valve gradually, observing the suction pressure gauge, and listening for the operation of the unloaders. As each cylinder cuts out, there will be a noticeable change in sound level of the compressor. Now gradually open the suction valve again, listening for the cylinders to cut in.

If the suction pressure does not remain at 32 pounds (within the limits given above), the control setting should be adjusted. To do this:

1. Remove the cap from the capacity control valve. This is on the crankcase cover. (See Figure II-2).

2. Turn the valve stem slowly until the proper suction pressure is obtained. Turning the stem clockwise raises the suction pressure;

counter-clockwise lowers it.

3. Replace the stem cap.

The above adjustment should be made after the equipment has been in operation long enough for the conditions to become steady and the compressor to warm up. Once the control has been adjusted, it should not require further attention unless trouble develops.

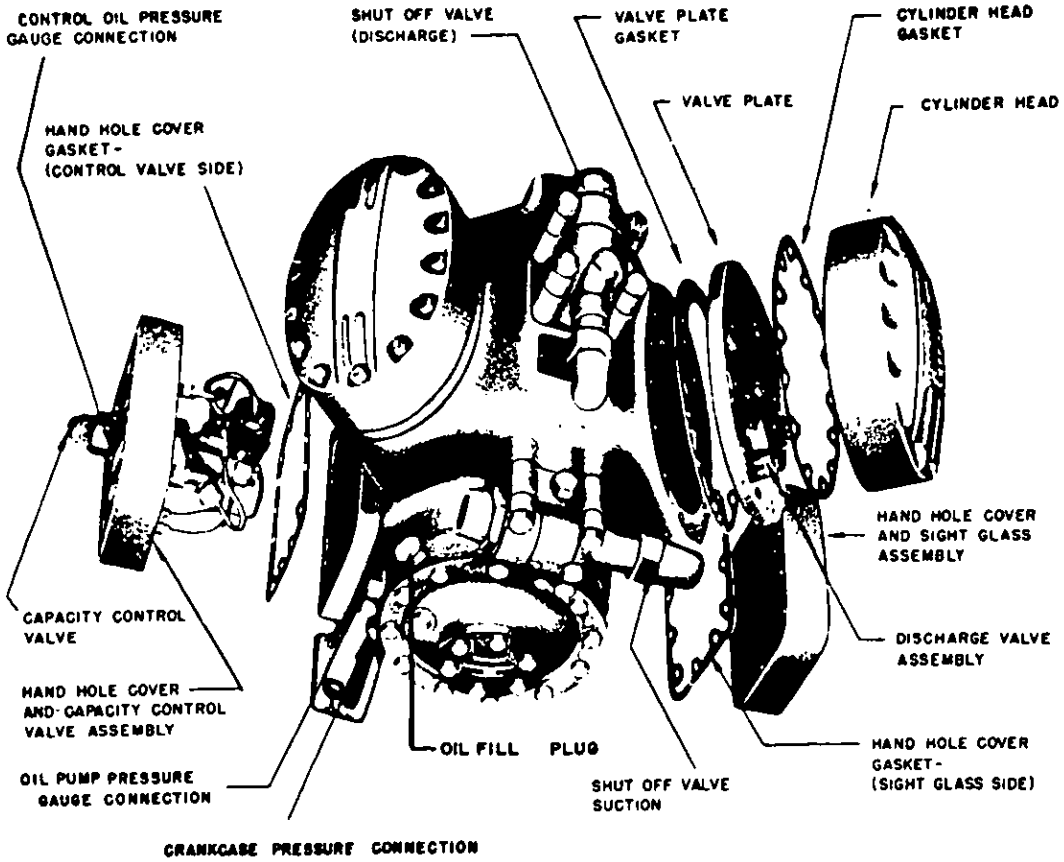


FIGURE II-2 COMPRESSOR WITH CAPACITY CONTROL

Checking the control system:

Should there be indications of faulty operation of the control system, a more thorough check must be made to locate the source of the trouble and make the necessary corrections. TABLE II-2 TROUBLE DIAGNOSIS CAPACITY CONTROL SYSTEM will be of assistance in this connection.

To make this check, it is necessary to take these preliminary steps:

1. Open the suction gauge valve.

2. Pump down and close the compressor suction and discharge valves. Loosen the oil fill plug to relieve the pressure in the compressor.

3. Apply an oil pump pressure gauge to the gauge connection as indicated in Figure II-2.

4. Apply a control oil pressure gauge to the control oil pressure gauge connection as illustrated in Figure II-2. Be sure these gauges indicate accurately.

5. Open the discharge and suction valves and operate the system until the crankcase is warm and the foaming has subsided.

Now proceed as follows:

A. Turn the control valve stem all the way counter-clockwise. The pump and control oil pressures should read 45 to 50 pounds per square inch higher than the suction pressure. Replace the pump if the pressures do not fall within this range.

1. If control oil pressure is lower than the pump pressure:

   a. Remove the thread protector from the pneumatic control connection of the capacity control valve stem and check for refrigerant leakage to atmospheric side of the bellows. See Fig. II-3.

   b. Remove capacity control valve stem assembly and check if stem is broken or the threaded block is out of its guide.

   c. If steps a and b do not remedy the trouble, a defective hydraulic relay, a broken oil tube or stuck control valve is responsible and compressor disassembly is necessary.

B. Turn the control valve stem all the way clockwise. The control oil pressure should drop to not more than seven pounds above the suction pressure.

C. Turn capacity control valve stem counter-clockwise until control oil pressure starts to rise. Continue turning stem very slowly and count the number of cylinders that are loaded. There should be three points at which the control oil pressure changes suddenly, causing the control oil pressure gauge needle to jump.

1. If correct number of unloading steps is counted and unloading is done quietly and rapidly, the operation is normal and no further checking is required.

D. If the correct number of unloading steps is counted, adjust the control valve for partial unloading of the compressor. When unloader cycling occurs at a rapid rate, (two or three second intervals) and does not stabilize after a few minutes operation, and:

1. If suction pressure swings beyond the step differential with rapid cycling, check expansion valve superheat setting. Adjust, if necessary.

2. If suction pressure does not swing widely with cycling, but oil pump pressure drops more than four pounds with each cycle, check oil pump for axial clearance, and replace if necessary. If this does not correct the cycling, hydraulic relay is defective and a new control cover assembly should be substituted.

E. If the unloader steps are not counted, or if unloading and loading causes suction valve noise of more than momentary duration, the hydraulic relay or the valve lifting mechanism is defective.

1. Install new control cover assembly and recheck unloader operation.

2. Pump down compressor, remove cylinder heads and valve plates, secure cylinder sleeves and proceed as follows:

   a. Check valve lifter pins and springs for height above suction valve seats. They should project from 0.33 to 0.36 inches above the seats. If incorrect, replace valve lifter and power element parts found off tolerance.

   b. Inspect valve lifter and power element parts, looking down through suction valve ports in the cylinder sleeves. Unloader fork shoes should be in position under lifter sleeve flange, and fork should be centered on fulcrum points on power element top cover. Replace defective parts.

   c. Operate compressor with heads and plates off and cylinder sleeves secured. Adjust capacity control valve to load and unload compressor and observe the following:

      c 1. Valve lifter pins or springs should retract below the valve seats when the cylinders are loaded. Power element stroke should be smooth, not jumpy. The lifter spring may remain up, but should drop with a light touch of the finger. Replace defective parts as needed.

c 2. Operate capacity control valve slowly through control range and watch control oil pressure and valve lifter pins. As successive cylinders unload, control pressure should dip abruptly and regain its former value. Any marked hesitancy in the pressure dip or regain, indicates a defective relay or a leaking oil line. Cylinders should load or unload in sequence.

c 3. Nominal control oil pressures at which cylinder loading and unloading steps take place should be:

Unloader Step Number	* CONTROL OIL PRESSURE (psig)	
	To Load	To Unload
1	28	19
2	26	15
3	23	12

Table II-1 - Control Oil Pressure for Capacity Control Operation

* Note: Control oil pressure is equal to the gauge reading minus the suction pressure.

Adjusting the Control Point

1. Screw external adjusting stem on the control valve all the way out (CCW). See Figure II-1.

2. Operate refrigerant system to obtain a suction pressure higher than the control point.

3. Reduce crankcase pressure to the control point by slowly closing the suction shut off valve.

4. Turn adjusting screw in (CW) slowly until the first cylinder unloads. The control system is now correctly set and the compressor will load fully when the suction pressure is 3 psi above the control point and unload fully when the pressure is 4 psi below the control point.

5. Recheck by opening suction shut off valve and then slowly closing. Watch suction pressure gauge and listen for the first cylinder to cut out.

6. Open but do not backseat the suction valve.

The control oil pressure change between successive unloading or loading steps should be about 3 pounds. The control oil pressure change between loading and unloading any one step should be about 11 pounds.

Pneumatic Compensation of the Capacity Control Valve

When pneumatic controls are connected to the capacity control valve, it is still necessary to set the capacity control in the manner just described. Air pressure should be off while this is being done. The effect of a pneumatic control is to reset the control point upward by the amount of the air pressure that is applied. For example, if a system is operating at a suction pressure of 40 psig and the control point has been set at 35 psig, the application of 5 psig air pressure will cause the first cylinder to unload. Not over 25 psig air pressure should be applied.

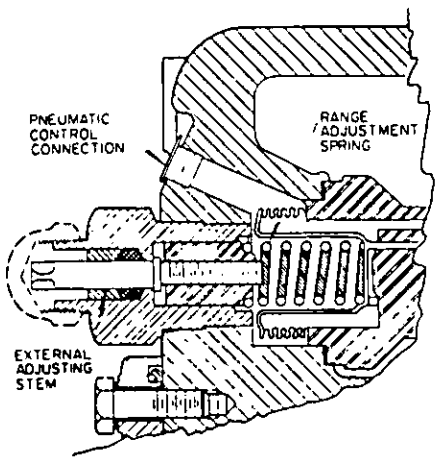


FIG. II-3 CAPACITY CONTROL VALVE

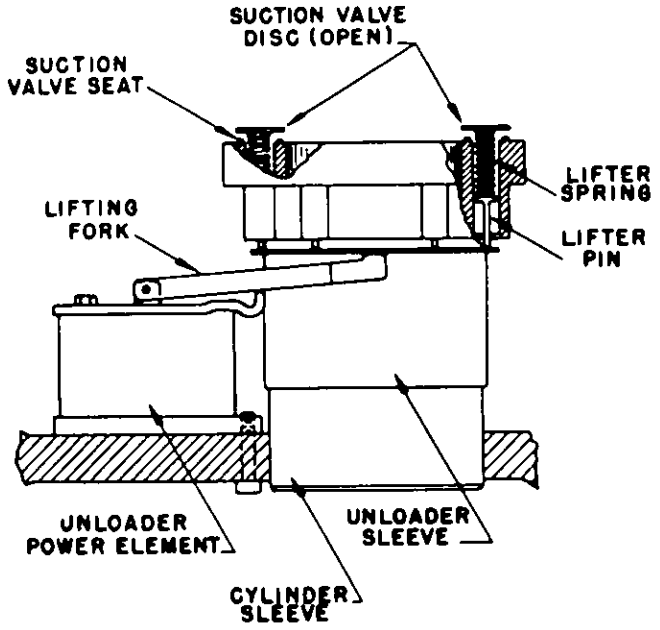


FIG. II-4 SUCTION VALVE LIFTING MECHANISM

The valve lifter mechanism is shown in Figure II-4, and control assembly which is mounted on the crankcase cover is shown in Figure II-3. In order to check the operation of the lifter mechanism or replace parts of the control assembly, it is first necessary to pump down the compressor before removing the cylinder heads or crankcase cover.

It is not necessary to pump down to remove the external adjusting stem. It can be removed by unscrewing the hexagonal body from the cover plate. In replacing the stem assembly, be sure the gasket is in place and in good condition.

If parts of the control valve assembly, other than those mentioned above, require replacement, do not attempt to make repairs. Apply a complete new control valve assembly.

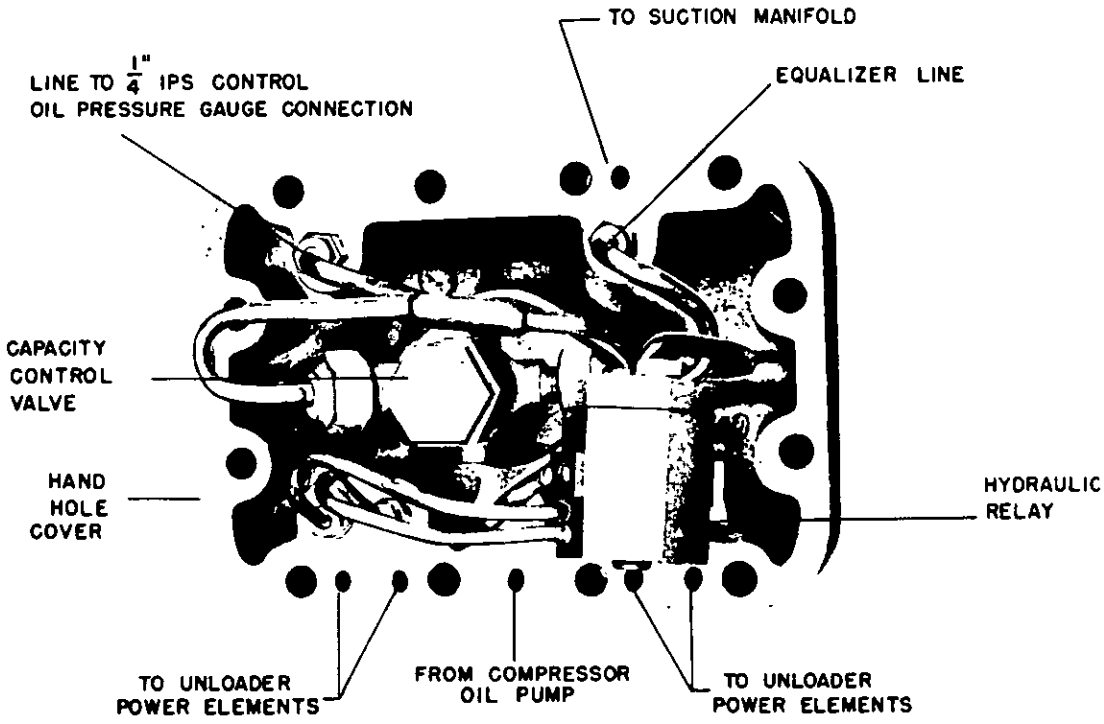


FIGURE II-5 CRANKCASE COVER AND CONTROL ASSEMBLY

COMPLAINT	POSSIBLE CAUSES	MEANS OF IDENTIFICATION	CORRECTION
Compressor will not unload.	Broken control valve stem.	Remove stem housing and inspect.	Replace
	*Inlet strainer stopped.	Control oil pressure remains high for all positions of adjustment stem.	Remove cover and clean.
	Stuck hydraulic relay.	Control oil pressure can be adjusted from pump pressure to 6 psi above crankcase pressure without unloading compressor.	Replace control cover assembly.
Compressor will not load.	Control valve stem traveling nut out of guide or stem broken.	Remove stem housing and inspect.	Engage nut or replace stem assembly.
	Stopped control oil strainer.	Control oil pressure cannot be raised by control valve adjustment.	Clean or replace strainer.
	Refrigerant leakage to atmospheric side of control valve bellows.	Remove pipe plug above adjusting stem and check for refrigerant leaks.	Temporary correction of slight leakage is to leave plug out. Replace cover assembly.
	Low oil pressure.	Check pump pressure with adjusting stem at full counter-clockwise position.	Adjust oil pressure to 45-50 psi.
	Control valve stuck open or orifice in relay stopped (rare).	Low oil pressure for all adjustment stem positions.	Replace cover assembly.
Any one cylinder will not unload	Inlet strainer in control valve stopped (rare).	Control oil pressure cannot be dropped to 6 psi above crankcase pressure.	Clean inlet strainer.

*Omitted on later models

TABLE II-2 TROUBLE DIAGNOSIS
CAPACITY CONTROL SYSTEM

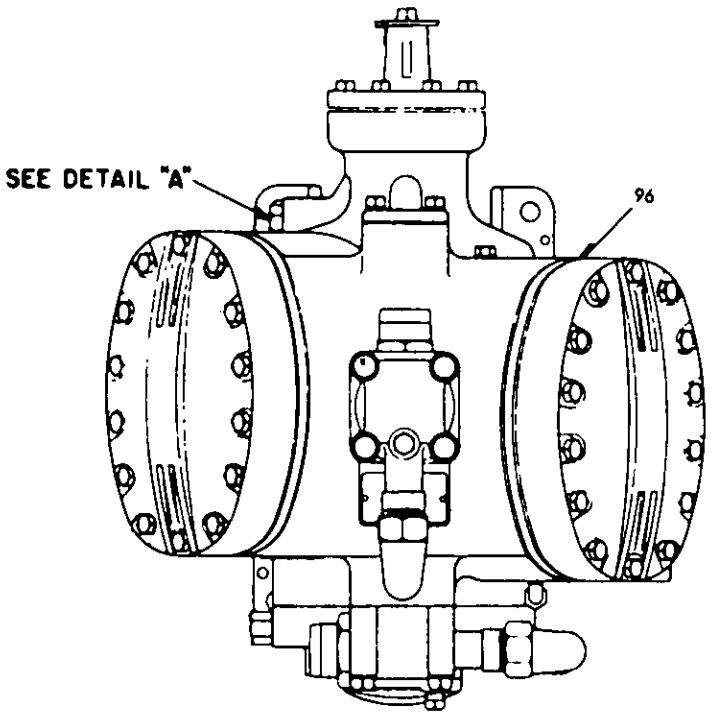
COMPLAINT	POSSIBLE CAUSES	MEANS OF IDENTIFICATION	CORRECTION
Any one cylinder will not unload.	Stuck hydraulic relay.	Operate compressor and by adjusting control valve check control oil pressure for four movements of hydraulic relay.	Replace control cover assembly.
	Valve lifter mechanism defective.	Remove cylinder heads and valve plates. 5F lifter springs should project .33" to .36" above valve seats.	Remove cylinder sleeve and piston and replace defective parts.
Any one cylinder will not load.	Control valve does not close.	Control oil pressure can not be raised to pump pressure.	Replace control valve.
	Low pump pressure.	Pump and control oil pressure low.	Clean control oil strainer, adjust oil pressure. Replace pump if necessary.
	Broken oil line to power element.	Low control oil pressure with drop in pump pressure at one step of unloading.	Repair line.
	Stuck hydraulic relay.	Operate compressor and by adjusting control valve, check control oil pressure for four movements of hydraulic relay.	Replace control cover assembly.
	Valve lifter mechanism defective.	Remove cylinder heads and valve plates, secure cylinder sleeves. Operate compressor and by adjustment of control valve, check that lifter pins and springs will retract below valve seats.	Remove sleeve to replace lifter parts, remove piston and rod to replace power element.

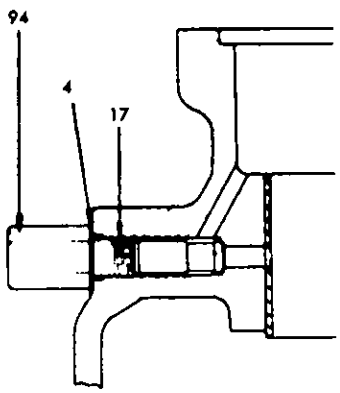
COMPLAINT	POSSIBLE CAUSES	MEANS OF IDENTIFICATION	CORRECTION
Noisy compressor operation varying with unloading.	Loose coupling parts or keying.	Hammering sound at coupling coincident with unloader operation.	Tighten coupling parts and set screws. Replace poorly fitted motor shaft key.
	Vibration of disc in discharge stop valve.	Rattle or howl originating at stop valve.	Backseat valve.
	Insufficient clearance between piston and valve plate.	Sharp, medium pitched metallic hammer at cylinder head when a cylinder is unloaded.	Replace over tolerance parts.
	Sluggish hydraulic relay.	Control pressure dip when cylinder unloads is not abrupt. Valve hammer or clatter when loading or unloading takes place.	Replace control cover assembly.
	Insufficient oil pressure.	Increased and steady valve clatter when a cylinder is unloaded.	Clean control oil strainer, adjust oil pressure, or replace oil pump as indicated.
Noisy compressor operation varying with unloading.	Defective valve lifter mechanism.	Valve hammer or clatter when unloading or loading takes place.	a) Replace stuck lifter pins (or) b) Check unloading fork for alignment (or) c) Check power element for sticky piston (or) d) Leakage of oil at tube connection to power element.
	Insufficient valve lifter pin lift when cylinder is unloaded.	Increased and steady valve clatter when a cylinder is unloaded.	Replace defective valve lifter mechanism parts.

COMPLAINT	POSSIBLE CAUSES	MEANS OF IDENTIFICATION	CORRECTION
Rapid unloader cycling.	Inter-action between capacity control valve to expansion valve.	Rapidly varying suction pressure equal or greater than step differential of control valve.	a) Use wide differential control valve spring. b) Resize expansion valve. c) Reduce pump pressure 45-50 psi. d) Tighten packing around push pins in expansion valve. e) Remove equalizer line from control valve to suction manifold and plug line to suction manifold.
	Partially plugged control oil strainer.	Oil pump pressure read at control oil strainer access plug drops more than 5 lbs when cylinder is loaded.	Replace strainer.
	Weak oil pump.	Oil pump pressure drops more than 5 lbs when cylinder loads.	Replace.
	Improperly machined or adjusted hydraulic relay.	Rapidly varying control oil pressure as loading and unloading takes place without accompanying suction pressure swings beyond the step differential of the control.	a) Replace control cover assembly. b) Disconnect the equalizer line to control valve and plug line to suction manifold.

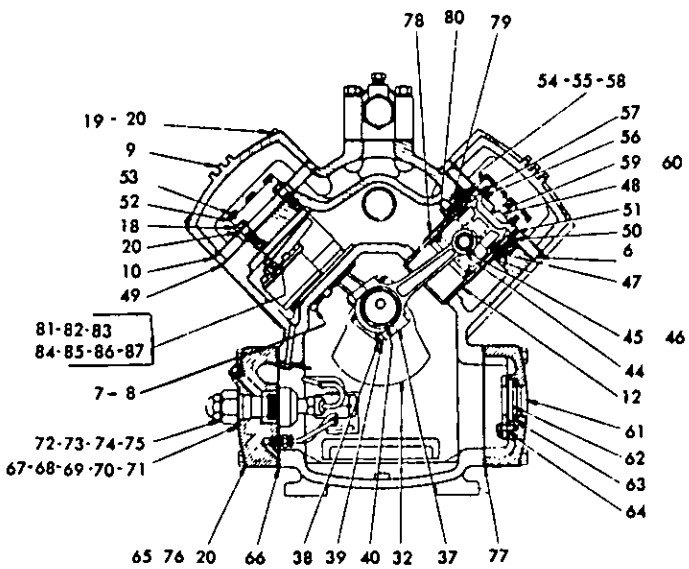
SECTION III

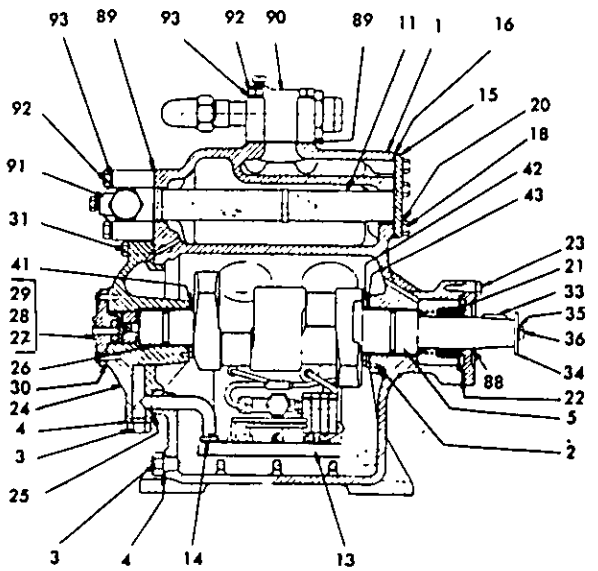
PARTS LIST COMPRESSOR ASSEMBLY 161705 (5F40)





DETAIL "A"





Service Parts 5F-40 Compressor

Item No.	Description	Cat. No.	No. Req'd.
1	Crankcase Assembly Includes:	163518	1
2	Dowel Pin 3/16" x 3/8" (Bearing Washer)	T-2463	(1)
3	Magnetic Plug	162418	(1)
4	Magnetic Plug, Gasket (5/8")	T-2466	(1)
5	Main Bearing, Seal End	161978	(1)
6	Dowel Pin, Valve Plate	T-2464	(4)
	#Unloader Oil Supply Tubes	-	-
	#Oil Supply Tubes	-	-
	#Tube Ferrules	-	-
7	Oil Return Check Valve Package Includes:	162126	2
	#Check Valve	-	(1)
8	Check Valve gasket	162489	(1)
9	Cylinder Head	162028	2
10	Cylinder Head Gasket	162487	2
11	Suction Strainer Assembly	162032	1
12	Cylinder Sleeve (With Holes)	163520	4
13	Oil Filter Screen Package Includes:	T-2455	1
14	Oil Filter Screen Gasket	162496	(2)
15	Manifold Cover Plate	162031	1
16	Manifold Cover Gasket	162488	1
17	Oil Regulating Valve Package Includes:	T-2465	1
(4)	Gasket (5/8")	T-2468	(1)
18	Cap Screw 3/8-16 x 1" (Manifold Cover)	157557	6
19	Cap Screw 3/8-16 x 3" (Cylinder Head, Suction Manifold)	162424	28
20	Cap Screw Gasket (3/8)	151286	34
21	Shaft Seal Package, Includes:	T-1401	1
22	Cover Plate Gasket	T-2458	(1)
	#Carbon Washer		
	#Cover Plate		
23	Cap Screw 3/8-16 x 1-1/4 (Shaft Seal Cover)	151375	8
24 (+)	Bearing Head and Oil Pump Assembly Includes:	T-2462	1
25	Bearing Head Gasket	162493	(1)
26	Main Bearing, Pump End	162429	(1)
(3)	Magnetic Plug	162418	(1)
	Oil By-Pass Plug		(1)
	Control Strainer		(1)
	Hollow Lock Screw	-	(1)
	Modulating Valve Adapter		(1)
(4)	Cap Screw Gasket (5/8")	T-2466	(3)
(20)	Cap Screw Gasket (3/8") (Bearing Head)	151286	(12)
27	Hex Head Cap Screw 1/4-28 x 3/4 (Oil Pump Cover)	164363	(6)
28	Cap Screw Gasket (1/4")	163534	(6)
(2)	Dowel Pin (Bearing Washer)	T-2463	(1)
29	Oil Pump Package (Matched Parts) Includes:	T-13006	(1)
	#Cover, Idler, Rotor and Bushing	-	
30	Oil Pump Cover Gasket	T-12652	(1)
(25)	Bearing Head Gasket	162493	(1)
31	Hex Head Cap Screw (3/8-16 x 1-3/4") (Bearing Head Cover)	T-2459	12
32	Crankshaft Assembly	162452	1
33	Woodruff Key #21	162505	1
34	Retaining Washer (3/8")	162450	1
35	Lockwasher (3/8")	4411	1
36	Cap Screw (3/8-24 x 7/8")	162502	1
37	Connecting Rod and Bearing Package Includes:	T-2451	4
	#Connecting Rod	-	(1)
38	Connecting Rod Bolt	162456	(2)
39	Connecting Rod Nut	T-2452	(2)
40	Connecting Rod Bearing Half	162458	(2)
41	Bearing Washer, Pump end	162461	1
42	Seal End Thrust Washer (steel)	162460	1
43	Seal End Bearing Washer (bronze)	162459	1
44	Piston and Pin Package (Unassembled) Includes:	162462	4
45	Piston Pin	162464	(1)
46	Piston Pin Lock Ring	T-2456	(2)
	#Piston	-	(1)
47	Piston Ring Package Includes:	T-7690	1
	#Compression Ring	-	(8)
	#Oil Ring	-	(8)
48	Valve Plate Package Includes:	T-2453	2
	#Valve Plate	-	(1)
49	Valve Plate Gasket	162488	(1)
(10)	Cylinder Head Gasket	162487	(1)
50	Suction Valve Disc	162468	(2)
51	Suction Valve Spring	162469	(12)
52	Guide Lockwasher	162476	(6)
	**Suction Valve Clip	161984	(4)
53	Cap Screw 1/4-28 x 1 (Guide to Valve Plate)	162425	(6)
54	Discharge Valve Guide Assembly Includes:	T-13007	(2)
	#Inner Seat	-	
55	Discharge Valve Guide	162471	(1)
56	Discharge Valve	162472	(1)
57	Discharge Valve Spring	162474	(6)
58	Seal Lock Plate	162475	(1)
(53)	Cap Screw (1/4-28 x 1") (Lock Plate to Guide)	162425	(3)
59	Dowel Pin - 3/16 x 3/4 (Guide)	162478	(1)
60	Dowel Pin - 1/4 x 1/2" (Guide)	163519	(1)
(18)	Cap Screw 3/8-16 x 1 (Valve Plate to Crankcase)	157557	(4)
(20)	Cap Screw Gasket (3/8")	151286	(4)
61	Handhole Cover and Sight Glass Assy. Includes:	162426	1
62	Sight Glass Package Includes:	T-13004	(1)
	Sight Glass Assembly	T-12670	(1)
64	Sight Glass Gasket	T-12671	(1)
65	Handhole Cover and Control Valve Assem. Includes:	163527	1
66	Handhole Cover Gasket	163532	(1)
	#Hydraulic Relay		(1)
67	Socket Head Cap Screw (5/16-24 x 1-7/8")	164358	(2)
68	Cap Screw Gasket (5/16")	164359	(2)
69	Control Valve Assy. Package Includes:	164360	(1)
70	Valve Gasket, Inner	163533	(1)
71	Valve Gasket, Outer	163531	(1)
72	Control Valve Assembly Includes:	164361	(1)
73	Spring (7# - for R-12 and R-500)	163529	(1)
74	External Valve Assembly	163528	(1)
75	Valve Body with Bellows	164362	(1)
76	Cap Screw 3/8-16 x 2-1/4" (Handhole Cover	162423	24
(20)	Cap Screw Gasket 3/8"	151286	24
77	Handhole Cover Gasket (Handhole Cover with Sight Glass)	162490	1
78	Unloader Sleeve	163535	3
79	Valve Lifter Spring	163536	18
80	Valve Lifter Pin	163537	18
81 (+)	Unloader Power Element Includes:	163524	3
	Unloader Cylinder Bracket		(1)
82	Unloader Cylinder Gasket (Bottom)	T-4923	(1)
	Unloader Cylinder		(1)
	Unloader Piston		(1)
	Unloader Piston Rod		(1)
	Unloader Spring Retaining Washer		(1)
	Unloader Spring (2")		(1)
	Unloader Spring (1 13/16")		(1)
	Unloader Cylinder Gasket (Top)		(1)
	Cylinder Cover Plate Assembly		(1)
83	Lockwasher (1/4")	T-9400	(3)
	Socket Head Cap Screw 1/4-28 x 1-3/4"		(3)
	Cotter Pin (1/16 x 3/8")		(1)
	Plate Washer		(1)
84	Clevis Pin	163526	(1)
85	Unloader Fork	T-2457	(1)
86	Unloader Bracket Gasket	163530	3
87	Socket Head Cap Screw 1/4-28 x 1" Unloader Assembly to crankcase	163521	6
(83)	Cap Screw Lockwasher (1/4")	T-9400	6
88	Dust Seal Package	T-2661	1
	Consists of:		
	Felt Seal	T-2661-1	(1)
	Felt Seal Housing Assembly	T-2661-2	(1)
89	Gasket, Shut Off Valve to Crankcase	162497	2
90 (*)	Shut Off Valve (Discharge) 1-3/8 ODS		
	(*) Valve (Mueller)	162480	
	Includes:		
	Seal Cap	164357	(1)
	Seal Cap Gasket	164356	(1)
	(*) Valve (Henry) 1-3/8 ODS	T-4924	
	Includes:		
	Seal Cap		(1)
	Seal Cap Gasket		(1)
	Tail Piece Adapter		(1)
	Gasket (Tail Piece Adapter)	T-2520	(1)
	Companion Flange		(1)
	Companion Flange Bolts (1/2-13 x 1-3/4)	51398	(4)
91 (*)	Shut Off (Suction) 1-5/8" ODS		1
	(*) Valve (Mueller)	162481	
	Includes:		
	Seal Cap	164357	(1)
	Seal Cap Gasket	164356	(1)
	(*) Valve (Henry)	T-4945	
	Includes:		
	Seal Cap		(1)
	Seal Cap Gasket		(1)
	Tail Piece Adapter		
	Gasket (Tail Piece Adapter)	T-2520	(1)
	Companion Flange		(1)
	Companion Flange Bolts	51398	(4)
92	Cap Screw		6
	For Valves T-4924 & T-4945	54825	
	For Valves 162480 & 162481	162482	
93	Gasket, Cap Screw	151303	8
94	Valve Cap	T-2467	1
(4)	Gasket, Valve Cap	T-2466	1
96	- Compressor (Service Replacement)	T-11902-1	
	** Accessories Used at Overhaul		
	o Gasket Set	162510	1
	o Suction Valve Clips	161984	4
	o Bearing Puller	T-2460	1
	o Sleeve Puller	162507	1

* Not sold separately

o Not Shown

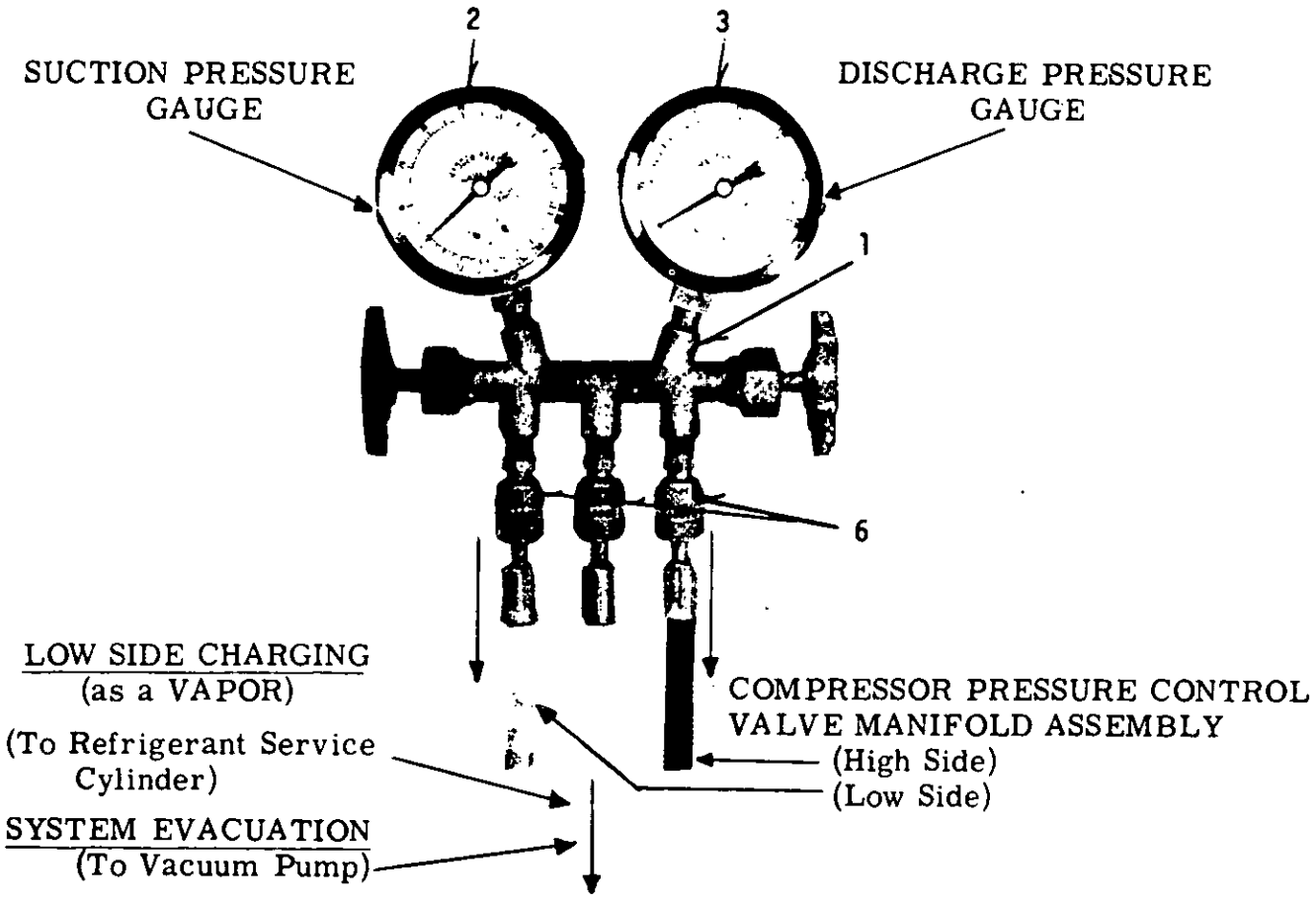
(*) When reordering replacement valves or components for items 90, 91 and 92 specify proper part number.

- Exchange available - Return worn or defective item to SAFETY ELECTRICAL EQUIPMENT CORP. for credit.

Item 73 for Refrigerant 22 service, specify Cat. No. 164310.

SERVICE MANIFOLD AND GAUGE ASSEMBLY
SAFETY CATALOG NO. T-12497

(FOR CHARGING, EVACUATING, AND SYSTEM TESTING OPERATIONS)

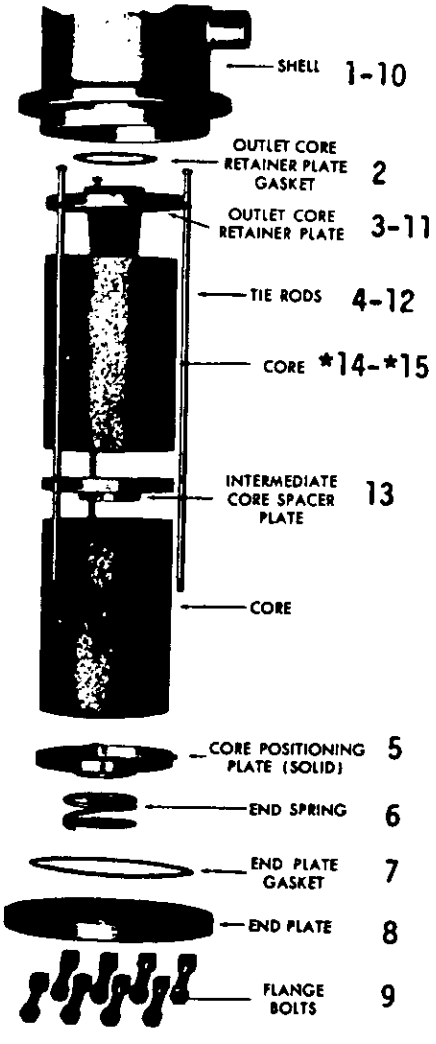


Item No.	Description	Catalog No.	No. Req'd.
1	Manifold and Gauge Assembly	T-12497-1	1
2	Gauge (30" - 250 psi)	T-12497-3	(1)
3	Gauge (0 - 500 psi)	T-12497-4	(1)
4	* Cap, Quick Seal	T-12497-6	(3)
5	* Gasket, Cap and Couplers	T-12497-7	(6)
6	Charging Line Set (36" Lines with 1/4" SAE Quick Couplers and * Elbow at one End)	T-12497-2	1 (3)
7	* Metal Carrying Case	T-12497-8	1
8	* Support Hook	T-12497-9	1

* Not Shown

FILTER-DRIER ASSEMBLY (LESS CORES)*

*Cat.No.	No.Cores	Connections(Solder)	
		Inlet	Outlet
163088	2	7/8 ODF	7/8 ODF
164177	1	5/8 ODF	5/8 ODF
164312	1	7/8 ODF	7/8 ODF



Item No.	Description	Cat.No.	163088* No.Req'd.	164177* 164312* No.Req'd.
1	Shell	T-13784-1		1
2	Gasket,Outlet Core Retainer Plate	T-13784-2	1	1
3	Outlet Core Retaining Plate	T-13784-3		1
4	Tie Rods	T-13784-4		3
5	Core Positioning Plate (Solid)	T-13784-5	1	1
6	End Spring	T-13784-6	1	1
7	Gasket, End Plate	T-13784-7	1	1
8	End Plate	T-13784-8	1	1
9	Flange Bolts Nuts (5/16 x 1-3/4)	T-13784-9	8	8
10	Shell	T-13784-10	1	
11	Outlet Core Retaining Plate	T-13784-11	1	
12	Tie Rods	T-13784-12	3	
13	Intermediate Core Spacer Plate	T-13784-13	1	
14*	Filter-Drier Core	T-9973		1
15*	Filter-Drier Core	163089	2	

Note: *Drier Cores, Items 14, 15 are not included as components of Filter-Drier Assembly and must be specified when ordering.

LIQUID LINE FILTER DRIER ASSEMBLIES, Catalog Numbers 163088, 164177, and 164312

A replaceable core type Filter Drier assembly, as shown on Page 1, is installed in the liquid line near the outlet of the receiver. Shut off valves are provided at the inlet and outlet connections so that the core(s) may be replaced without opening the entire system.

The function of the Filter Drier is to keep the circulating liquid free from contaminants such as moisture, acid, and foreign matter. The assembly includes a heavy steel shell for high burst strength and a porous core molded from a blend of highly efficient desiccants which are held together by an inert binder. Moisture and acid from the refrigerant and oil mixture are adsorbed and retained on the surface of the desiccant granules. The porous structure of the core and the tapered mesh screen also serve to filter out the solid contaminants which may be carried over in the liquid refrigerant.

After the core assembly has become saturated, it is no longer effective and must be replaced with a new one. Similarly, after a period of time the core may become restricted by dirt and entrained foreign matter which will reduce the flow of refrigerant. This condition may be determined by feeling the inlet and outlet lines when the equipment is operating. There should be no appreciable difference in temperature. Should the outlet connection be much colder or the Moisture Indicator show other than a "dry" condition, a new core assembly should be applied.

Under normal conditions, it should not be necessary to renew the core assembly more often than once a season. If the system is opened for the purpose of making repairs, it is well also to install a new core assembly at that time.

The construction of the Filter Drier is shown on Page 1.

TO APPLY A NEW CORE ASSEMBLY:

CAUTION: Do not remove the core from the sealed shipping container until ready to install. Also handle the core carefully to avoid scraping or chipping.

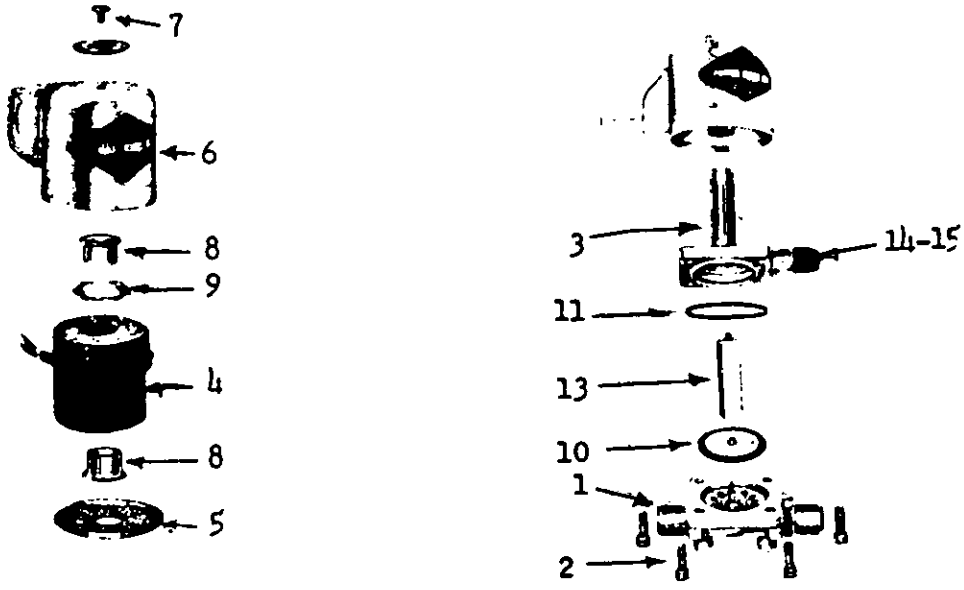
1. Make sure that the Filter Drier shell is completely pumped down and free of refrigerant. Close the line shut off valves tightly. Loosen flange bolts to bleed off residual pressure.
2. Remove the flange bolts, end plate, and internal core assembly..
3. After withdrawing the end plate, item 8, and the core assembly, remove the rods, discard the used core(s), and remove the flange gasket. Then:
   a. Place the end plate on a flat surface with the gasket side upward.
   b. Center the spring, item 6, on the plate and with the core positioning plate, item 5, (outer flange upturned) fit the recess into the spring coil.
   c. Remove the core from the sealed shipping container and place it on the core positioning plate. Apply a new cover plate gasket.
   d. Add the core and apply the outlet core retaining plate (rim down turned) where Filter Driers, Catalog Number 164177 and 164312 are used.
   e. On the multi core,(2), Filter Drier Assembly, Catalog Number 163088, locate the intermediate core spacer plate (this plate has a center hole with lip edge that fits in the core hole) and add core, Catalog Number 163089 and outlet core retaining plate, item 11.

NOTE: Take extreme care to make sure that the outlet core retaining plate is the last plate to be positioned - always on top of the last core. The screen on the outlet core retaining plate must be inserted into the center of the core.

   f. Align the holes in the core plates and secure the three (3) long bolts into the tappings in the end plate to a snug seat.
   g. Wipe clean the inside of the shell, and after blowing the dust from the core assembly, insert into the shell. Tighten the flange bolts evenly to the maximum.
   h. Test for leaks.

SOLENOID VALVE

CATALOG NO.		VOLTAGE	COIL HOUSING-ELECTRICAL ENTRANCE	REMARKS
VALVE	COIL (ITEM 4)			
T-14315-2	T-14270	32 V.DC	Std.Junction Box	
T-3330-10	T-7820-6	64 V.DC	Std.Junction Box	
T-3330-6	T-7820-3	115 V.DC	1/2 NPT Conn.	
T-3330-11	T-7820-4	115 V.AC	Std.Junction Box	
S-8132-3	T-14270-1	64 V DC	Std.Junction Box	With Transient Suppressor, T-16896-11
S-8132-4	T-14270-1	64 V DC	Std.Junction Box	With Transient Suppressor, T-16896-11



Item No.	Description	Catalog No.	No. Req'd.
1	Body Assembly	T-15133-1	1
2	Body and Bonnet Screws	T-15133-2	4
3	Bonnet and Enclosing Tube	T-15133-3	1
4	Coil (See Table)		1
5	Coil Bottom Plate	T-15133-4	1
6	Coil Housing w/Junction Box	T-15133-5	1
7	Coil Retaining Screw	T-15133-6	1
8	Coil Sleeve	T-15133-7	2
9	Coil Spring	T-15133-8	1
10	Diaphragm	T-7821	1
11	"O"-Ring, Body-Bonnet	T-7822	1
12	*"O"-Ring, Locating Sleeve	T-7822-2	1
13	Plunger	T-15133-9	1
14	Seal Cap	T-15061-1	1
15	Seal Cap Gasket	T-15061-2	1

* Not Shown

To Remove Solenoid Coil

First remove the retaining screw at the top of the coil housing. The entire coil assembly may then be lifted off the enclosing tube.

To Reassemble Coil Housing Components, make sure that the parts are placed on the enclosing tube in the following order:

1. The coil bottom plate with the outer edge up.
2. The lower coil sleeve with the flange on the bottom. (Flange down)
3. The coil itself (or its replacement) with lead exits at the bottom.
4. The coil spring with the flat edges up.
5. The upper coil sleeve with flange at top (flange up). The sleeve projects through the coil spring.
6. The coil housing. Make sure coil lead wires do not catch over or under the coil.
7. The electrical data plate. Press down firmly and insert coil retaining screw. Rotate housing to proper position and tighten screw securely.

To Disassemble Valve

The valve may be taken apart by removing the four socket head body screws which hold the body and bonnet together.

After removing the screws, carefully lift off the bonnet assembly (upper part of the valve). Do not drop the plunger. The diaphragm may now be lifted out. Use caution not to damage the machine faces when the valve is apart.

NOTE: THE ABOVE PROCEDURE MUST BE FOLLOWED BEFORE BRAZING SOLDER TYPE BODIES INTO THE LINE.

To Reassemble

Place the diaphragm in the body with the pilot port extension UP. Hold the plunger with the synthetic seal against the pilot port. Make sure the bonnet "O" rings are in place, then lower the bonnet assembly over the plunger, make sure that the locating sleeve in the bonnet enters the mating hole in the body. Insert body screws and tighten uniformly.

To Operate the Valve Manually

The valve is equipped with a manual operating stem which permits the main port to be opened without the coil being energized.

The manual stem is located in the bonnet assembly above the outlet connection. It is a 3/16" square wrench stem under a seal cap which opens an auxiliary pilot port, allowing system pressures to actuate the diaphragm in a normal manner, identical to the action involved when the plunger is raised electrically to open the pilot port. A slight turn (approximately 1/2 revolution) counter-clockwise opens the auxiliary port.

Tightening stem clockwise causes the port to be well sealed by pressing the stainless steel stem against the brass seat and returns the valve to automatic operation. The manual stem is sealed with an "O" ring to provide a leak-free construction.

Do not attempt to screw the manual stem in too far. Do not continue to screw the stem in if resistance to turning increases suddenly. When this occurs, the diaphragm is up as far as it should go and any further movement will bend or distort the buffer plate. To return to automatic operation, back the stem out. Always replace the seal cap after operating the manual stem.

General Service Hints

Note: Diaphragms and plunger assemblies will not withstand soldering heat and must be removed when the valve body is being soldered into the line. When this is necessary, follow the steps previously outlined for disassembly and reassembly.

To check operation of the valve, first cycle the switch controlling the solenoid coil. Movement of the plunger will be audible if the coil is okay. Otherwise, check for proper voltage at coil terminals. If the voltage is okay, replace coil. Be sure the manual stem is properly positioned for automatic operation. Otherwise complaints of failure to open or failure to close tightly can involve only the plunger and diaphragm. Disassemble the valve and inspect the diaphragm and synthetic seat on the plunger. Foreign material interferring with the action of the plunger or diaphragm is often responsible for the difficulty. Inspect both plunger seat and diaphragm for damage. Make sure difficulty was not caused by incorrect assembly of parts. Generally, the installation of a new diaphragm, a new plunger, or both will correct such complaints.

The junction box or conduit connections on the coil housing can be moved to any desired position by loosening the retaining screw at the top of the coil housing and rotating the housing to the desired position. Be sure to tighten the retaining screw after this operation.

INSTRUCTIONS FOR FIELD REPLACEMENT OF RESISTANCE COILS IN BLAST COIL HEATERS

1. The replacement resistance coil is shipped prewound on the proper size arbor and with the terminals assembled to its ends. Insulators for the return bends made by the coil when strung through the heater and replacement terminal insulators are provided when required.

2. The enclosed diagrams must be followed when positioning the coils in the frame of the heater, installing the bus, locating supply connections, and reconnecting any built-in components which were disconnected to facilitate coil replacement.

3. It may not be necessary to remove the terminal pan if the first bracket is spaced 3-1/2" behind it. Otherwise the pan may be removed by drilling out the spot-welds by which it is attached. It will be necessary, likewise, to remove the back pan if insulators are to be installed at the return bends of the resistance coils. The terminal pans which have been removed may be reassembled to the heater and attached with sheet metal screws after all terminals have been inserted through their insulator bushings.

4. The replacement coil is shipped close-wound, and must be stretched by the electrician to the proper length before placement in the heater is attempted. This proper stretched length is determined by the width of the heater and by the number of passes which the coil makes through the heater, and is found by the formula:

   Stretched Length = Number of Passes X (Heater Width Minus 1")

   It is important that the coil not be over-stretched.

5. The stringing of the properly stretched resistance coil commences with the determination of its mid-point. Both ends are passed through the heater frame simultaneously. Care must be taken to insure that these passes are made through the correct location, and in the direction that will place the center return bend at the proper end of the heater. For example, if the coil is to make four passes, the mid-point of the coil must bend across the front bracket (i.e. at terminal end).

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6. If the return bends of the coil are to be insulated, the center insulator must be carefully positioned in the coil before it is passed through the heater. The insulator should be placed on the straightened section of coil, so that the resistance wire lays in the groove of the insulator, and the wire must then be bent down sharply through the grooves at the ends of the insulator. It is important that the wire passing through the end groove of the insulator be centered on the adjacent windings of the coil. If the coil is to receive additional return bend insulators, it should be similarly formed about them before the return pass of the coil through the heater is commenced.

7. The male half of the phenolic terminal insulator bushing must be placed in the terminal pan from the side internal to the duct, before the coil terminal is passed through the terminal pan. (If the terminal pan has been removed, all of the coils should be strung before this phase of the job is attempted). Care must be taken that the terminal is completely seated into this section of the insulator bushing, so that the terminal is prevented from rotating when its hardware is installed.

8. The terminals are fastened into their insulator bushings by a nut tightened* down against a washer on top of the female section of the bushing. It is essential to insure that the terminal is completely seated into the bushing so that it is prevented from turning.

   *Bushing may be cracked if over-tightened.

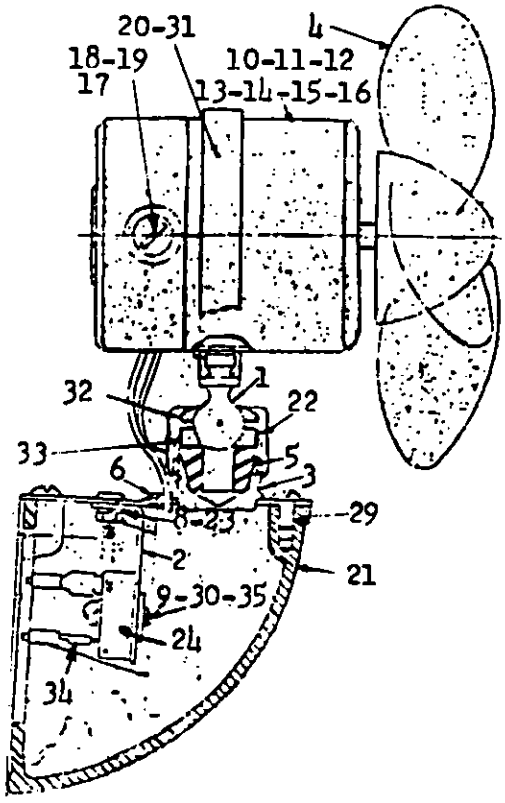
9. In some cases where the replacement resistance coils are intended to convert the heater to a different electrical specification, the supply conduit knockout originally provided in the terminal pan may no longer be suitable. New knockouts must then be provided in accordance with the National Electrical Code.

10. The factory assumes no responsibility for the workmanship of electricians in the field, nor does the Underwriters' Laboratories allow their label to remain on heaters which have been reworked in the field. A new nameplate is included with the replacement coils whenever the electrical characteristics of the heater have been changed by installation of replacement coils. This nameplate must replace the original nameplate on the heater.

6" RUBBER BLADE AIR CIRCULATING FAN FOR ROOMETTES & BEDROOMS

Catalog Nos.	Voltage	Current
M-3897-1	36 Vdc	1.6
M-3897-2	72 Vdc	.8
M-3897-3	125 Vdc	.55
M-3897-4	115 Vac	.26

ITEM NO	DESCRIPTION	CATALOG NO.	NO REQ'D M-3897-1	M-3897-2	M-3897-3	M-3897-4
1	Ball Rivot	T-12435	1	1	1	1
2	Bracket, Complete	T-18013-1				1
3	Cover, Complete	T-12463-1	1	1	1	1
4	Fan	T-12462	1	1	1	1
5	Grommet	156393	1	1	1	1
6	Grommet	T-12532	1	1	1	1
7*	Insulator	T-12525	1	1	1	
8	Lockwasher #8	53884	4	4	4	2
9	Lockwasher #10	52909				1
10	Motor (36 VDC)	T-12461-1	1			
11	Motor (72 VDC)	T-12461-2		1		
12	Motor (115 V AC/DC)	T-12461-3			1	1
13*	Armature	T-14592	1			
14*	Armature	T-14593		1		
15*	Armature	T-14610			1	1
16*	Bearing	T-14614	2	2	2	2
17*	Brush & Spring Assembly	T-14611	2			
18*	Brush & Spring Assembly	T-14612		2	2	2
19	Brush Cap	T-14613	2	2	2	2
20	Motor Band	T-12449	1	1	1	1
21	Mounting Base	M-3885-2	1	1	1	1
22	Nut, 1-1/8-12 NF-3B	T-12440	1	1	1	1
23	Nut #8-32	52884	4	4	4	2
24	Rectifier	T-17278-1				1
25*	Resistor, 15 ohms	T-12460-7	2			
26*	Resistor, 150 ohms	T-12460-13		1		
27*	Resistor, 100 ohms	T-12460-12		1		
28*	Resistor, 250 ohms	T-12460-15			2	
29	Screw, Truss Head NYLOK #10-32 x 3/8"	T-12527-1	3	3	3	3
30	Screw #10-32 x 3/4"	4089				1
31	Set Screw,Headless #10-32	T-12464-3	2	2	2	2
32	Socket Bushing	T-12438	1	1	1	1
33	Socket Bushing	T-12439	1	1	1	1
34	Terminal (Faston)	T-13585-1				4
35	Washer #10	52832				1



* NOT SHOWN

AIR CIRCULATING FAN ASSEMBLIES FOR ROOMETTES AND BEDROOMS

1. INTRODUCTION

This description covers the line of rubber blade air circulating fans designed for use in roomettes and/or bedrooms of battery powered sleeping cars.

2. MECHANICAL DESIGN

The fan assembly design incorporates provisions for mounting a motor and a blade.

a. The method of mounting permits not less than 90° horizontal and 45° (15° up and 30° down) vertical adjustment in the direction of air flow. After being positioned within the established limits, the fan will remain in the set position under normal vibrational acceleration levels experienced in a rail car. Position retention is accomplished without requiring any action other than directing the air flow. The mounting will retain full capability for the life of the fan assembly.

b. Motor

The motor incorporates two permanently lubricated bearings, one at the blade, and one at the commutator end of the armature shaft. The material used does not support combustion nor will the motor frame exceed 20°F above the ambient when the fan is operated on high speed setting at 125% of rated voltage for a minimum of 8 hours. The brushholders are integral with the housing and located so that the brushes may be changed without removing the fan from the wall bracket.

c. Fan Blade

The 3 blade rubber fan is 6" in diameter and supplied with a screw and adapter to maintain shaft and blade concentricity. The material hardness of the individual blades is no greater than a durometer reading of 60-65 shore A.

d. General

The assembly, less the fan blade, hub, and motor, is painted with a metalastic enamel, medium gray color.

3. ELECTRICAL DESIGN

a. Motor

The motors are arranged for three speed operation through a remote control switch provided by the customer.

b. Brushes

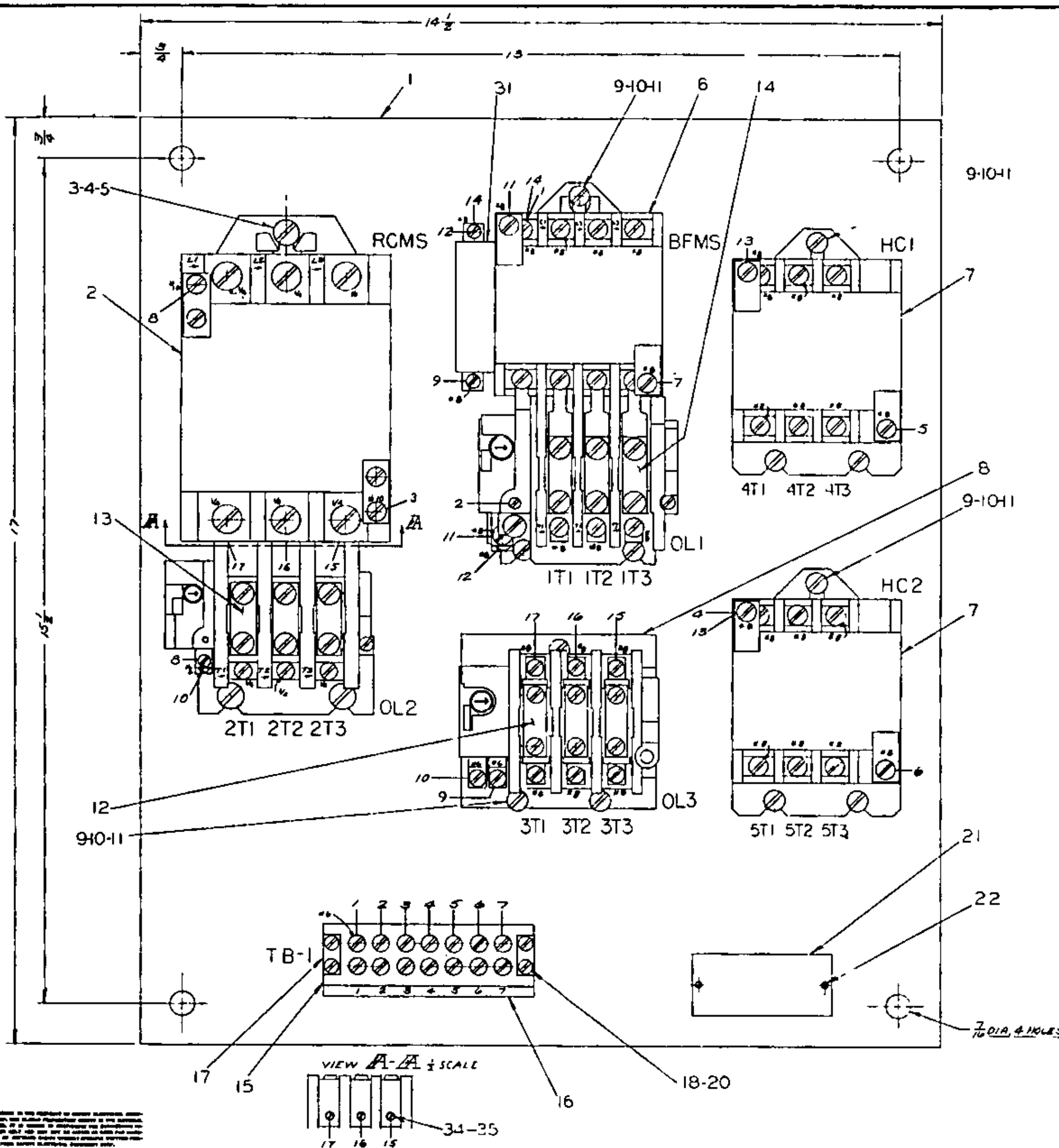
Nominal brush life is of the order of 17500 hours of operation.

4. PERFORMANCE

At high speed, the air delivery is not less than 250 CFM

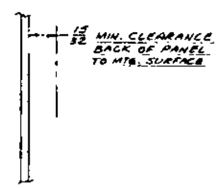
Nominal Performance Data

Voltage	Current			Speed		
Switch Setting	Pos. 1	Pos. 2	Pos. 3	Pos. 1	Pos. 2	Pos. 3
36 VDC	.95	.7	.55	25/2600	19/2000	25/1600
72 VDC	.48	.3	.2	25/2600	19/2000	16/1700
125 VDC	.3	.17	.14	26/2800	17/1900	13/1500
115 VAC	.452			3540		
120 VAC	.417			3450		
125 VAC	.398			3390		



LEAD NO.	WIRE SIZE FOR SPEC W-946	WIRE LENGTH	FROM	TERM.	TO	TERM.
1	#14	10"	TB1-1	T-6107-9	BFMS	T-6107-16
2	"	11"	TB1-2	T-6107-9	BFMS	T-6107-16
3	"	12"	TB1-3	T-6107-9	RCMS COIL	T-6107-13
4	"	14 1/2"	TB1-4	T-6107-9	HC2 COIL	T-6107-16
5	"	10 1/2"	TB1-5	T-6107-9	HC1 COIL	T-6107-16
6	"	12"	TB1-6	T-6107-9	HC2 COIL	T-6107-16
7	"	16"	TB1-7	T-6107-9	BFMS COIL	T-6107-16
8	"	25"	RCMS COIL	T-6107-13	OL2	T-6107-9
9	"	11"	OL3	T-6107-9	BFMS AUX	T-6107-16
10	"	10"	OL3	T-6107-9	OL2	T-6107-9
11	"	14"	BFMS COIL	T-6107-16	OL1	T-6107-16
12	"	12"	BFMS AUX	T-6107-16	OL1	T-6107-16
13	"	13"	HC1 COIL	T-6107-16	HC2 COIL	T-6107-16
14	"	3 1/2"	BFMS AUX	T-6107-16	BFMS	T-6107-16
15	#10	7 3/4"	RCMS	T-6107-10	OL3	T-6107-2
16	"	7 3/4"	RCMS	T-6107-10	OL3	T-6107-2
17	"	7 3/4"	RCMS	T-6107-10	OL3	T-6107-2

B-4290-1	PART NO.	DESCRIPTION	ITEM NO.
1	B-4296-1	PANEL	1
1	T-16872-3	COMPRESSOR MOTOR STARTER	2
3	4836	SCREW, 1/4-20 X 1/2 LONG	3
3	500287	FLAT WASHER - 1/4	4
3	3924	LOCKWASHER - 1/4	5
1	T-16872-2	BLOWER MOTOR STARTER	6
2	T-19519-1	HEATER CONTACTOR	7
1	T-16811-1	OVERLOAD RELAY	8
12	50813	SCREW, 10-32 X 1/2 LONG	9
12	52909	LOCKWASHER #10	10
12	32032	FLAT WASHER #10	11
3	T-16813-20	OVERLOAD HEATER	12
3	T-16813-39	OVERLOAD HEATER	13
3	T-16813-14	OVERLOAD HEATER	14
1	T-2395-7	TERMINAL BLOCK	15
1	S-4915-14	MARKER STRIP	16
2	T-15927-3	STRADDLE PLATE	17
4	5173	SCREW, #6-32 X 3/4 LG.	18
			19
4	59444	LOCK WASHER #6	20
1	T-3858	NAME PLATE	21
2	52905	DRIVE SCREW	22
11	T-6107-9	TERMINAL LUG	23
15	T-6107-16	" "	24
2	T-6107-13	" "	25
	SPEC. W946	WIRE #14	26
"	" W946	WIRE #10	27
"	" N-387	WIRE MARKER - SIZE # 7	28
"	" N-387	WIRE MARKER - SIZE # 4	29
"	T-7629-1	TY-RAP	30
1	T-16874-1	AUXILIARY CONTACT BLOCK	31
3	T-6107-2	TERMINAL LUG	32
3	T-6107-10	TERMINAL LUG	33
3	6768	SCREW, #10-32 × 7/16 LG	34
3	T-4460-5	LOCKWASHER - SA	35



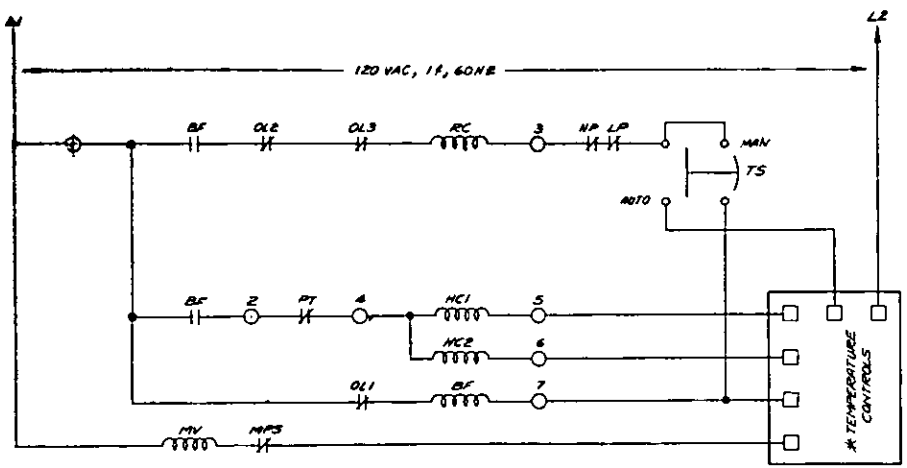
MAIN POWER: 460 VOLT, 3φ, 60 HZ
CONTROL POWER: 120 VOLT, 1φ, 60 HZ

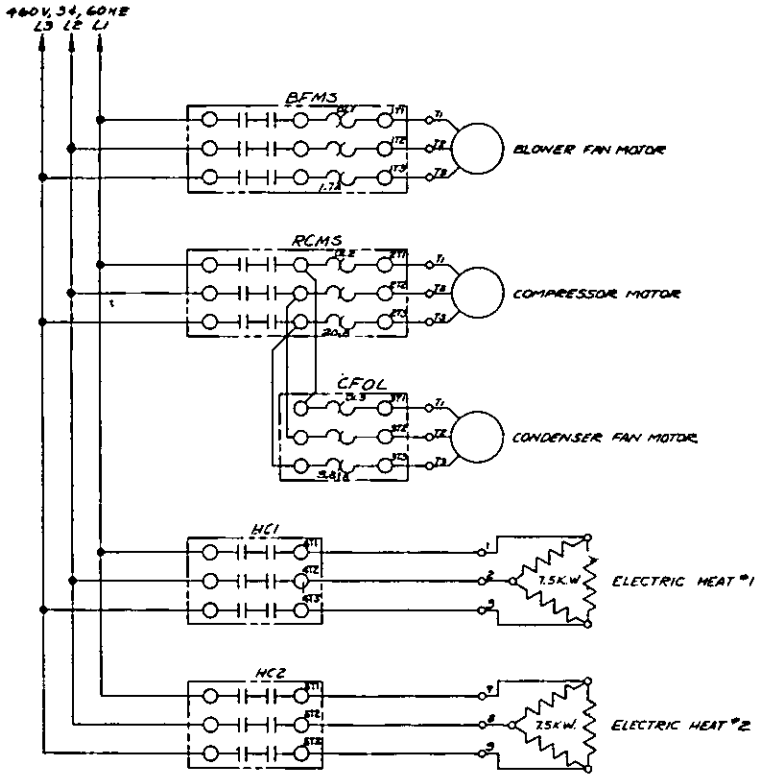
NOTES:
1. FOR LEGEND & SCHEMATIC WIRING DIAGRAM SEE DWG. B-4822
2. MAX. OVERALL HEIGHT 9 1/8"
3. TORQUE ALL SCREWS PER M-381-1.
4. ITEMS 23 THRU 33 NOT SHOWN ON DRAWING
5. WIRE MARKERS TO BE CUT & STAMPED AS SHOWN 3/4
6. PLATE ALL FERROUS HARDWARE PER P-870.

SAFETY ELECTRICAL EQUIPMENT CORP.

A/C STARTER PANEL
AMTRAK SLEEPER CAR

B-4290





BFMS BLOWER MOTOR STARTER
CF-CONDENSER FAN STARTER
HC-HEAT CONTACTOR
HP-HIGH PRESSURE CUT OUT
LP-LOW PRESSURE CUT OUT
MV-MODULATING VALVE
MPS-MODULATING PRESSURE SWITCH
OL-MOTOR OVERLOAD
PT-HEAT PROTECTIVE THERMOSTAT
RCMS-REFRIGERANT COMPRESSOR MOTOR STARTER
TS-TEST SWITCH
○-TERMINAL ON STARTER
✱-NOT SUPPLIED BY "SAFETY"
□-TERMINALS ON TEMP. CONTROL

SCHEMATIC WIRING DIAGRAM
AMTRAK SLEEPER CAR

4302

3.2 Temperature Controls

The temperature control panel mounted, in the switch locker, controls ventilation, heating, air conditioning. One model of panel is used on both car series, it is unique to these 31 cars, as are the thermostats.

3.2.1 Panel Description (See Fig. 3.6 & 3.7)

The panel has three controls, the selector switch, cool bypass and the circuit breakers. The selector switch is used to select either heat (day, 72° or night, 74°) cooling (day 72° or night, 74°) or OFF (Layover, 50°). In the OFF position, the blower and exhaust fans are off; in the other positions they are on.

Seven neon pilot lights illuminate to indicate the temperature control panel desires a specific function. See Fig. 3.8. The lights do not indicate whether the car is doing as requested.

The blower light indicates the air vane switch is picked up, without regard to whether the blower is running, thus providing a check for this vital safety feature to make sure it drops out when the blower stops.

The cool bypass light illuminates to indicate this feature has been activated. This feature bypasses the cooling thermostats for 30 minutes, running the A/C unit in half cool for that time. Once the timer runs out, control is restored to the thermostats. Cool override is initiated by pressing the "Cool Override" push button, and is cancelled by pressing "Override Cancel." When cool override is in effect, the override lamp is illuminated.

The temperature control panel is connected with the A/C pressure switches such that if the unit should shut off for either excessive head pressure or low suction pressure, the HP/LP light will come one. Unlike the later HEP cars, the HP/LP light here will only light while the fault condition exists.

The two circuit breakers on the panel protect equipment from faults:

1. "temperature control" feeds 120 VAC to the external loads of the panel.

2. "control" feeds the internal functions of the panel including thermostats and bottle relays.

The bottle relays on the panel and thermostats are fed 120 VDC power, derived from a bridge rectifier on the panel. All relay circuits are the series thermostat type, with an increase in temperature energizing the relay.

There are 2 MS type connectors on the bottom of the temperature control panel: the left is for power and control outputs, the right is for thermostats. The thermostat connector is intended for use with the "Bruss Box" test unit. The thermostat plug is detached, and the test unit connected to both the temperature control panel and the thermostat plug. This allows test of the complete temperature control system including contactor operation. Refer to test spec. PQ-79-1 Section 3.3 for this procedure. The connectors also allow for easy removal of the panel from the car.

The temperature control panel operates from 120 VAC, provided by the temperature-control control transformer in the electric locker. There are 2 circuit breakers contained there also, the 480 V transformer primary and the 120 V transformer secondary.

Near the temperature control panel is a blue "shunt trip" pilot light. This light illuminates to indicate power is available to operate the shunt trip feature on the overhead heat. It should be lighted whenever the car is on 480V HEP. Refer to Section 3.3.

FIGURE 3.6
TEMPERATURE CONTROL PANEL

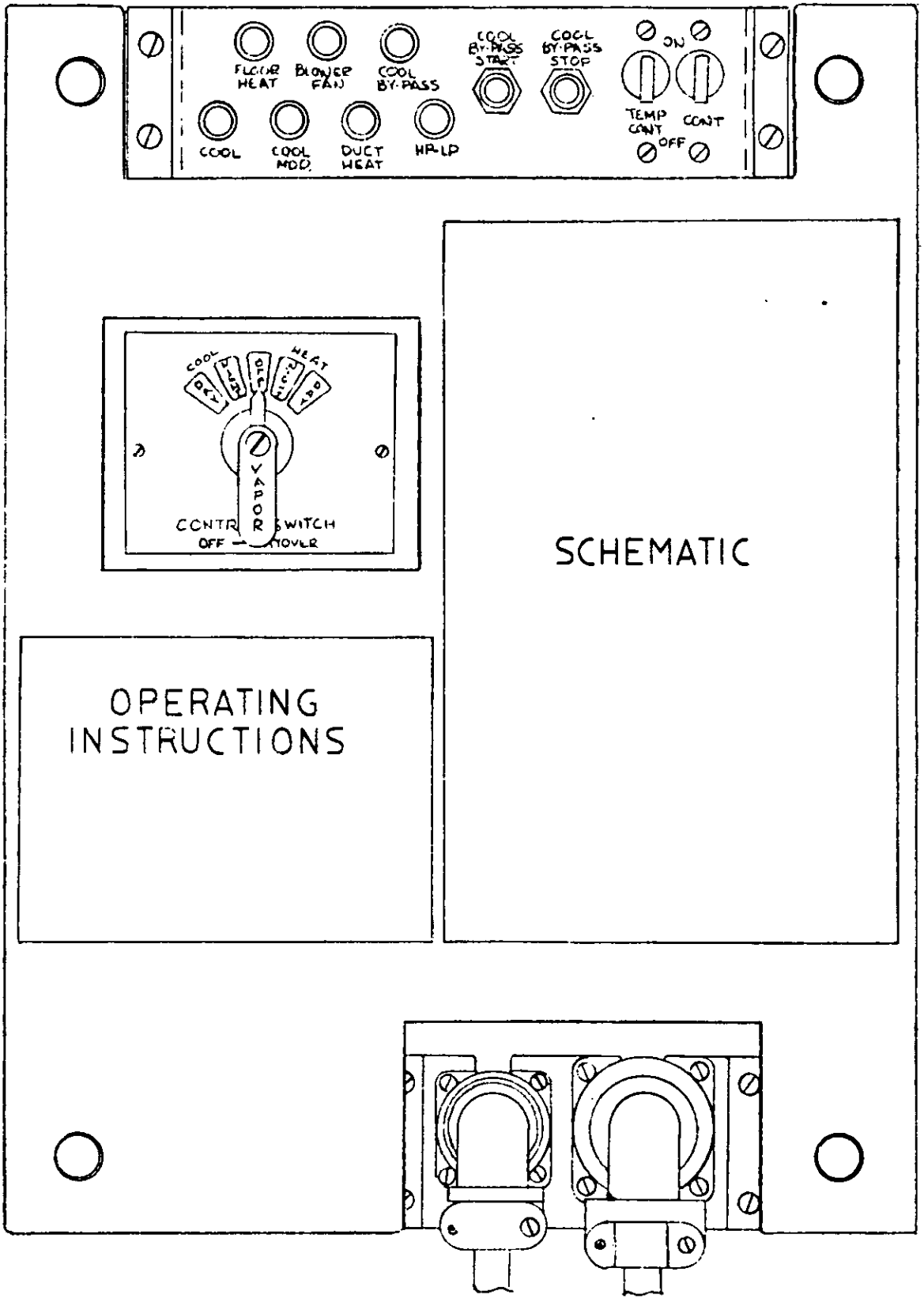


FIGURE 3.7

TEMPERATURE CONTROL PANEL COVER INSTRUCTIONS

INSTRUCTION CHART OPERATION SCHEDULE
FOR #17756475 TEMPERATURE CONTROL PANEL

CONTROL SWITCH POSITION	FUNCTION AT INTERIOR TEMPERATURE °F	SIGNAL LAMP INDICATION						
		COOL	COOL MOD	BLOWER CONTACTOR	FLOOR HEAT	DUCT HEAT	*COOL BY-PASS	**HP-LP
LAYOVER	BELOW 50°				ON			
COOL - NIGHT	ABOVE 76° 74°- 76° BELOW 74° (VENT)	ON ON	ON	ON ON ON				
COOL - DAY	ABOVE 74° 72°- 74° BELOW 72° (VENT)	ON ON	ON	ON ON ON				
HEAT - NIGHT	BELOW 74° ABOVE 74° ABOVE 74° (VENT)			ON ON ON	ON	ON		
HEAT - DAY	BELOW 72° ABOVE 72° ABOVE 72° (VENT)			ON ON ON	ON	ON		

*COOL BY-PASS START: NOTE: SELECTOR SWITCH MUST BE IN COOL POSITION.
MANUAL COOL CONTROL START: DEPRESS COOL BY-PASS BUTTON, INITIATES PARTIAL COOLING FOR 30 MINUTES OVERRIDING COOL THERMOSTATS.
MANUAL COOL BY-PASS STOP : DEPRESS COOL BY-PASS STOP BUTTON TO STOP COMPRESSOR INITIATED ON PRIOR 30 MINUTE TIMING CYCLE.

**HP-LP SIGNAL LIGHT WHEN ENERGIZED INDICATES A FAULT CONDITION OF THE COMPRESSOR AND MUST BE REPORTED.

Fig. 3.8

Pilot Light Assignment

LIGHT	MEANING	
Blower Fan	Blower Fan Running & Air Vane Switch Picked Up	
Cool	Request For 1/2 Cool (RCMS)	
Cool Mod	Call For Full Cool (Mod. Valve) On	
Duct Heat	Call For Overhead Heat - 1 or 2 Stages (HC1 or HC1 + HC2)	
Floor Heat	Heat Selected	Call for hall heat (FH3)
	Layover Selected	Call for bedroom, roomette & hall heat (FH1, FH2 & FH3)
Cool Bypass	Cool By Pass in Effect - 1/2 Cool (RMCS)	
HP-LP	High Pressure/Low Pressure A/C System Fault	

Figure 3.9
TEMPERATURE CONTROL PANEL RELAY FUNCTIONS

RELAY DESIGNATION	RELAY NAME	FUNCTION	WHEN PICKED UP
TDR	Time Delay Relay	Provides 30 minute cool override: Causes 1/2 cool mode.	During Cool Bypass
HCR	Heating/Cooling Relay	Heating Selected - provides control circuit to hall floor heat contactor FH3. Layover Selected - provides control circuit to bedroom, roomette and hall floor heat contactors FH1, FH2, FH3. Cooling Selected - provides control circuit to A/C panel to start A/C contactor RCMS.	When 74° Hall Heat thermostat is satisfied (i.e., hall is warm enough). When 50° Layover Heat thermostat is satisfied (i.e., car is warm enough). When 72° Cool thermostat is closed (i.e., 1/2 cooling is required).
DR	Duct Relay	Provides control circuit to overhead heat contactors HC1 and HC2.	When 74° duct thermostat is satisfied (i.e., duct is warm enough).
CMR	Cooling Modulation Relay	Provides control circuit to modulation solenoid valve for full cool.	When 76° full cool thermostat is closed (full cooling required).

3.2.2 Thermostats

Three types of thermostats are used on this converted HEP equipment: (See figure 3.10)

1. Fenwal differential expansion, used for;

   a. Antifreeze thermostats (2)

   b. Outside thermostats (3)

   The thermostat is used in a series circuit to directly control the corresponding contactor.

2. Chromolox WR-80 direct acting wall mounted. These 18 units are used 1 per room to control the floor heat in each room. The thermostat switches the heater power directly, 240 volt single phase. They are passenger adjustable over a range of 40° to 80°F.

3. Mercury Tube (5) are used to control the bottle relays of the Temperature Control Panel. These are plug-in types; all except the layover thermostat are equipped with a heater winding (compensator). By applying a voltage continuously to these windings, it is possible to make the thermostat think it is slightly warmer than the car actually is. This is how day and night settings (2° difference) are provided. In addition, anticipation is provided. This is similar to the procedure just explained except that here the voltage is applied only during times when the heat is on. This is useful to prevent heating overshoot. When a heater is turned off, there is still heat in the elements, and thus the car temperature will continue to climb for a little while after the heat is turned off. With anticipation, the heat is turned off just soon enough to prevent this overshoot.

These thermostats are all used in series circuits with the bottle relays, which in turn do the actual circuit switching.

Occasionally a mercury tube thermostat acquires a "split column;" there is a break in the column of mercury. It can usually be seen, but can be checked easily with an ohmmeter. It is sometimes possible to repair this defect:

With a match (NOTHING LARGER OR HOTTER), very gently heat the bulb of the thermostat while watching the mercury column. When it starts to rise, remove the heat. If the mercury rises far enough, it will rejoin the rest of the column and the thermostat will function normally.

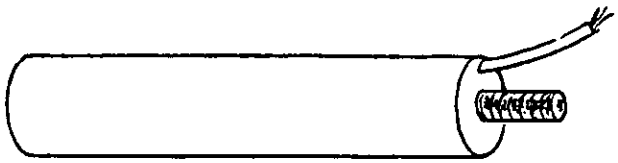
NOTES:

1. Do not use a thermostat with a split column - it will not work properly.

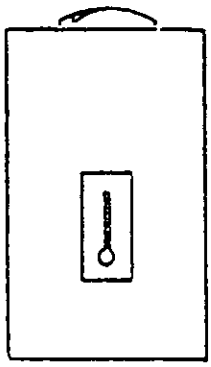
2. Use care in handling mercury thermostats - they break easily.

3. Avoid mercury from broken thermostats - it is quite poisonous and can be absorbed through the skin or by breathing the fumes (which are produced at room temperature).

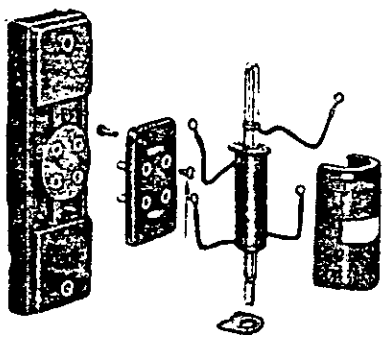
4. Make sure the hatch key hole in the ceiling hatch over the cooling thermostats is plugged. If it is not, air will blow out from the overhead duct onto these thermostats, and the car will not cool properly!



FENWAL



CHROMOLOX



VAPOR

THERMO - PINS 1,2
EXCEPT LAYOVER = 1,3

HEATER WINDING - PINS 3,4
READS 600 OHMS
TYPICAL

FIGURE 3-10 THERMOSTAT TYPES

Fig. 3.11 lists thermostats and functions. Figure 3.12 is a part list and Figures 3.13 indicates the location of the thermostats.

Figures 3.14 - 3.18 show the control points of the temperature control system in heating, cooling and off positions.

Each of the 18 rooms has individual room control via an in-line thermostat, mounted on the wall of the room. Also associated with each room is an Auto-OFF toggle switch, which allows turning off the individual room heat. Each room has its own pair of pushbutton type circuit breakers, mounted inside the wall between room and passage behind the service hatch.

Thermostats require little maintenance, but should be inspected periodically, and if dirty, gently cleaned with compressed air.

Use care to not break the glass on mercury tubes-it is toxic and can be absorbed through the skin or the fumes (produced at room temperature) inhaled.

Fig. 3.11

Thermostat Assignment & Function

OR = OPEN ON RISE CR = CLOSE ON RISE

Outside Thermostats:

20°	Overhead Heat Staging	(OR)
50°	A/C Lockout	(CR)
70°	Bedroom/Roomette Floor Heat Lockout	(OR)

Cooling Thermostats:

74°	1/2 Cooling	(CR)
76°	Full Cooling	(CR)

Hall Heat Thermostat:

74°	Hall Floor Heat	(CR)

Duct Heat Thermostat:

74°	Duct Heat	(CR)

Layover Heat Thermostat:

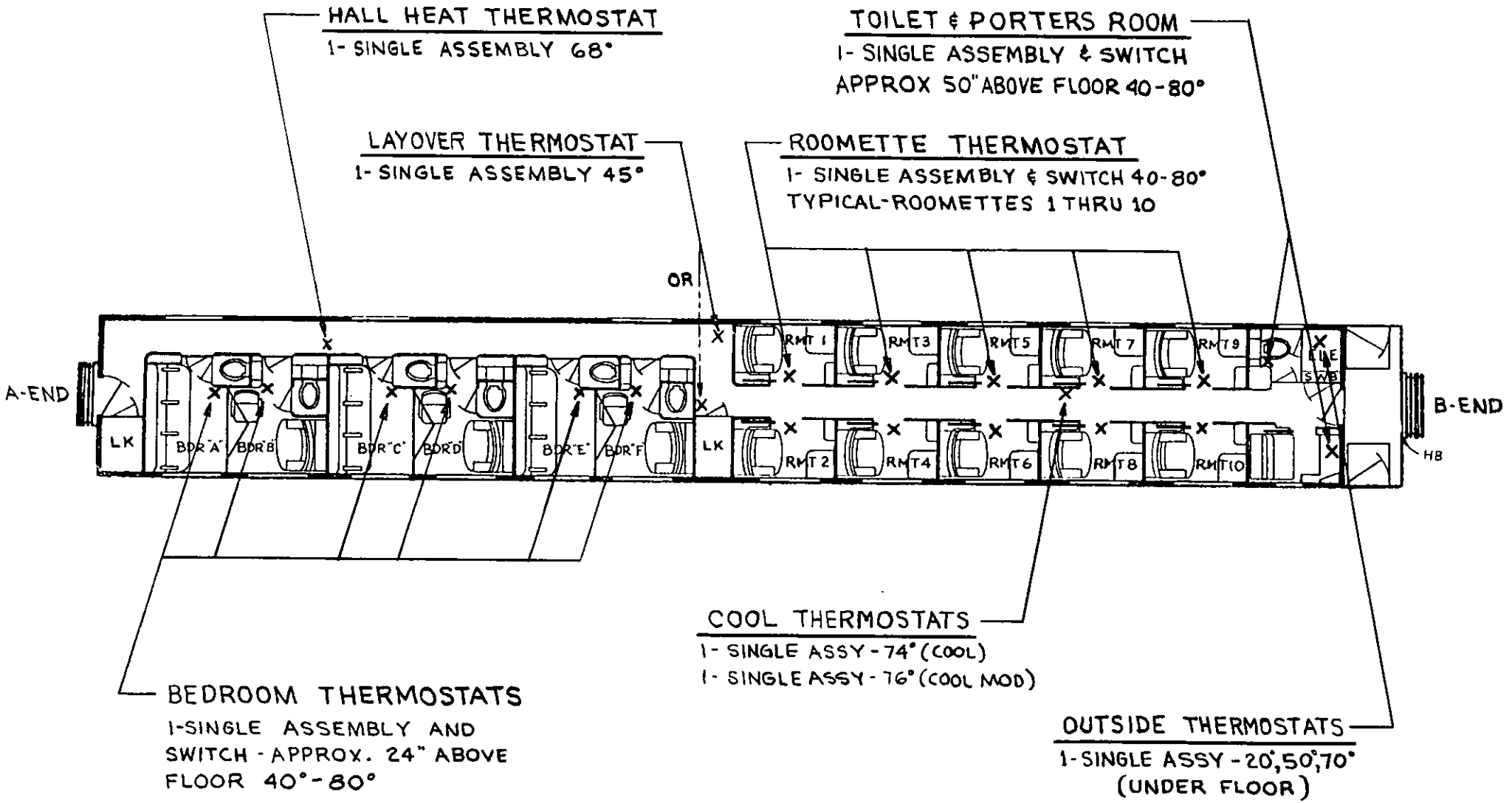
50°	Layover Floor Heat	(CR)

Bedroom & Roomette Room Thermostat:

Adjustable 40-80°, 1 per room		(OR)

Figure 3.12
Heating and A/C Thermostat Part List

ITEM	FUNCTION	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1	---	Outside Thermostat Assembly, Complete with 20,50 & 70° Thermostats	Vapor	17651764-1	25P9009123	
2	20° - O.H. Heat Staging	Thermostat, Differential Expansion, 20° O.R.	Fenwal	17000-0 Set 20°	25N6003934	
3	50° - Cool Lockout	Thermostat, Differential Expansion, 50° C.R.	Fenwal	17021-0 Set 50°		
4	70° - F.H. Lockout	Thermostat, Differential Expansion, 70° O.R.	Fenwal	17000-0 Set 70°	25K6003935	
5	50° - Layover	Mercury Tube, Plug-In	Vapor	15033278 50°	25X9009122	
6	74° - Hall Heat	Mercury Tube, with 600 ohm Heater, Plug-In	Vapor	15033270 74°	25B9009121	
7	74° Duct Heat	Mercury Tube, with 600 ohm Heater, Plug-In		Vapor 74°	16820188	25E9009120
8	74° Cool	Mercury Tube, with 600 ohm Heater, Plug-In	Vapor	15033269 74°		
9	76° Cool Mod.	Mercury Tube, with 600 ohm Heater, Plug-In	Vapor	15033269 76°	25A4000162	
10	Room Thermo-stat	Heavy Duty, 22A, 240V Adjustable Wall Mount	Chromolox	WR-80	25K9011822	
11	Cover, Thermo-stat	For Items 5, 6, 8, and 9	Vapor	15436442		



NOTE: ROOM THERMOSTATS HAVE ON-OFF SWITCH MOUNTED BENEATH THEM

FIGURE 3.13
THERMOSTAT LOCATIONS
10-6 SLEEPER TYPICAL

3.2.3 Blower Logic

The blower fan is controlled by the BFMS contactor and operates in either the heating or cooling position of the selector switch of the temperature control panel. The blower is OFF in the selector OFF position. The exhaust fans, controlled by the exhaust fan contactor, EFC, operate in either heat or cool, but not during OFF.

An emergency fan switch is mounted high on the wall near the center of the car at the hall offset. The purpose of this switch is to enable someone to turn off the blowers in case of a car fire. The switch is labeled, and is covered by a flip-top door to prevent accidental turn off.

	MANU.	MANU#	AMT#	AMMS#
SPST Toggle Switch	Cutler Hammer	7580K4		
Red Switch Protection Cover	Cutler Hammer	8497K2		

NOTE: IN CASE OF A CAR FIRE, IMMEDIATELY TURN OFF EITHER THE TEMPERATURE CONTROL SELECTOR SWITCH OR THE EMERGENCY FAN SWITCH. THIS IS IMPORTANT TO REDUCE THE AMOUNT OF FRESH AIR BROUGHT INTO THE CAR WHICH WOULD HELP THE FIRE TO BURN AND SPREAD.

3.2.4 Cooling Logic

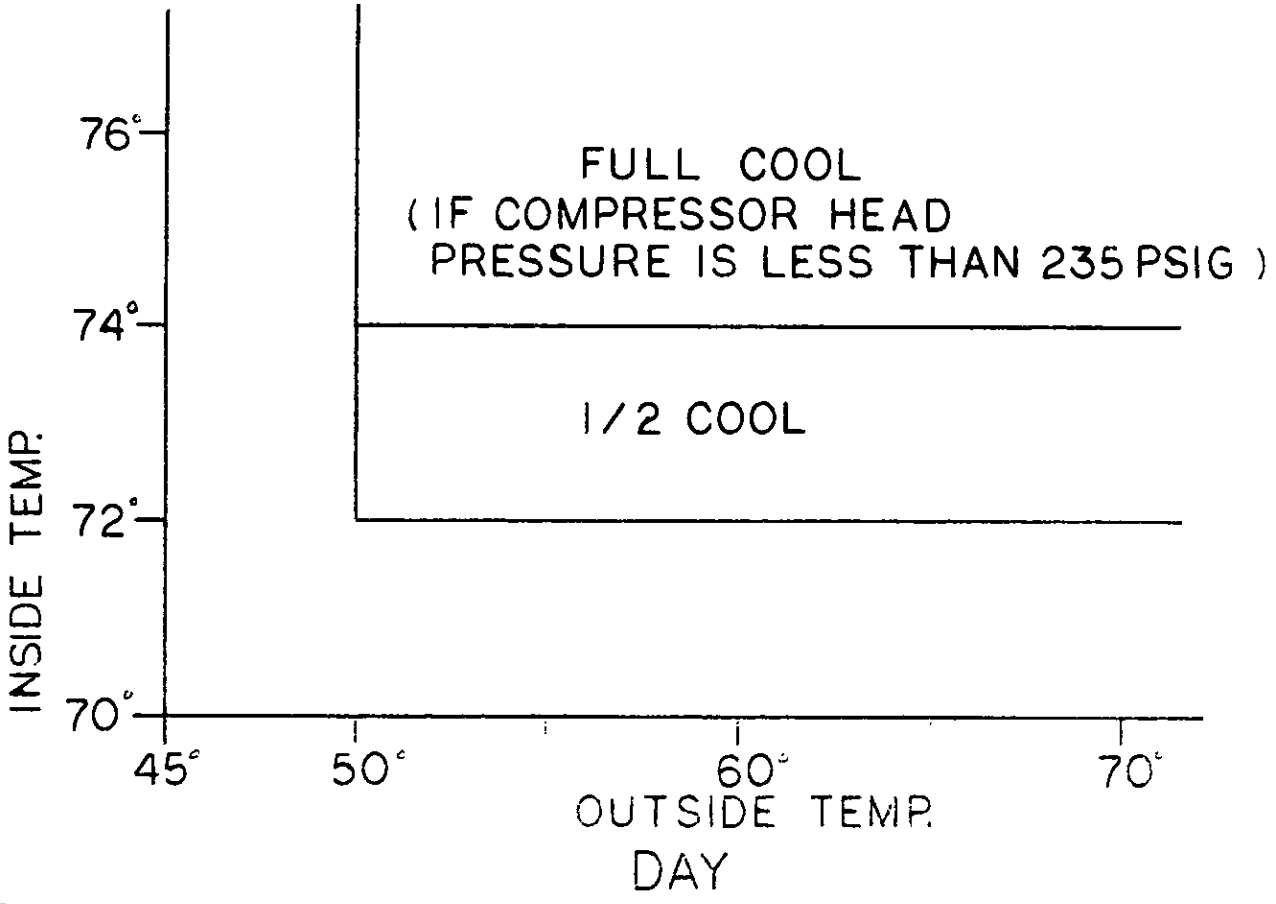
Refer to Figure 3.14 for the cooling control point temperatures. Note in the day position, the car is 2° cooler than in the night position. The following discussion assumes temperature controls are in "day."

Cooling is available only when the outside temperature is above 50°, as sensed by the fresh air thermostat. Return air (on the wall) thermostats sense the car interior temperature and enable the cooling to start if it is above 72°.

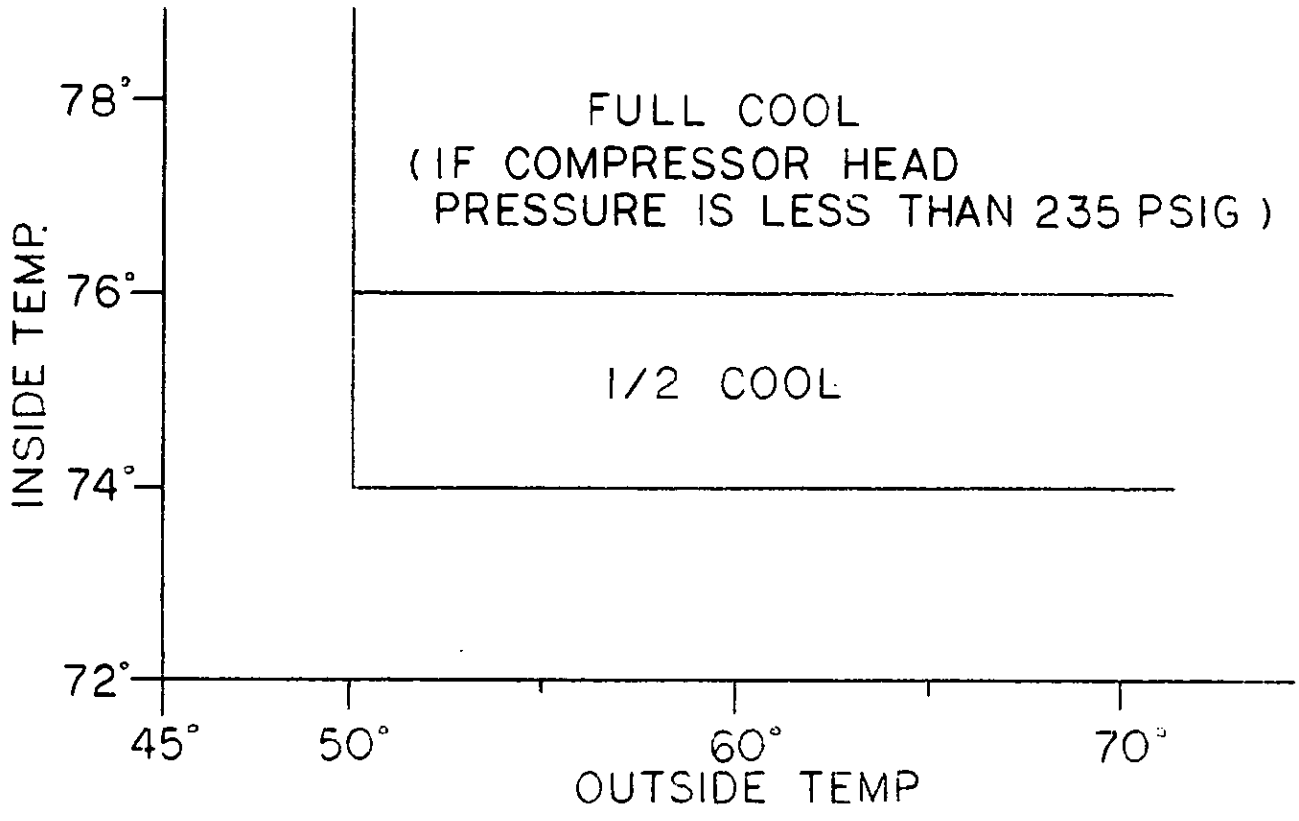
As the car temperature rises above 72°, the cool thermostat closes, energizing HCR relay, which in turn starts the A/C compressor and condenser fan. Freon flows into 1/2 of the evaporator, that is, 1/2 cool. Half cool is in effect up to 74°. The cool pilot light comes on to indicate 1/2 cool request.

Above 74°, the cool modulation thermostat is closed, energizing CMR, which energizes the modulation solenoid. Freon now flows into the entire evaporator; full cooling is in effect. The cool mod pilot light comes on to indicate request for full cooling.

FIGURE 3.14



DAY



NIGHT

If during full cool operation the head pressure should rise above 235 psig and thus actuate the modulation pressure switch, MPS, the switch will open and put the unit back into 1/2 cool. The purpose of this feature is as follows: in a very hot ambient or if condenser air flow is restricted, it is harder to condense the freon in the condenser and the head pressure rises. If allowed to get too high, eventually the high pressure switch will open and shut the system down. If a modulation pressure switch is used and is set to open at pressures slightly below the high pressure switch, it can keep the system running. By shutting off the full cool solenoid, the condenser does not have to work as hard, does not get as hot and the freon pressures are lower. Thus the system stays on line, providing 1/2 cooling, (far better than no cooling). If the freon pressure drops after a time, the modulation switch again closes and restores the evaportor to full cool. In very hot weather, say above 110°F, the system may oscillate between full and 1/2 cooling via the MPS.

As the car temperature drops, eventually it it will drop below 74°, establishing 1/2 cool. As the temperature continues to drop over a period of time, it will fall below 72° and the A/C unit will shut off. This system does not use pump down.

This discussion was based on the temperature control panel selector in day position. If it is in the night position, the temperatures are 2° higher.

A 1/2 hour timing relay is incorporated on the Vapor panel, for cooling override, which allows operation of the A/C system without regard to car interior temperature, although the system still locks out below 50°F outside temperature. Start and stop pushbuttons are located on the panel to control this timer. The red cool bypass pilot lamp illuminates to indicate the timer is in operation.

The pressure switches used with this A/C system include the following:

PRESSURE SWITCH SETTINGS

SWITCH	OPENS	CLOSES
LP	2 PSIG	7 PSIG
HP	275	225
MPS	235	205

The A/C logic includes the following safety features:

1. Lockout below 50° outside temperature.
2. Overload relays for blower fan, condenser fan and compressor motors to protect against overload. Manual reset is required for each.
3. Air vane switch and blower fan interlock to prevent evaporator freezeup should the blower fail to operate.
4. Low pressure shutdown (but not lockout) self resetting.
5. High pressure shutdown (but not lockout) self resetting.

For complete tests of the A/C system and control logic, refer to Test Specification PQ-79-1, Section 3.3, 3.6 and 3.9.

3.2.5 Overhead Heat Logic (See Figures 3-15 & 3-16)

The car is equipped with a 2-stage overhead heater. This heater is not intended to actually heat the car, but rather to warm the incoming fresh air to the car temperature (approx. 74°). Accordingly, air delivered from this duct will not feel very warm; do not confuse this with a overhead heating defect. (Floor heat actually provides most car heating.

Duct air temperature is used to control the overhead heat. A 74° duct heat thermostat (located in the ceiling outside bedroom F) controls the Duct Heat relay. At a temperature of less than 72° day (74° night) the DR relay is dropped out bringing on the overhead heat contactors. Whether one or 2 stages of heat is on depends only upon outside temperature: if it is above 20°, one stage is on; if it is below 20° both stages are on. The Duct Heat pilot light indicates when overhead heat is requested.

Cycling rates of up to 4 per minute are acceptable, though they are rarely observed.

The overhead heater must have air flow across the elements. To avoid overheating and possible fire, it is important that the overhead heat does not come on unless the blower is operating. Three protective circuits are employed:

1. Interlock on BFMS - contactor must be picked up, (running blower).

2. Air Vane switch must sense air flow. (Indicated by blower pilot lamp being on). It is located either with the evaporator blower or slightly downstream of the evaporator in the main air duct.

3. Shunt trip of the overhead heat circuit breaker is the last resort to turn off an overheating unit. Powered by

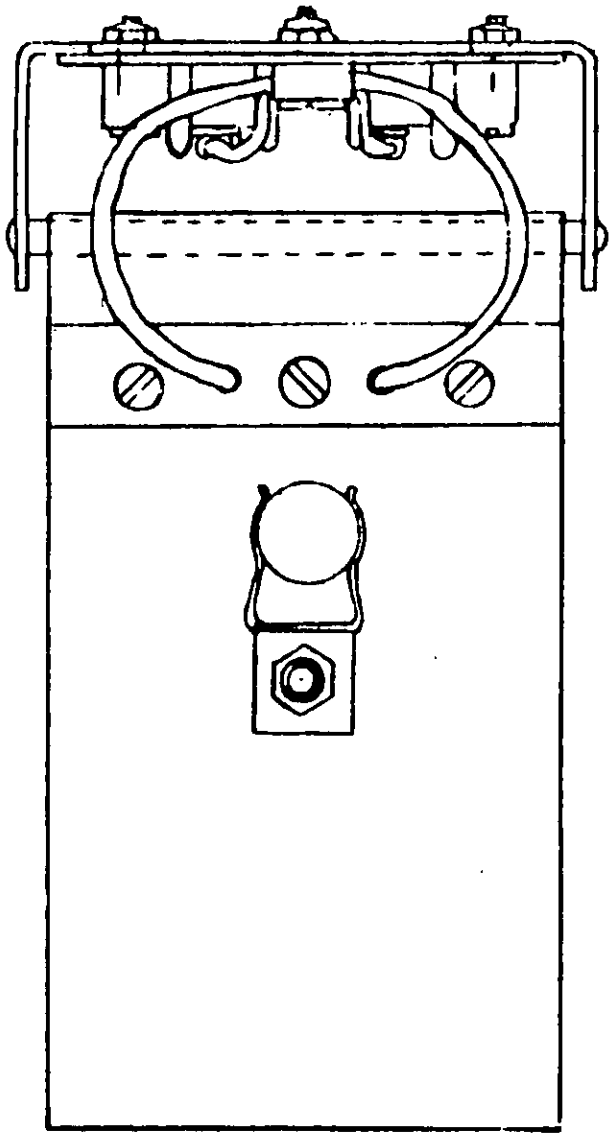
a separate transformer, (the bottom of the 2 in the 480 locker) this circuit consists of a 200°F thermostat located near the heater elements and the shunt trip coil of the overhead heat circuit breaker. AT 200°F and above, the thermostat will close and turn off the circuit breaker. The shunt trip pilot lamp in the switch locker should be illuminated whenever the car is on power. This indicates that shunt trip power is available to operate the emergency shut down should it be called upon to do so. Since this is an important safety feature, the cause of this bulb not lighting must be investigated. (See Section 3.3)

NEVER JUMPER OUT OR BYPASS ANY OF THESE SAFETY FEATURES. A FIRE MAY START AND INJURIES RESULT.

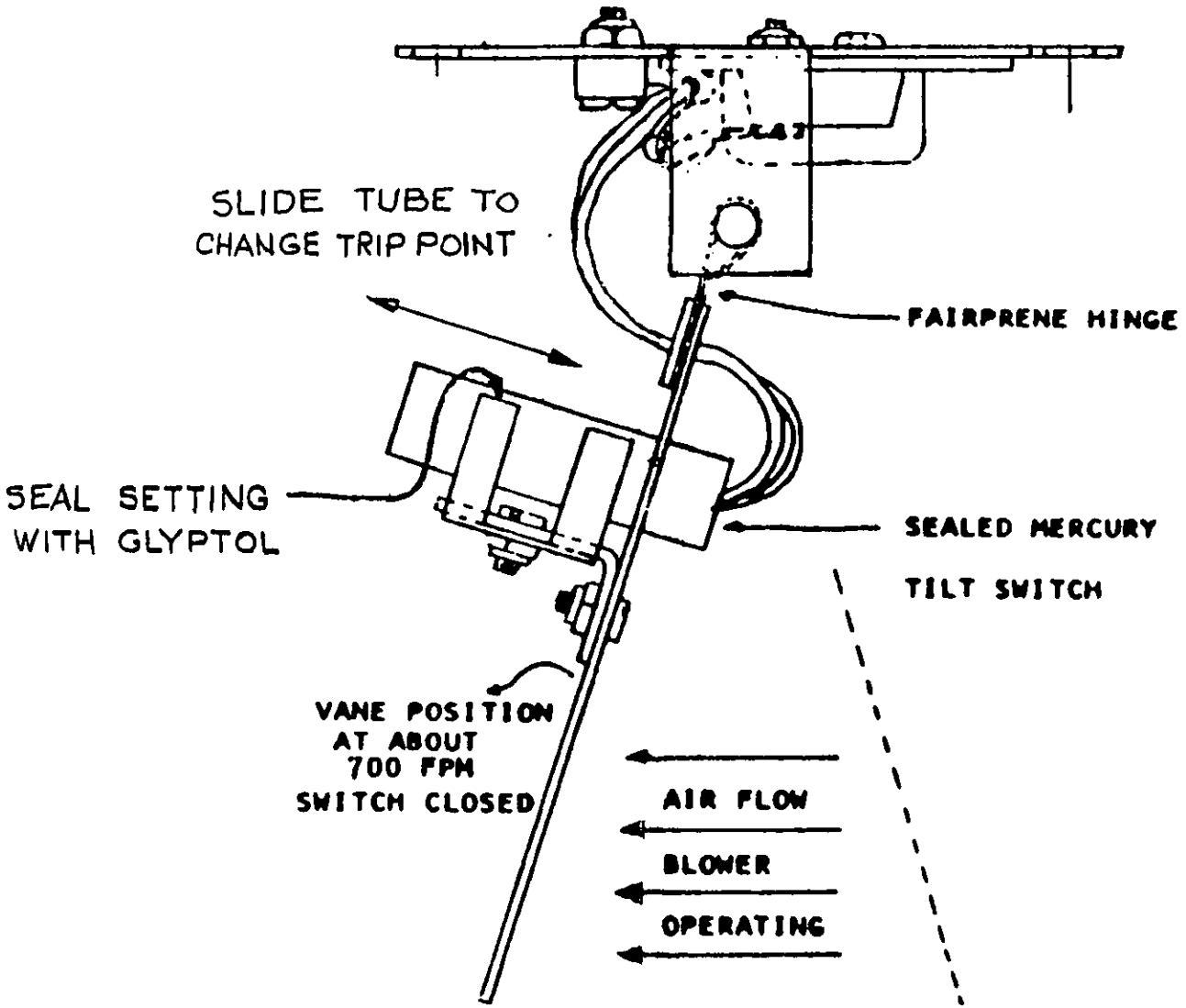
The air vane switch, figure 3.15, is a paddle operated mercury switch, hung in the air stream of the main air duct. When significant air flow is present the paddle swings upward, making the switch contacts. Loss of air flow allows the switch back down, opening the switch. Car safety depends upon proper operation of this switch.

Care must be taken that the switch turns off every time, not only marginally. Never test the switch by raising it and then releasing it and letting it swing: this will often give a false turnoff. Instead, use the car blower to move the switch, and turn off the EVAPORATOR Breaker to let the fan coast down as it would be in a real situation. If the vane switch works reliably, then it should be okay. If it does not turn off, the black tube can be moved back and forth to adjust the trip point. If this is done, however, use Glyptol or RTV to lock the tube into place once the final setting is made.

It is extremely important to check the operation of the air vane switch periodically, as described in the Map form and test. PQ-79-1, Section 3.4.



AIR VANE SWITCH

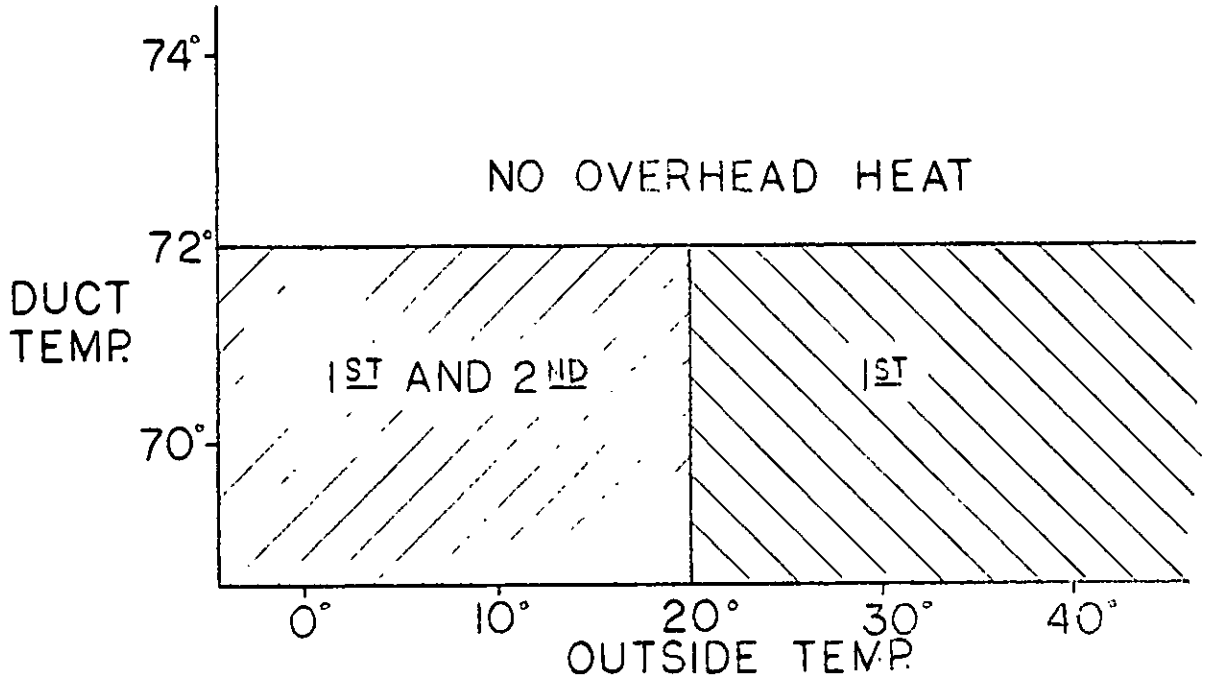


OGONTZ # 8373-2M
AMT # 25N9010345
AMMS #

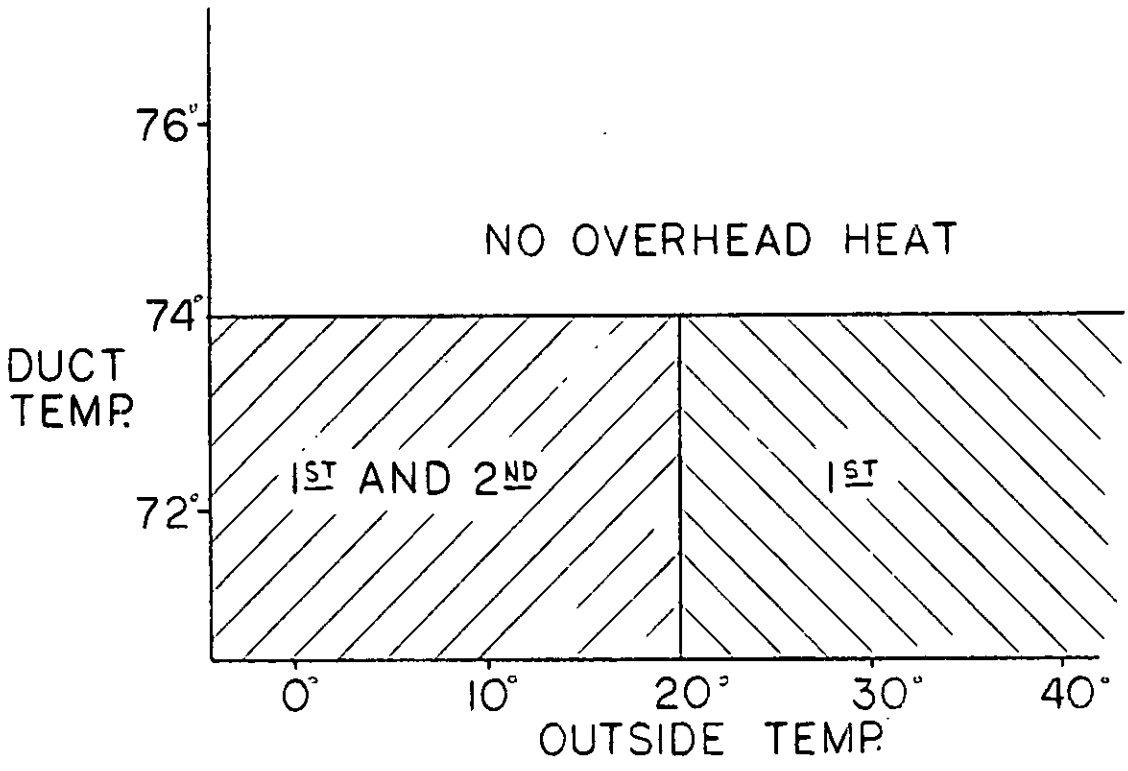
FIGURE 3.15

AIR VANE SWITCH

FIGURE 3.16



DAY



NIGHT

3.2.6 Floor Heat Logic

Bedrooms & Roomettes (Fig. 3-17)

On these cars, each compartment has its own thermostat, and the temperature control panel only provides a lockout feature. It does this by causing the two room floor heat contactors to pick up when the outside temperature is below 70°F; and the panel is set for heating.

The contactors FH1 (bedrooms) and FH2 (roomettes, toilet & porter's room) control the 240 volt feed to the buses feeding the room heat. There is no pilot light indication for these buses.

Each of the 18 rooms of the car (10 roomettes, 6 bedrooms, public toilet and porter's room) has a 240 volt, individually thermostatically controlled heater. The thermostat is in-line with the element, and has a passenger-adjustable range of 40-80°. Each room is separately protected with its own circuit breaker (accessed from the hall outside the room) and has an OFF-AUTO switch, which is merely an OFF/ON switch to turn the heat off should the room thermostat fail. Each room heater is equipped with an internal high temperature cutout, set to 135°F, to turn it off should it get excessively hot.

Hall (Fig. 3.17)

The floor heat for the hall is controlled by the FH3 contactor. This in turn is controlled by the Vapor panel HCR relay. The wall mounted thermostat in the hall between rooms A & B controls the HCR relay. If the HCR is dropped out, hall heat will come on. Hall heat is controlled at 72° day, 74° night. The floor heat pilot light indicates the call for hall heat.

Layover Heat (Fig. 3.18)

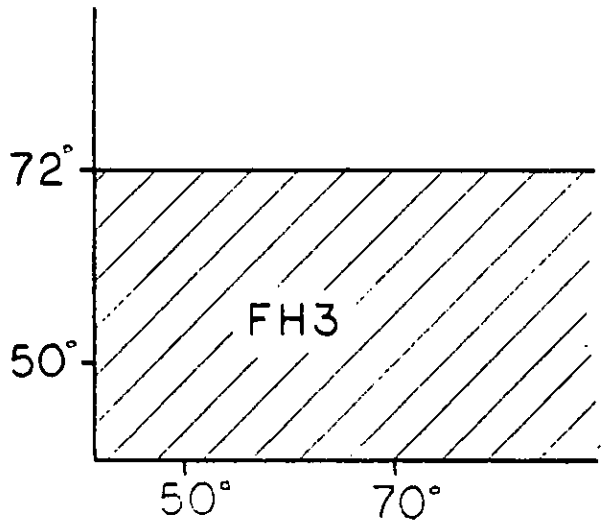
When the car is set for Layover heat (the Vapor selector switch in OFF) the blowers are turned off and heating is done by floor heat alone. Now the 50°F layover thermostat (located at the bend in the hallway) is used to control the HCR relay, and this controls the FH1, FH2 and FH3 contactors. Room thermostats still operate to turn off any rooms which might get above the setting of their respective thermostats. The floor heat pilot lamp lights to indicate layover heat being requested.

For complete tests of the heating system and logic, refer to Test Specification PQ-79-1, Sections 3.3, 3.5 and 3.9.

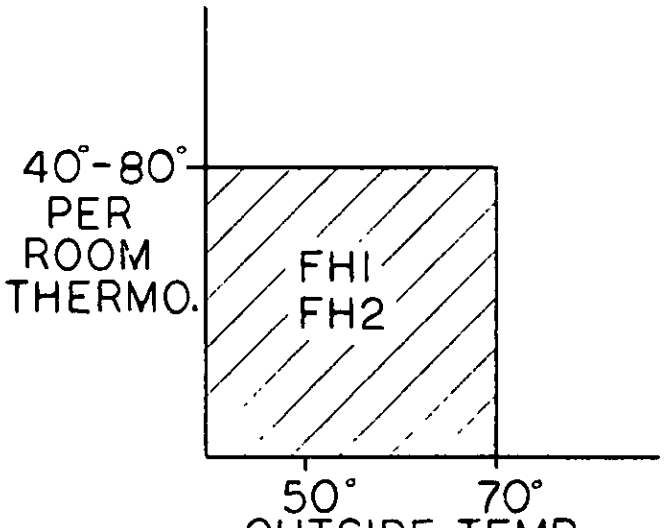
3.2.7 Damper Logic

N/A

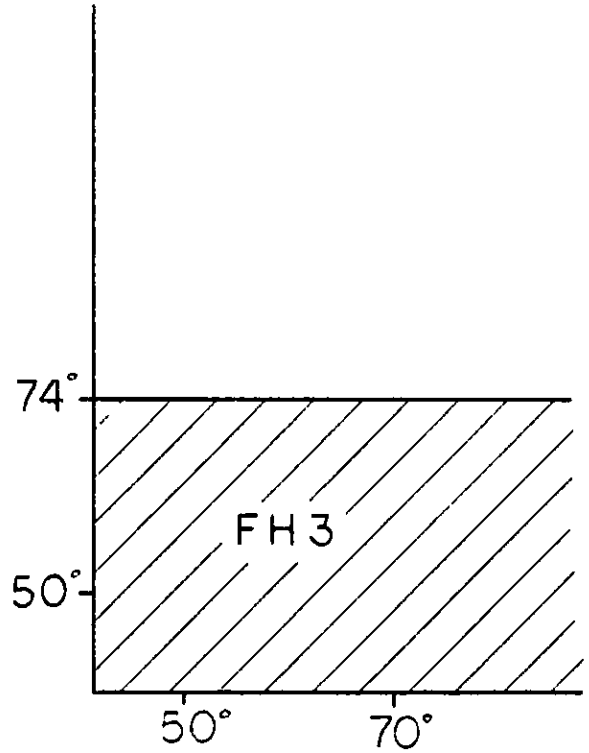
FIGURE 3.17
FLOOR HEAT



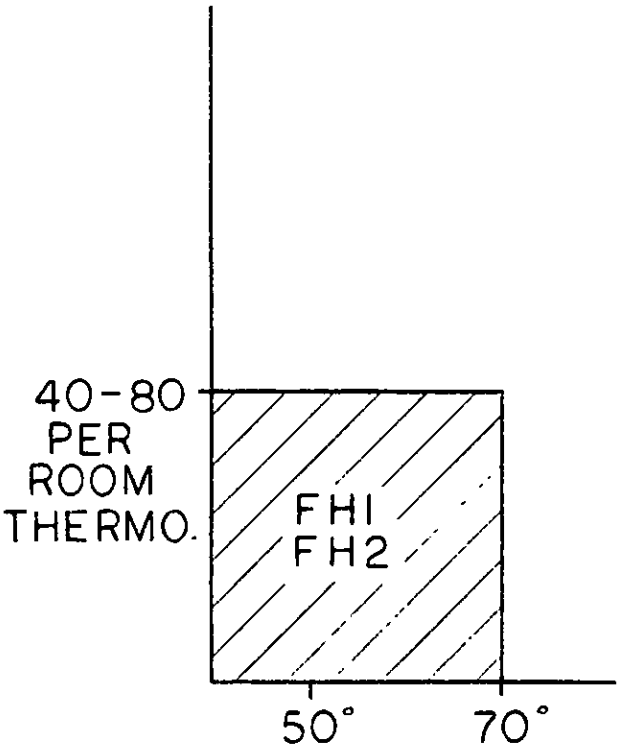
HALL
DAY



BEDROOMS & ROOMETTS
DAY



HALL
NIGHT



BEDROOMS & ROOMETTS
NIGHT

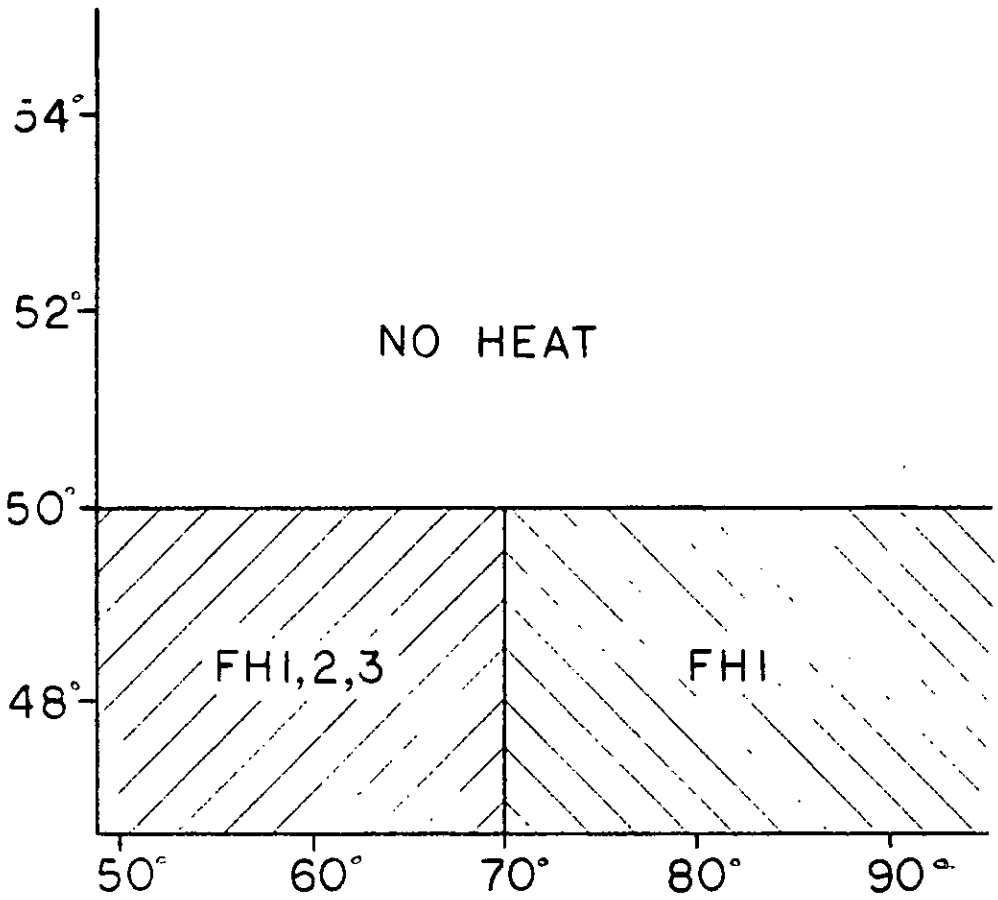


FIGURE 3.18
LAYOVER

Section 3.2.8

TEMPERATURE CONTROL PANEL MANUAL

Vapor
Temperature Control Panel
Part #17756475

Figure 3.20
TEMPERATURE CONTROL PANEL PART LIST

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1		Temperature Control Panel, Semi-automatic HEP sleeping car, 120 VAC	Vapor	177X6475	25X9009119	
2		CMR Relay, Bottle, 120 VDC	Vapor	35040175-17		
3		HCR Relay, Bottle, 120 VDC	Vapor	35040180-09		
4		DR Relay, Bottle, 120 VDC	Vapor	35040176-09		
5		CR Rectifier, Bridge	Vapor	17511123		
6		TDR Relay, 30 Minute	Vapor	97411034-03		
7		Varistor, 120 VAC Line	Vapor	17620640-04		
8		Pushbutton (Cool Bypass)	Vapor	56310013		
9		Circuit Breaker, 5 Amp	Vapor	97320543-03		
10		Pilot Lamp, Neon, NE2D	Vapor	16910131-01		
11		Supressor, Relay Coil	Vapor	97510339		
12		Switch, Selector - Heat - Cool	Vapor	15432882-21		
13		Knob for Selector Switch	Vapor	15010465		
14		Resistor, Anticipation, 55K, 10W (R7, R9)	Vapor	95010020		
15		Resistor, Setdown 20K, 3W (R1, R2, R6, R8)	Vapor	95020021		
16		Resistor, Series 3K, 3W	Vapor	95020021-26		

OPERATING INSTRUCTIONS AND SERVICE MANUAL

Vapor Co.
Temperature Control Panel
Part #17756475

Table of Contents

List of Illustrations

1. Introduction

1.1 General

This manual describes the Vapor #17756475 temperature control system as supplied for use on the 2900 series sleeping cars.

1.2 Features

A. Panel Controls:

1. Selector Switch - Heat - day & night
   Cool - day & night
   Off (layover)
2. Cool Bypass
3. Cool Bypass Cancel
4. Circuit Breakers (2)

B. Inputs - 8-Thermostats:

1. 20, 50, 70° Outside (differential expansion)
2. 50° Layover Mercury Tube
3. 74° Hall Heat Compensated Mercury Tube
4. 74° Duct Heat Compensated Mercury Tube
5. 74, 76° Cool Compensated Mercury Tube

C. Outputs

1. Blower & exhaust fan ON/OFF
2. Overhead heat, 2 stages
3. Layover heat (floor heat)
4. Hall heat
5. Cooling, 2 stages

D. Pilot Light Indications
7 Lamps indicating

1. Blower fan
2. Heat: floor and duct (overhead)
3. Cool: 1/2 and full
4. Cool Bypass
5. HP-LP shutdown

E. Connections
2 Military Connectors

1. 14 - Pin power
2. 35 - Pin thermostats

F. Size
12" wide, 16" high, 6" deep, weight 18#

2. Installation & Operation

2.1 Installation

The panel is mounted on a vertical surface using 4-1/4-20 bolts near the corners.

Thermostats should be mounted to ensure good air flow, easy access, and freedom from local heat or cold air sources.

2.2 Operation

A. Circuit Breakers - should be left on at all times; turn off only for servicing.

B. Selector Switch - select either heat, cool or layover, as required:

1. Layover: The blower fan and exhaust fan are off. Floor heat is controlled to maintain car temperature of 50°F.

2. Heat: Day = 72°, Night = 74°. Car will run blower fan and exhaust fans. Overhead and hall heat will each cycle to maintain the selected temperature. Bedroom and roomette heat is available if outside temperature is below 70°.

3. Cool: Day 72°, Night = 74°. Car will run blower fan and exhaust fans. Car will operate in 1/2 cool if temperature is 72-74 (DAY) or 74-76 (NIGHT). If above that temperature, full cool in effect.

NOTE: Change from heat to cool is not automatic.

C. Pilot Lights - Neon pilot lights come on to indicate function requested by temperature control panel. Refer to Amtrak manual Section 3.2

D. Cool Bypass - The car can be put into 1/2 cool without regard to car interior temperature by pressing the cool bypass button. The system will operate in this mode for 1/2 hour at which time the system reverts back to normal thermostat control. Cool bypass can be shut off by merely pressing cool bypass stop.

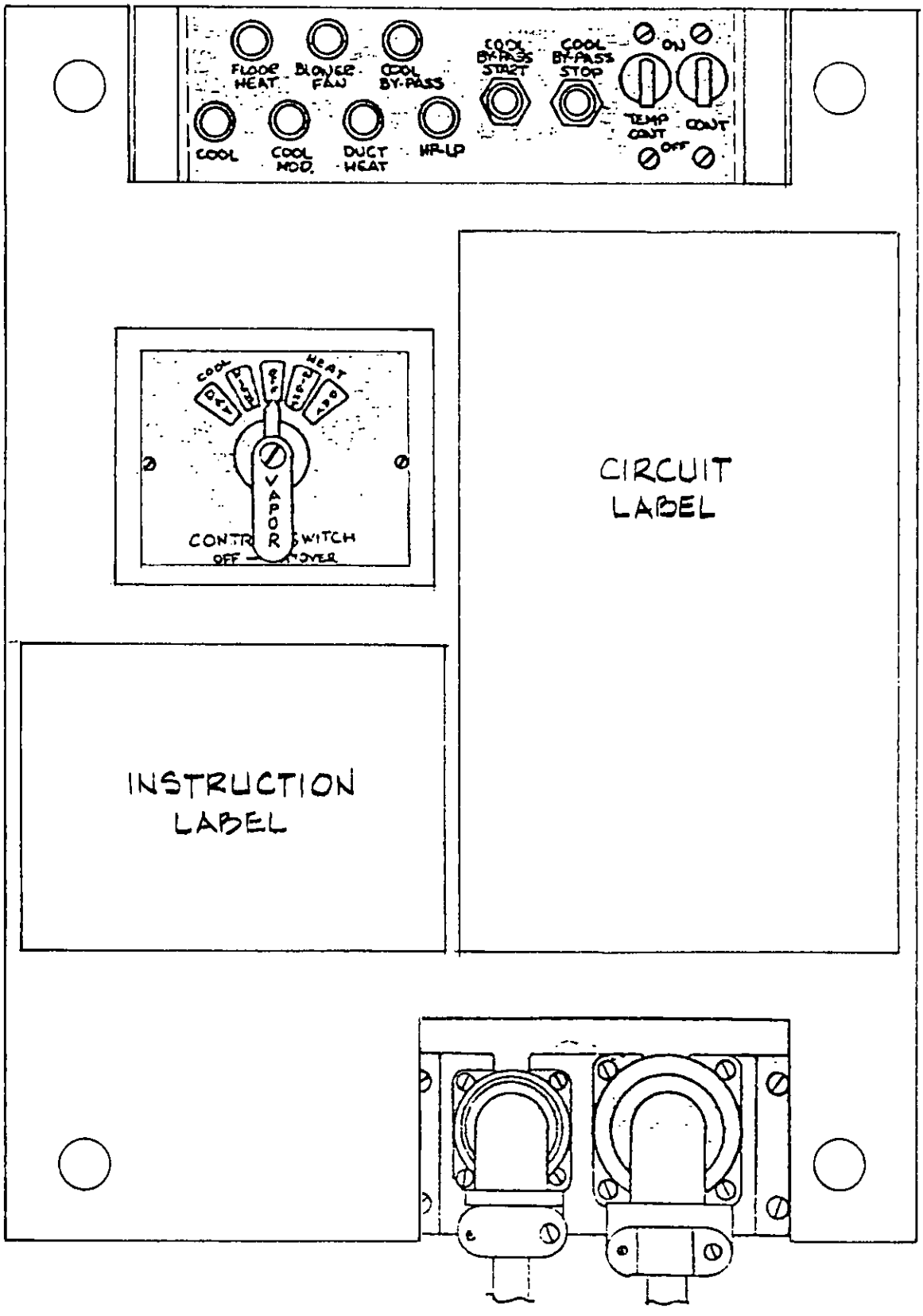


FIGURE 2.1

FRONT VIEW OF PANEL WITH COVER

INSTRUCTION CHART OPERATION SCHEDULE
FOR #17756475 TEMPERATURE CONTROL PANEL

CONTROL SWITCH POSITION	FUNCTION AT INTERIOR TEMPERATURE °F	SIGNAL LAMP INDICATION						
		COOL	COOL MOD	BLOWER CONTACTOR	FLOOR HEAT	DUCT HEAT	*COOL BY-PASS	**HP-LP
LAYOVER	BELOW 50°				ON			
COOL - NIGHT	ABOVE 76°	ON	ON	ON				
	74°- 76°	ON		ON				
	BELOW 74° (VENT)			ON				
COOL - DAY	ABOVE 74°	ON	ON	ON				
	72°- 74°	ON		ON				
	BELOW 72° (VENT)			ON				
HEAT - NIGHT	BELOW 74°			ON	ON	ON		
	ABOVE 74°			ON				
	ABOVE 74° (VENT)			ON				
HEAT - DAY	BELOW 72°			ON	ON	ON		
	ABOVE 72°			ON				
	ABOVE 72° (VENT)			ON				

*COOL BY-PASS START: NOTE: SELECTOR SWITCH MUST BE IN COOL POSITION.
MANUAL COOL CONTROL START: DEPRESS COOL BY-PASS BUTTON, INITIATES PARTIAL COOLING FOR 30 MINUTES OVERRIDING COOL THERMOSTATS.
MANUAL COOL BY-PASS STOP : DEPRESS COOL BY-PASS STOP BUTTON TO STOP COMPRESSOR INITIATED ON PRIOR 30 MINUTE TIMING CYCLE.

**HP-LP SIGNAL LIGHT WHEN ENERGIZED INDICATES A FAULT CONDITION OF THE COMPRESSOR AND MUST BE REPORTED.

FIGURE 2.2

PANEL OPERATING INSTRUCTIONS

3. System Operation/Circuit Description

Refer to the panel schematic, drw. 17756475. Input power is 120 VAC.

The panel circuitry is relatively simple. All thermostats are connected in series with the corresponding relay coils. Thus when the thermostat is warmed, the circuit is made, and the relay is energized. The selector switch chooses between heating circuits and thermostats and cooling circuits and thermostats in the Heat-OFF-Cool selection.

The relays and thermostats operate on 120V DC power, rectified by the bridge rectifier. The varistor protects the rectifier and time delay relay from electrical spikes which might be present.

Cooling, duct and hall heat thermostats are each equipped with a heater winding, which allows two special operations: set down and anticipation. The thermostat can be made to think the air temperature is slightly warmer than it actually is by supplying a little heat from this winding. The winding is supplied with a low voltage from anticipation and setdown resistors.

Setdown is the process in which the same thermostat can be made to operate at 2 different temperatures at different times. This is the technique used to achieve the Day-Night temperature settings on the temperature control panel. In the Night position, no voltage is applied to the heater winding, and the thermostat operates at the rated temperature. In the Day position, a small voltage is applied continuously to the heater winding via the selector switch and setdown resistor. This lowers the effective operating temperature by 2°F, thus a 74° thermostat then makes at 74-2° = 72°F.

Anticipation is similar to setdown, but here the heater winding is only activated when the car heat is cycled ON. The circuit is made via a set of contacts on the heating relay. When the heat is cycled off, the car temperature will continue to rise for a short time because it takes a while for the heater elements to cool off. Anticipation is chosen to compensate for this heat, thus the thermostat turns off the heat a little before reaching the desired temperature, and the heat left in the heater elements brings the car up to the desired temperature. This approach allows more accurate control of car temperature than a non-anticipation system. Anticipation is used on the duct and floor heat thermostats.

Note: Setdown and anticipation can be used simultaneously, and, in fact, are used in the Day-Heat position.

Cool bypass is a 30-minute cycle initiated by pressing the Cool Bypass button. This energizes the time delay relay TDR which remains energized for 30 minutes before dropping out. The Cool Bypass Stop button interrupts the coil circuit of the relay, causing it to drop out. Relay contacts close to put the A/C into partial cool during the bypass mode.

Two 5 AMP circuit breakers are used to protect the temperature controls. The "temperature control" breaker feeds loads external to the panel, namely heating and A/C contactors. The "control" circuit breaker protects the logic of the panel itself - relays and thermostats.

4. Periodic Maintenance

4.1 Mechanical

A. Temperature Control Panel

The No. 17756475 temperature control panel should be cleaned and inspected at the three month intervals. No other maintenance requirements are anticipated. Follow the procedure outlined below at each inspection period.

Step	Procedure
1.	Set system temperature control transformer (in electric locker) and panel circuit breakers to OFF.
2.	Remove panel cover.
3.	Blow all dust and lint from panel assembly; use 30 psig dry compressed air.
4.	Closely inspect all wiring connections. Repair or replace any wiring with worn or frayed insulation.
5.	Tighten all wiring connections as required.

CAUTION: USE CARE - DO NOT OVERTIGHTEN SET DOWN RESISTOR MOUNTING SCREWS. OVERTIGHTENING WILL CRACK THE RESISTOR.

6. Closely inspect relay contacts. Do not attempt to file or dress burned contacts. Where relay contacts are burned to such an extent as might cause a malfunction, replace the relay. Relay contacts may turn black (tarnish) from oxidation without impairing operation. Excessively tarnished contacts may be cleaned with a standard burnishing tool, or with a clean piece of hard stock paper similar to a business card. Use care, do not bend or attempt to file or dress relay contacts. This will change the contour and ruin the contact wipe.

7. Check all relay, switch and terminal strip mounting screws. Tighten as required.

8. Check that all thyrector leads are secure to relay coils; resolder if broken or loose.

9. Replace panel cover and reactivate control system.

10. Check operation of all pilot lamps, and that the HP/LP is red in color.

B. Mercury Tube Thermostats

Vapor double bulb mercury tube thermostats should be cleaned at the time of inspection. Use low pressure air (30 psig) or a fine brush to remove any dust from the sensing end of the thermostat. Thermostats should not be unplugged from their sockets unless a malfunction is suspected. Use care not to insert thermostats in wrong sockets when replacing or reinstalling.

Double bulb mercury tube thermostats may be tested with an ohmmeter. Connect an ohmmeter (accurate to ±3 percent across connector pins #3 and #4. A 600 ohm reading ±5 percent should be obtained. Where this reading cannot be obtained, the thermostat is presumed to be defective and must be replaced. The layover thermostat is a single bulb thermostat, lacking the heater winding.

The thermostat setting may also be checked (for functional operation) with an ohmmeter by connecting the meter across connector pins #1 and #2 (pins 1 & 3 on the layover thermostat). Where the ambient is above the "fixed" setting, the ohmmeter should read zero ohms. Below the fixed setting, the ohmmeter should read infinite resistance.

NOTE: The "fixed" thermostat setting is the actual manufactured setting (without any setdown applied).

Check the ambient of the test area with a thermometer. Where the ambient is lower than the setting, holding the thermostat sensing portion in a warm air stream will cause the mercury to rise and make contact. The ohmmeter should read "zero" ohms. Do not use an air stream above 90°F. Similarly, a cold air stream will cause the mercury column to drop and break contact. A calibrated control box must be used to check actual thermostat settings. Defective thermostats should be returned to the factory for repairs.

CAUTION: DO NOT USE HIGH CURRENT OR HIGH VOLTAGE TEST DEVICES SUCH AS TEST LAMPS WHEN CHECKING THERMOSTATS FOR CONTINUITY. SUCH DEVICES WILL CAUSE THE MERCURY COLUMN TO RUPTURE AND DAMAGE THE THERMOSTAT.

C. Bi-Metal Type Thermostats

The three outside thermostats, located below the floor of the electric locker are the bi-metal type. They can be tested with an ohmmeter, which should read zero when the thermostat is closed. These thermostats are non-repairable, field adjustment of the thermostats is not permitted. The only way these thermostats can be calibrated is in a oil bath designed for the purpose; other approaches will certainly result in incorrect settings which will cause car malfunctions.

4.2 Electrical

There is no independent test of the temperature control panel - it is tested through the use of a test unit. The test procedure is given in Amtrak test specification PQ-79-1 Section 3.3. This should be done as part of the heating and A/C preseason tests.

5. ELECTRICAL SCHEMATICS

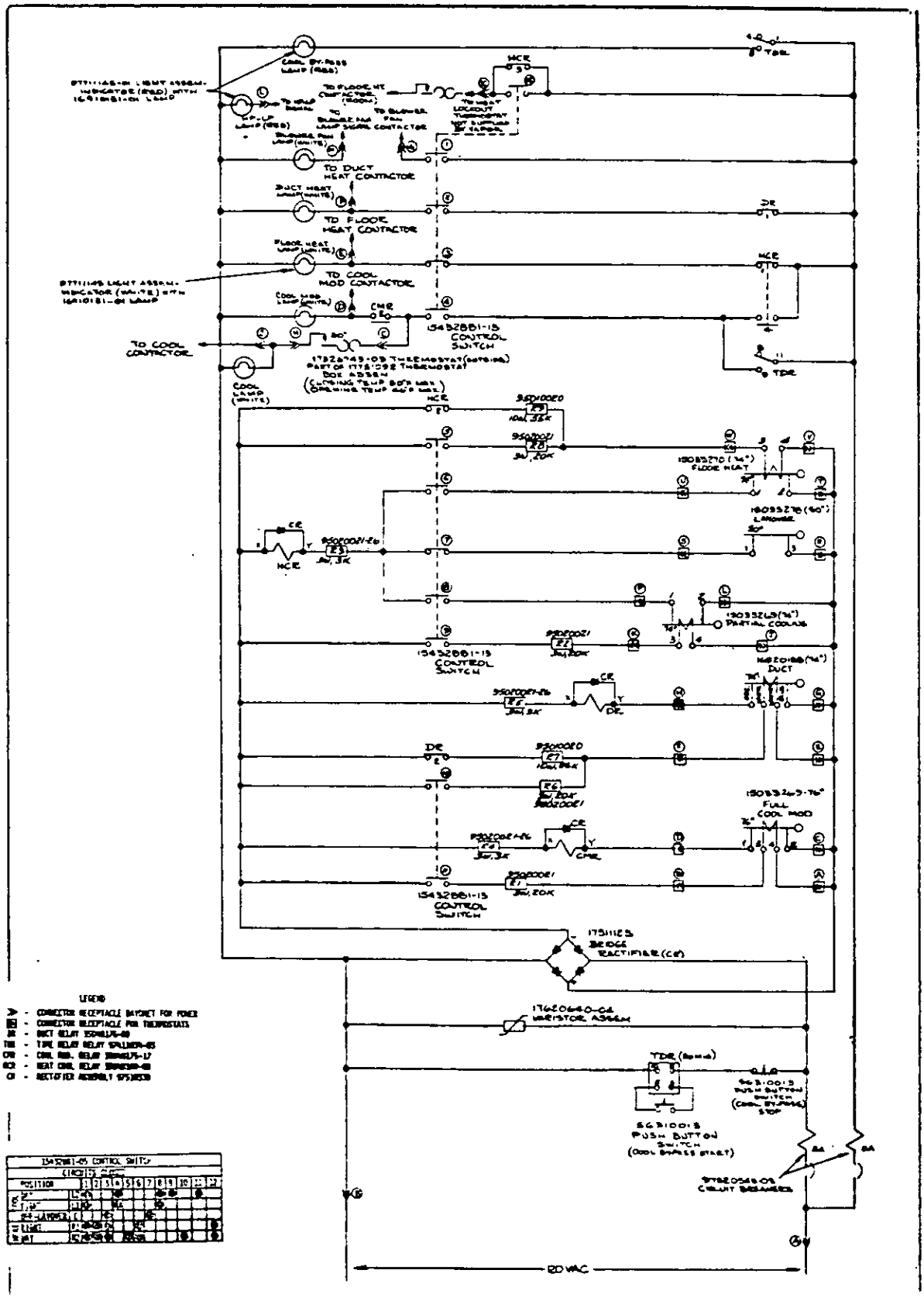


FIGURE 5.1

SYSTEM SCHEMATIC

VAPOR DWG. 177041-13

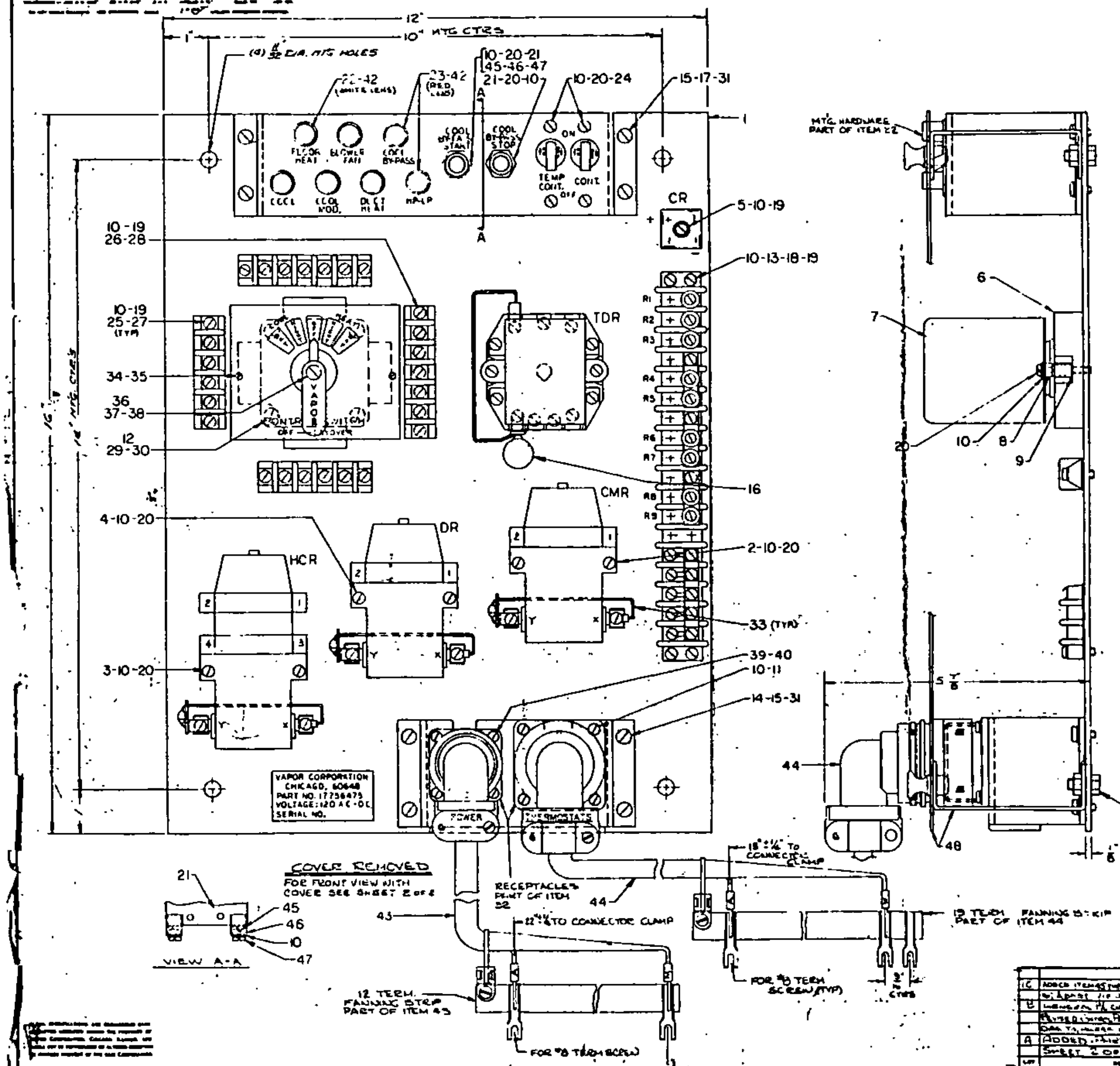
Figure 5.2

Temperature Control Panel Wiring Diagram
Vapor Drwg. #17756451 Sht.-2

6. Location Diagram and Part Drawings

Figure 6.1
DRAWING LIST

Temperature Control Panel	17756475-1
Temperature Control Panel Wiring	17756475-2
Cover and Bracket Assembly	17731469
Label, Instruction	17721472
Label, Circuit	17721471
Thermostat Box Assembly (Outside)	17651764-1
Thermostat (Cooling and Cool Mod.)	15033269
Thermostat (Duct)	16820188
Thermostat (Floor Heat)	15033270
Thermostat (Layover)	15033278



ITEM	PART NO.	DESCRIPTION	QTY	REMARKS
1	17731065	PLATE - MOUNTING	1	
2	35040175-17	RELAY - PILOT (CMR)	1	
3	35040180-09	RELAY - PILOT (HCR)	1	
4	35040176-09	RELAY - PILOT (DR)	1	
5	17511123	RECTIFIER - BRIDGE (CR)	1	
6	57310790	SOCKET - RELAY	1	
7	97411034-03	RELAY - TIME DELAY (HYDRID) (TDR)	1	
8	57410305-03	POST - HEX	2	
9	1106	LOCKWASHER (EXT.) (CODE 528)	2	SEE NOTE#1
10	6(5/16"OD X .028"TK)	FLATWASHER	69	SEE NOTE#1
11	#6-32 X 3/8" LG.	SCREW PAN HD. SEMS (EXT.)	6	SEE NOTE#1
12	15432882-21	SWITCH - CONTROL	1	
13	17731068	TERMINAL STRIP ASSEMBLY	1	
14	17731066	BRACKET - MOUNTING (CONNECTORS)	1	
15	#8-32 X 3/8" LG.	SCREW PAN HD. SEMS (EXT.)	8	SEE NOTE#1
16	17620640-04	VARISTOR ASSEMBLY	1	
17	17721146	BRACKET - MOUNTING	1	
18	97213571	INSULATOR STRIP	1	
19	#6-32 X 5/8" LG.	SCREW PAN HD. SEMS (EXT.)	13	SEE NOTE#1
20	#6-32 X 5/16" LG.	SCREW PAN HD. SEMS (EXT.)	14	SEE NOTE#1
21	34310019	SWITCH-SNAP ACTION	1	
22	97711145	LIGHT ASSEM-IND. (WHITE)	5	
23	97711145-01	LIGHT ASSEM-IND. (RED)	2	
24	97320543-03	CIRCUIT BREAKER (5 AMP)	2	
25	96910012-02	STRIP - TERMINAL	2	
26	96910012-03	STRIP - TERMINAL	2	
27	97110025-07	STRIP - INSULATOR	2	
28	97110025-08	STRIP - INSULATOR	2	
29	#10-32 X 5/16" LG.	SCREW PAN HD. SEMS (EXT.)	4	SEE NOTE#1
30	#10(7/16"OD X .032"TK)	FLATWASHER	4	SEE NOTE#1
31	#8(3/8"OD X .032"TK)	FLATWASHER	8	SEE NOTE#1
32	17731070	HARNESS - WIRING	1	
33	97510399	RECTIFIER ASSEMBLY	3	
34	17711069	INDICATING PLATE (CONTROL SWITCH)	1	
35	#4 X 3/16" LG.	SCREW - SELF TAPPING (TYPE B)	2	SEE NOTE#1
36	15010465	KNOB - SWITCH (7300-8-1)	1	E-10559
37	#6-32 X 3/4" LG.	SCREW RD. HD.	1	SEE NOTE#1
38	#6	WASHER - SPLIT TYPE	1	SEE NOTE#1
39	4-40 X 3/8" LG.	SCREW PAN HD. SEMS (EXT.)	4	SEE NOTE#1
40	4(9/32"OD X .025"TK)	FLATWASHER	4	SEE NOTE#1
41				
42	16910191-01	LAMP-NEON (NE-2D)	7	
43	17731054	CONNECTOR & STRIP ASSEMBLY	1	
44	17731056	CONNECTOR & STRIP ASSEMBLY	1	
45	57411176	SPACER	2	
46	96320010-39	INSULATOR	2	
47	6-32 X 3/4" LG.	SCREW-PAN HD (SEMS) EXT.	2	
48	17751469	COVER & BRACKET ASSEM.	1	
49	1/4-20 X 1/2" LG.	SCREW - HEX HD.	4	SEE NOTE#1
50	1/4-20	NUT - HEX.	4	SEE NOTE#1

NOTE:

1. STEEL, CADMIUM PLATE COMMERCIAL FINISH.
2. TERMINAL LUG FASTENING MUST BE IN ACCORDANCE WITH DRAWINGS 67101001 THRU 67101005 WHICHEVER APPLIES.
3. PANEL, MATERIAL: 13 GA. STEEL
   FINISH: WHITE GLOSS ENAMEL. PAINT WITH BLACK SILK SCREEN LETTERING.
4. [illegible] TEST PROCEDURE [illegible]
5. SCHEM. WRG. DIAG. 17704475

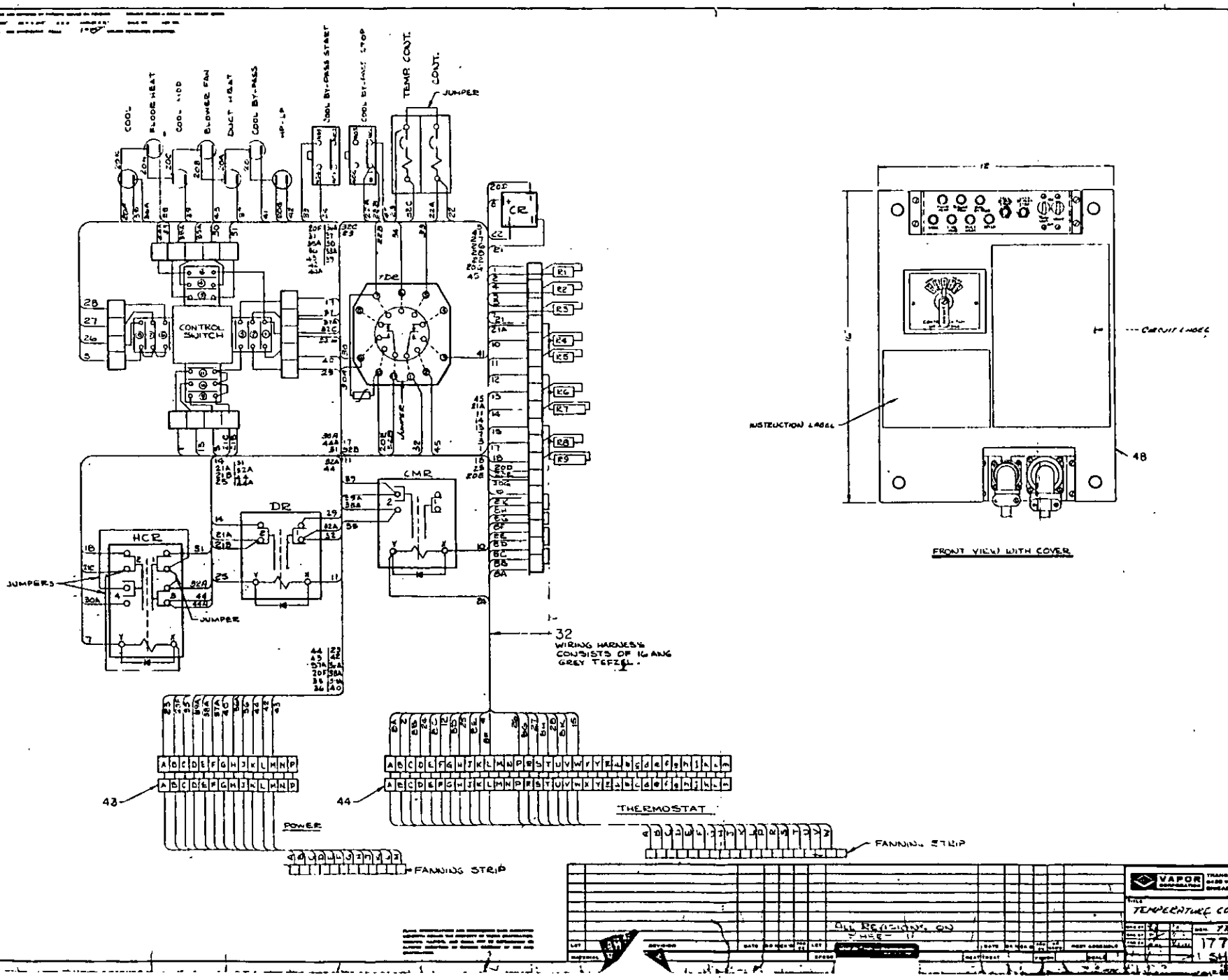
ACTUAL WEIGHT 17.5 LB. AMTRAK

LTR	REVISION	DATE	BY
C	ADDED ITEMS 45 THRU 50 ITEM 20 [illegible]		
B	[illegible]		
	REVISED [illegible]		
	[illegible]		
A	ADDED PARTS LIST & SHEET 2 OF 2	7/22/77	

VAPOR CORPORATION — TRANSPORTATION SYSTEMS DIVISION, 6420 WEST HOWARD STREET, CHICAGO, ILLINOIS 60648

TITLE: TEMPERATURE CONTROL PANEL

17756475 SHEET 1 OF 2

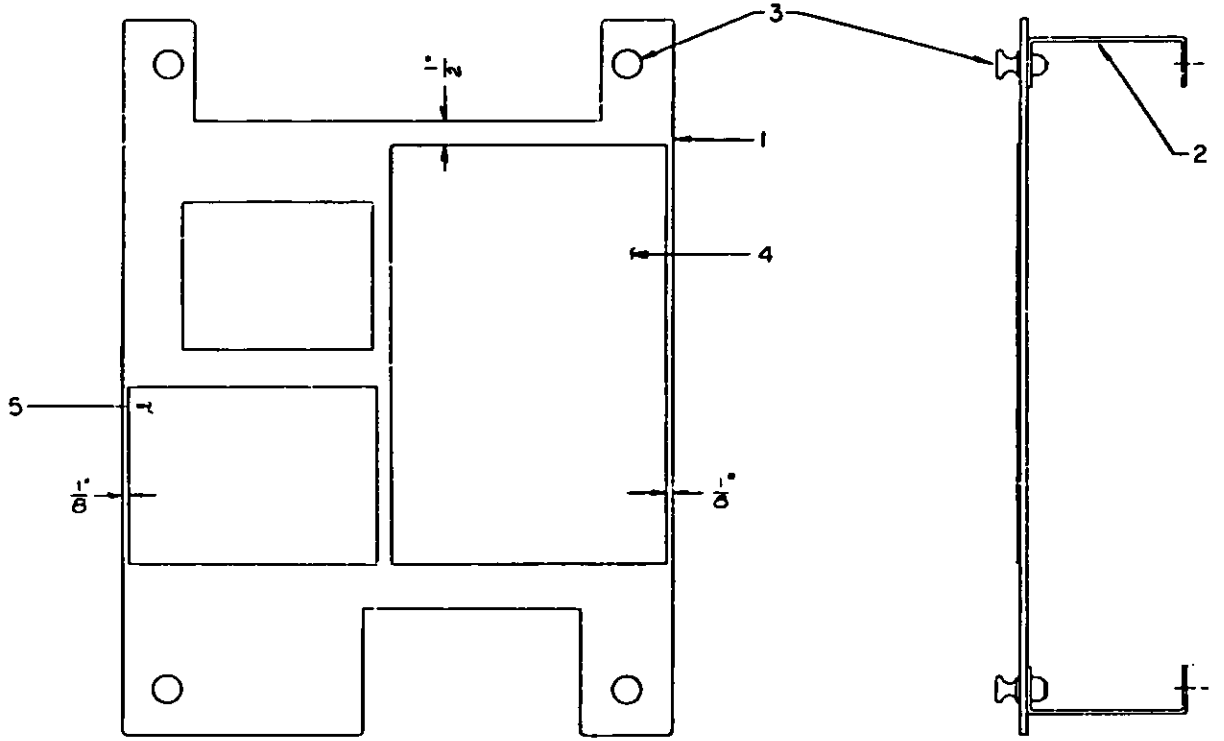

COOL
BLOWER HEAT
COOL HIGH
BLOWER FAN
DUCT HEAT
COOL BY-PASS
HP-LP
COOL BY-PASS START
COOL BY-PASS STOP
TEMP CONT.
CONT.
JUMPER
CR
CONTROL SWITCH
CMR
DR
HCR
JUMPERS
JUMPER
32
WIRING HARNESS CONSISTS OF 16 AWG GREY TEFZEL.
48
44
POWER
THERMOSTAT
FANNING STRIP
FANNING STRIP
INSTRUCTION LABEL
CIRCUIT BOARD
48
FRONT VIEW WITH COVER
VAPOR
TEMPERATURE CONTROL PANEL
17756475
SHEET 2 OF 2

6-3

6-4

PARTS LIST

ITEM	PART No.	DESCRIPTION	QTY	REMARKS
1	17731468	COVER	1	
2	17711467	BRACKET-COVER	4	
3	17711470	LATCH	4	
4	17721471	LABEL-CIRCUIT	1	
5	17721472	LABEL-INSTRUCTION	1	



ASSOCIATED DRAWINGS

VAPOR CORPORATION
TRANSPORTATION SYSTEMS DIVISION
6420 WEST HOWARD ST.
CHICAGO, ILLINOIS 60648

TITLE
COVER & BRACKET ASSEM

T1029-2

17731469

REVISIONS

LET	DESCRIPTION	DATE	DRN	CHK	ENG

DISCLOSURES SHOWN HEREON ARE COVERED BY PATENTS ISSUED OR PENDING REMOVE BURRS — BREAK ALL SHARP EDGES

TOLERANCES — .XXX = ± .005" .XX = ± .015" ∠ = ± ANGLES = ½° GALS. WT. ACT. WT.

DO NOT SCALE DRAWING. USE DIMENSIONS ONLY 1 = 1 UNLESS OTHERWISE SPECIFIED. FRACTIONS = ± 1/64"

INSTRUCTION CHART OPERATION SCHEDULE
FOR #17758A75 TEMPERATURE CONTROL PANEL

CONTROL SWITCH POSITION	FUNCTION AT INTERIOR TEMPERATURE °F	SIGNAL LAMP INDICATION						
		COOL	COOL MOD	BLOWER CONTACTOR	FLOOR HEAT	DUCT HEAT	*COOL BY-PASS	**HP-LP
LAYOVER	BELOW 50°				ON			
COOL - NIGHT	ABOVE 76°	ON	ON	ON				
	74°- 76°	ON		ON				
	BELOW 74° (VENT)			ON				
COOL - DAY	ABOVE 74°	ON	ON	ON				
	72°- 74°	ON		ON				
	BELOW 72° (VENT)			ON				
HEAT - NIGHT	BELOW 74°			ON	ON	ON		
	ABOVE 74°			ON				
	ABOVE 74° (VENT)			ON				
HEAT - DAY	BELOW 72°			ON	ON	ON		
	ABOVE 72°			ON				
	ABOVE 72° (VENT)			ON				

*COOL BY-PASS START; NOTE: SELECTOR SWITCH MUST BE IN COOL POSITION.
MANUAL COOL CONTROL START: DEPRESS COOL BY-PASS BUTTON, INITIATES PARTIAL COOLING FOR 30 MINUTES OVERRIDING COOL THERMOSTATS.
MANUAL COOL BY-PASS STOP : DEPRESS COOL BY-PASS STOP BUTTON TO STOP COMPRESSOR INITIATED OR PRIOR 30 MINUTE TIMING CYCLE.
**HP-LP SIGNAL LIGHT WHEN ENERGIZED INDICATES A FAULT CONDITION OF THE COMPRESSOR AND MUST BE REPORTED.

MATERIAL:
WHITE PRESSURE SENSITIVE PAPER TOUCH DOWN - SPLIT LESS - REMOVEABLE ADHESIVE

SIZE:
4 x 5 3/8"

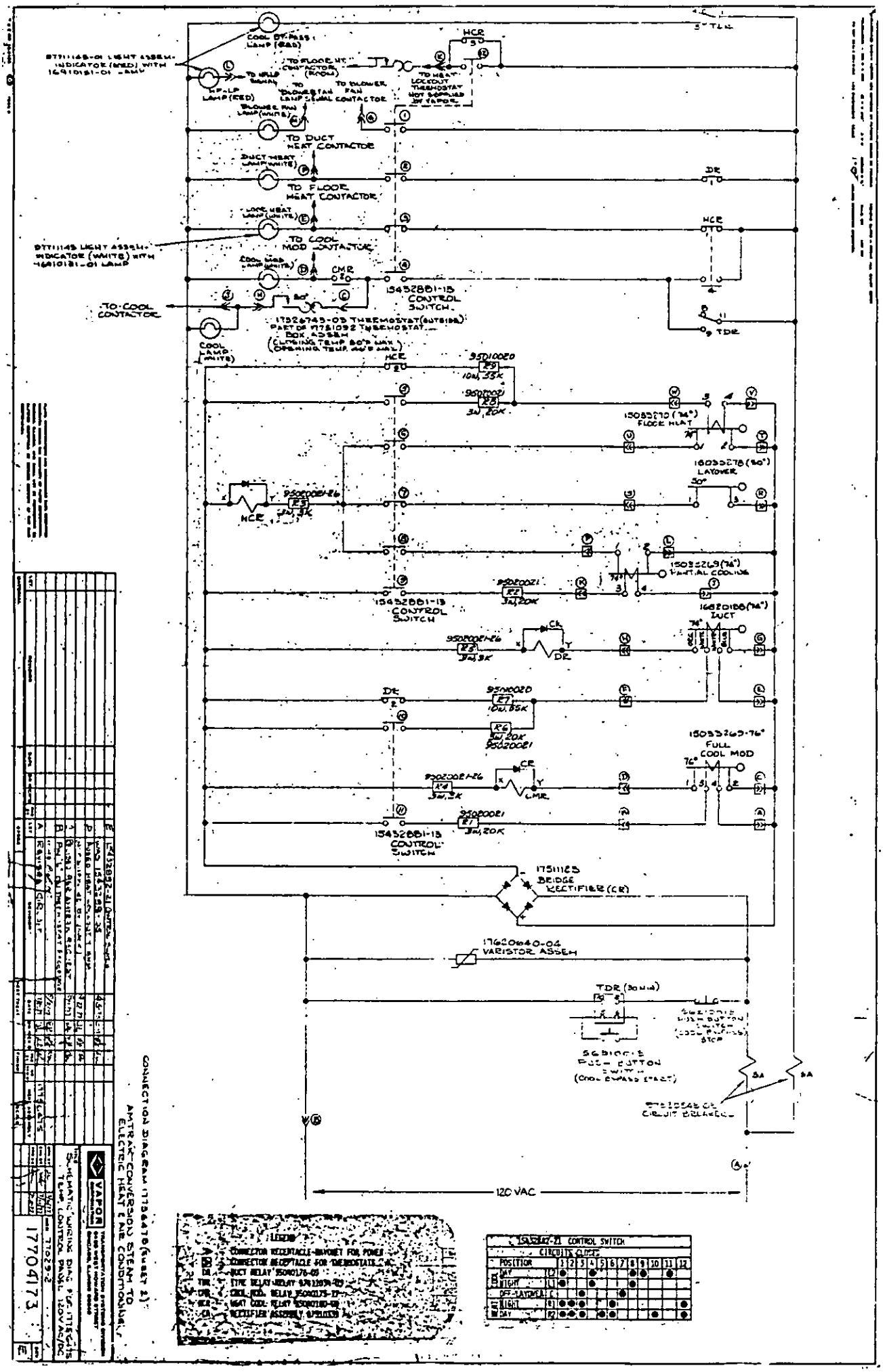
LET.	REVISION	DATE	DRN.	CK'D	ENG. OK.	LET.	REVISION	DATE	DRN.	CK'D	ENG. OK.	MOD. NO'S	NEXT ASSEMBLY
													1775/469

MATERIAL: See Note SPECS HEAT TREAT FINISH SCALE

VAPOR CORPORATION
TRANSPORTATION SYSTEMS DIVISION
6420 WEST HOWARD STREET
CHICAGO, ILLINOIS 60648

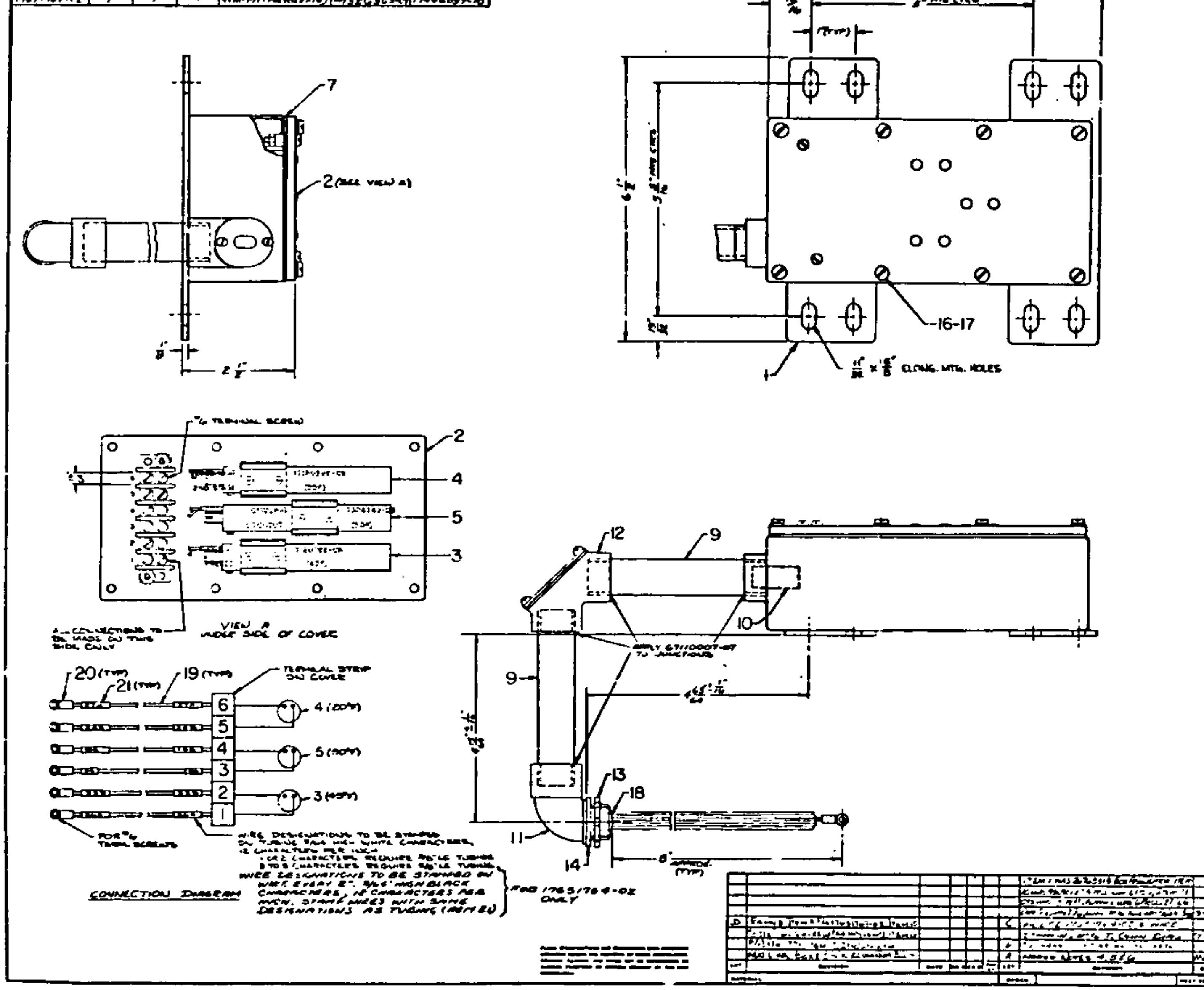
TITLE: LABEL-INSTRUCTION

DRN BY	JL	12/12/11	MRN. 77029-2
CHK BY		12/19/11	17721472
ENG OK		12-19-11	REV.



CONNECTION DIAGRAM 17736418 (SHEET 2)
AMTRAK CONVERSION STEAM TO ELECTRIC HEAT & AIR CONDITIONING

17704173



DATA TABLE

PART NO.	QUANTITIES ITEM 3	ITEM 4	ITEM 5	ITEM 19	ITEM 21	NEXT ASSEM.
1765 1764	1	1	1	[illegible]	[illegible]	[illegible]
17651764-01	—	—	—	[illegible]	[illegible]	[illegible]
17651764-02	1	1	1	[illegible]	[illegible]	[illegible]

LIST OF PARTS

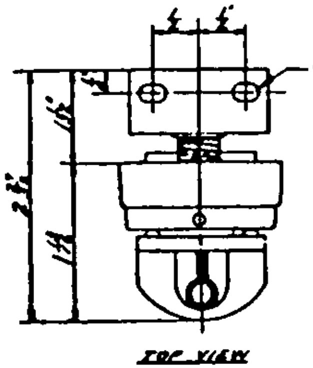
ITEM	PART NO.	DESCRIPTION	QTY	REMARKS
1	[illegible]	BOX-ASSEM. WELDED	1	
2	17621763	COVER ASSEM.	1	
3	17120799-06	THERMOSTAT-BI-METALLIC (40°)	[illegible]	SEE NOTE 4
4	17120799-09	THERMOSTAT-BI-METALLIC (20°)	[illegible]	SEE NOTE 5
5	17520765-05	THERMOSTAT-BI-METALLIC (50°)	[illegible]	SEE NOTE 6
6				
7	17651767-01	GASKET	1	
8				
9	[illegible]	NIPPLE-CONDUIT (1/2" x 6" LG.)	2	
10	17010080	WRAP-HARNESS	1 [illegible]	
11	95090020	ELBOW-SNCAT (1/2" x 90°)	1	
12	9509124	ELBOW MALL (1/2" x 90°)	1	
13	[illegible]	CONDUIT LOCKNUT	1	
14	[illegible]	GASKET [illegible]	1	
15				
16	[illegible]	SCREW-PAN HD. SEMS (EXT.)	8	STAINLESS STEEL
17	[illegible]	FLATWASHER	8	
18	[illegible]	SLEEVE-INSULATOR (1/2")	1	
19	SEE TABLE	WIRE ELECTRICAL (16 AWG WHITE)	[illegible]	
20	15815076-12	TERMINAL-RING TONGUE	12	
21	SEE TABLE	[illegible]	[illegible]	
	67110007-07	ADHESIVE (ANAEROBIC TYPE)	A.R.	
	56216476-04	TIE-HARNESS	4	SEE NOTE 1

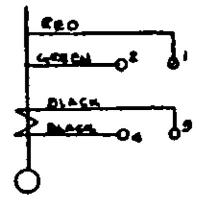
NOTES

1. EXCESS WIRE TO BE LOOPED IN BOTTOM OF BOX SO THAT THE COVER MAY BE REMOVED WITHOUT STRAINING WIRES. APPLY 56216476-04 HARNESS TIES TO WIRES.
2. MAT'L: BOX & COVER COR-TEN A STEEL
FINISH: BOX & COVER BLACK GLOSS ENAMEL
MAT'L: GASKETS VIRGIN NEOPRENE
3. VAPOR TEST PROCEDURE - PSS [illegible]
4. CLOSING TEMP. 45° ± 3°F MAX. OPENING TEMP. 50°F.
5. CLOSING TEMP. 20° ± 3°F. MAX. OPENING TEMP. 25°F.
6. CLOSING TEMP. 50°F MAX. OPENING TEMP. 45°F. MIN.

SYM	PART Nº	DESCRIPTION	AMT	REMARKS
1	15010379	THERM. MTG. BRACKET	1	
2	15030380	CASE ASSEM.-INSTRUMENT (NO)	1	
3	(SEE TABLE)	TUBE PANEL ASSEM (COMP)	1	
4	(SEE TABLE)	TAPE - PRESSURE SENS. 1/8 W x 1/16	1	YELLOW
5	(SEE TABLE)	LABEL - IDENT.	1	

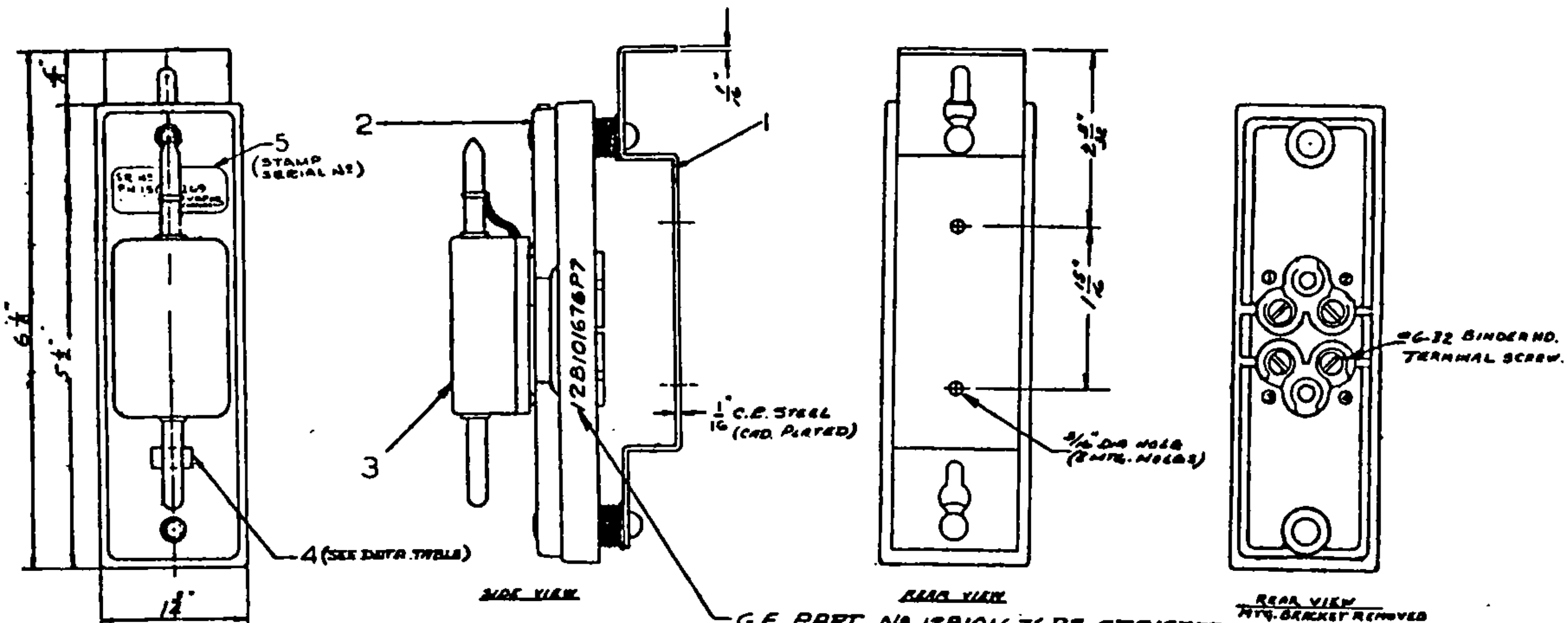
LIST OF PARTS





DATA TABLE					
PART NO	RESISTANCE	TEMP SETTING °F	SYM 3	SYM 4	SYM 5
15033269(▲)	600Ω	SPECIFY TEMP	15022961(▲)	NOT USED	41521685-04
15033269-01(▲)	250Ω	SPECIFY TEMP	15022961-01(▲)	NOT USED	41521685-05
15033269-02	600Ω	41	15022961-02	16590006	41521685-06

(▲) SPECIFY TEMP. WHEN ORDERING



G.E. PART Nº 12B101676P7 STAMPED 1/8" HIGH WITH WHITE SILK SCREEN PAINT 67110073. (FOR 15033269-02 ONLY.)

FORMER VAPOR PT Nº DN-2501.

LTR	REVISION	DATE		
3	ADDED SYM 5			
4	GE PART WAS 12B101676 P3 FOR VAPOR NO 15033269-02			
	FOR 15033269-02 TEMP SETTING WAS ...			

VAPOR CORPORATION — TRANSPORTATION SYSTEMS DIVISION, CHICAGO, ILLINOIS

THERMOSTAT (FOR DUCT MOUNTING)

15033269 K

6-9

ALL DISCLOSURES SHOWN HEREON ARE COVERED BY PATENTS ISSUED OR PENDING. REMOVE BURRS—BREAK ALL SHARP EDGES.

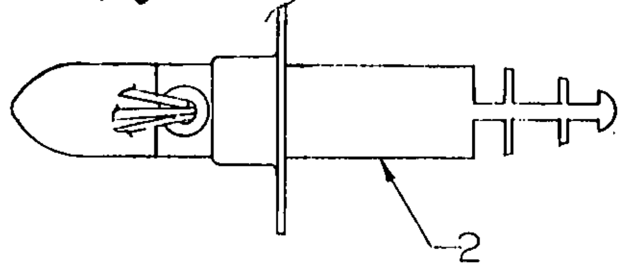
TOLERANCES – .XXX = ± .005" .XX = ± .01" .X = ± ANGLES ± 1/2° CALC. WT. ACT. WT. FRACT ± 1/64"

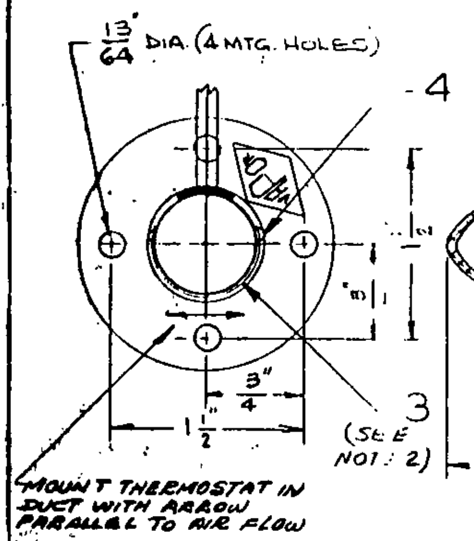
DO NOT SCALE DRAWING. USE DIMENSIONS. SCALE 1 = 1 UNLESS OTHERWISE SPECIFIED.

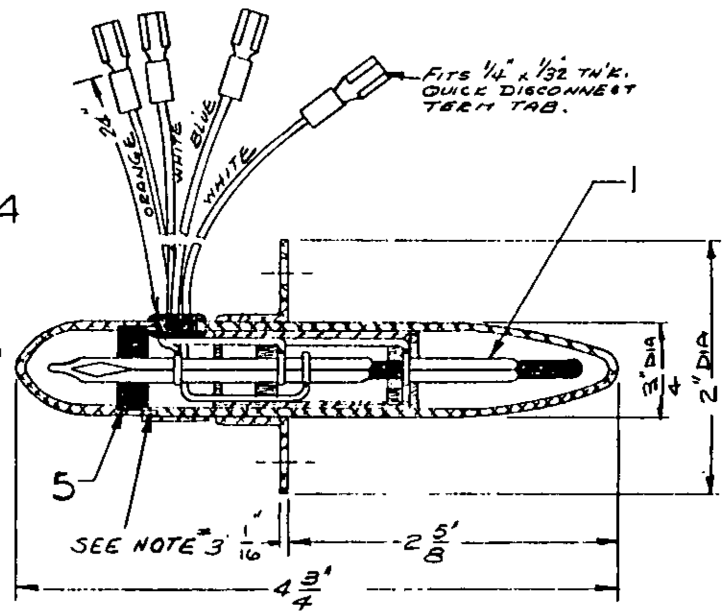
LIST OF PARTS

	SYM	PART Nº	DESCRIPTION	AMT.	DRG. Nº
△	1	16810191	TUBE ASSEM.-THERM	1	
	2	48A37	SHORT CASE ASSEM.-FLANGE MTG	1	ALUM.
	3	16016043	PLATE-NAME	1	
	4	E-3234	RIVET-SEMI-TUBULAR	2	CODE C39
	5	49A561	GROMMET	1	

△ – SPECIFY DEGREES DESIRED IN PART Nº FOR SYM. 1. EXAMPLE: 16810191 (TEMP °F)

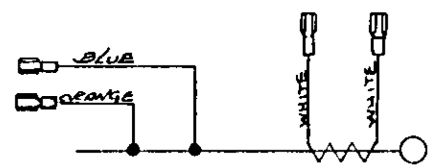






NOTES:

1. THERMOSTAT LEAD WIRES SHALL BE STAGGERED SO TUBE WILL BE CENTERED IN CASING.
2. BEND NAME PLATE TO 3/8" R. (INSIDE) AFTER STAMPING. PART Nº & TEMP
3. ALL THREADS TO BE COATED WITH CODE # 132 ANTI-SEIZE COMPOUND.
4. * SPECIFY DEGREES DESIRED (IN PART Nº) FOR DUCT THERM. EXAMPLE: 16820188 (TEMP °F)



CONNECTION DIAG.

REFERENCE DRAWING 53B84

LET.	REVISION	DATE	DR'N	CK'D	PRO. CE.	NO. REQ'D	NEXT ASSEMBLY
D	ADDED MATL. "ALUM." TO SYM 2 PART Nº 48A37	7/3/71	DC	RJ	OC		
C	SYM. 3 #16016043 WAS #26418191	7-30-68	BS		CK		
B	SYM 3 PT #25418191 WAS 46A747	7-23-68	KL				
A	REVISED SYM 1 TO ASSEM.	7/8/68					

MATERIAL | SPECS | HEAT TREAT | FINISH | SCALE

SINGER
TRANSPORTATION SYSTEMS DIVISION
VAPOR CORPORATION
6420 WEST HOWARD STREET
CHICAGO, ILLINOIS

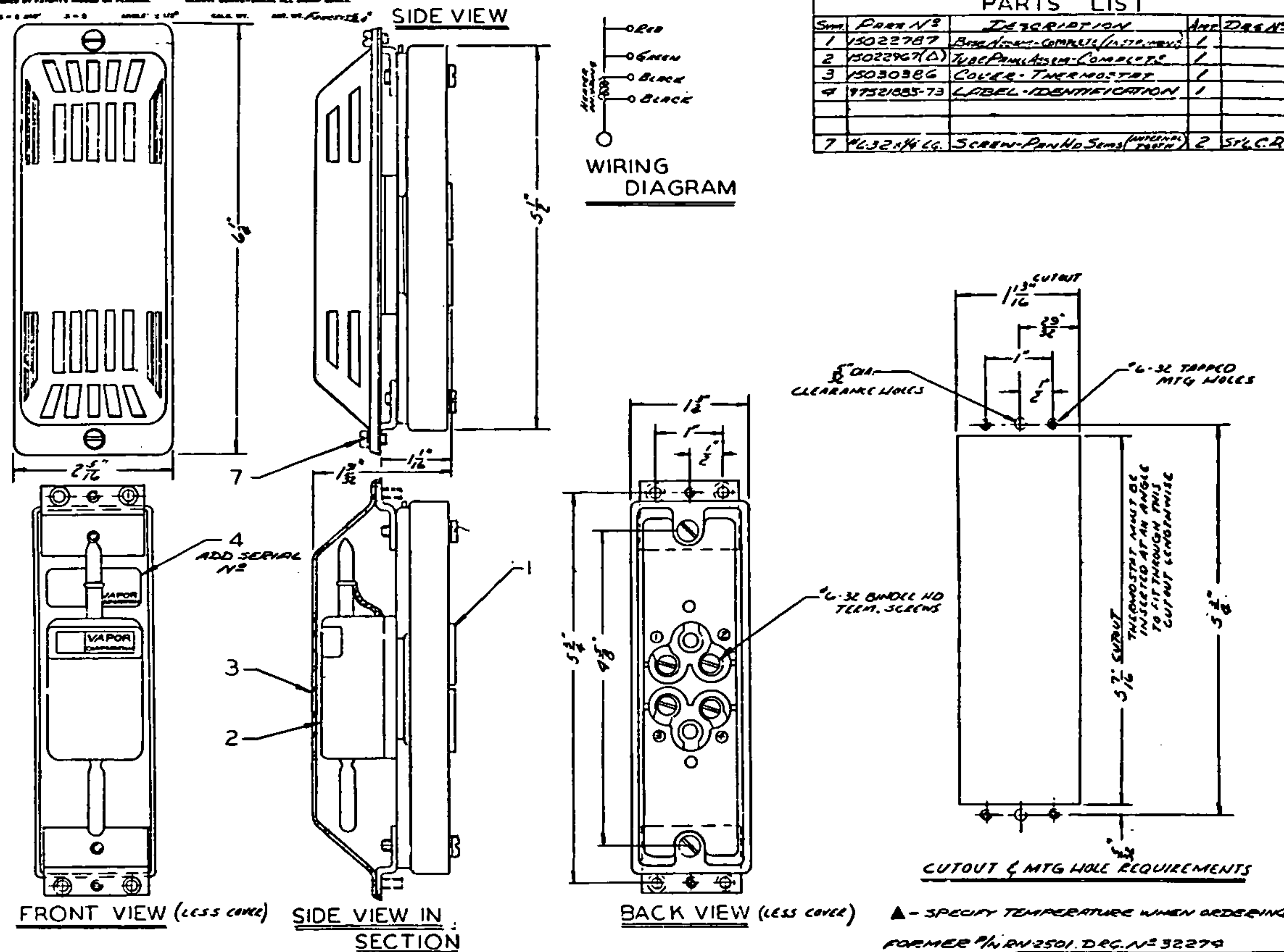
TITLE 16820188 (*) THERMOSTAT-DUCT.

DRN BY J. Z. | CHK BY | PRO. BY
MRN. 66067

16820188

REV D

6-10



PARTS LIST

SYM.	PART Nº	DESCRIPTION	AMT.	DRG Nº
1	15022787	Base Assem - Complete (Instr. [illegible])	1	
2	15022967(Δ)	Tube Panel Assem - Complete	1	
3	15030386	Cover - Thermostat	1	
4	97521885-73	Label - Identification	1	
7	#6-32 x 1/4 Lg.	Screw - Pan Hd Sems (Internal Tooth)	2	Stl. C.R.

▲ - SPECIFY TEMPERATURE WHEN ORDERING

FORMER P/N RN-2501. DRG. Nº 32279

REF. DRG 15033270

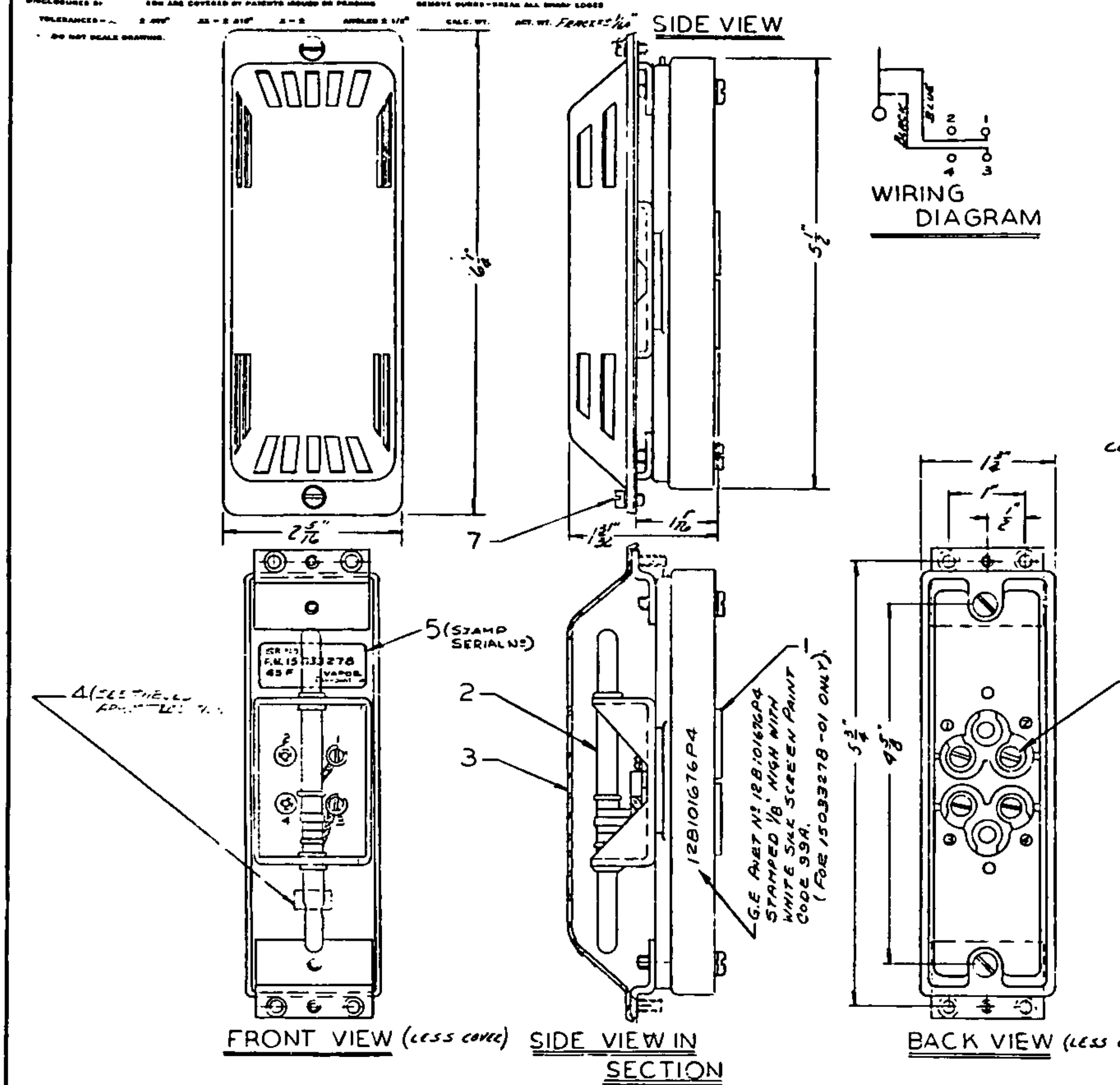
VAPOR CORPORATION
RAILROAD AND TRANSIT
6420 W HOWARD STREET CHICAGO, ILLINOIS

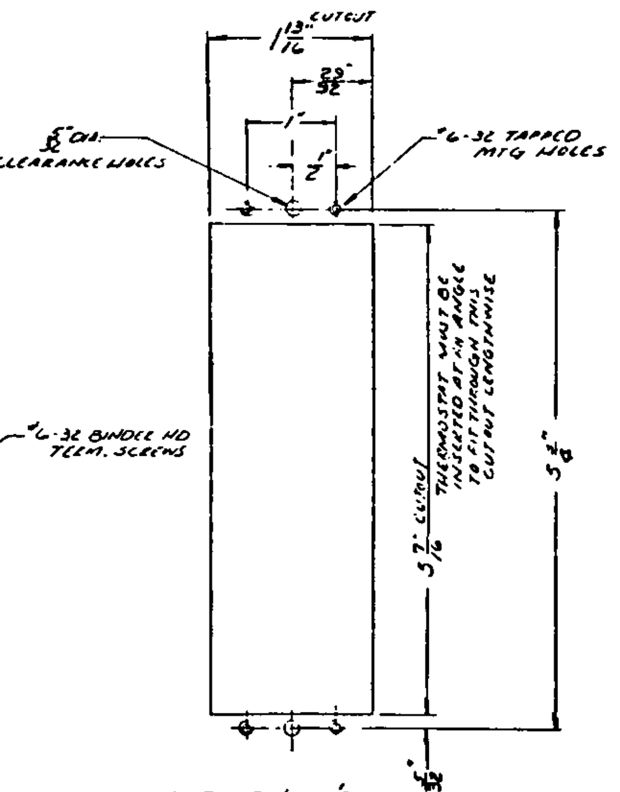
15033270 (▲)
THERMOSTAT (RECESSED TYPE)

15033270 D

PARTS LIST				
SYM	PART Nº	DESCRIPTION	AMT.	IRS Nº
1	15022797	BASE ASSEM. COMP (INSTR)(RN2502AA)	1	22088
2	SEE TABLE	TUBE PANEL ASSEM-COMP (N2522-1BB)	1	21955
3	15436442	COVER - THERM.	1	
4	SEE TABLE	TAPE - PRESSURE SENS (1/4 W x 1/2 LG)(CRG)	1	
5	SEE TABLE	LABEL - IDENTIFICATION	1	
7	#6-32 x 1/4 LG	SCREW FIL. HD SEMS (INTERNAL TOOTH)	2	SPL CODE 3

DATA TABLE				
PART Nº	TEMP SETTING	SYM. 2	SYM. 4	SYM 5
15033278 (▲)	SPECIFY TEMP	15022797 (▲)	NOT USED	97521885-03
15033278-01	55 °F	15022797-01	16590068-05	—





CUTOUT & MTG. HOLE REQUIREMENTS

(▲) SPECIFY TEMP. WHEN ORDERING

FORMER VAPOR PART Nº RN-2522-1

REF. DRG. 4EC387

M | SYM 5 PART Nº WAS 97521685-65 FOR 15033278.

L | ADDED SYM 5

VAPOR CORPORATION

THERMOSTAT (RECESSED TYPE)

15033278

6-11

7. Repair Procedures and Trouble Shooting

7.1 Field Repairs

Minor repairs can be done on the car, such as changing defective lamps, etc. More complicated problems require removal of the panel from the car. Use test procedure PQ-79-1 to determine if the panel is operating properly, or if the panel is elsewhere. Also, refer to trouble shooting chart, Fig. 7.1.

General

When troubleshooting the temperature control system with the Diagnosis Chart refer to the schematic and connection wiring diagrams, drawing No. 17704173 and 17756475, respectively. The schematic diagram indicates the general "scheme" of the system's operation. The connection diagram indicates actual system wiring and connections to specific terminals and components.

Where resistance or voltage measurements are to be made a suitable multi-meter such as the Simpson Model 260 or equivalent should be used.

Before deciding a particular system in a car is malfunctioning check that all switches and circuit breakers are properly set and there is 120 VAC, and 480 VAC supplied to the system. Also check that the system has been activated from the temperature control switch as required.

Figure 7.1
Trouble Shooting Chart

Symptom	Probable Cause	Correction
1. No overhead heat	1. Selector switch not in heat	1. Select heat
	2. Defective DR relay	1. Replace
	3. Defective selector switch	1. Replace
2. 1st stage overhead heat OK, no second stage	1. Defective 20° outside thermostat.	1. Replace
3. Overhead heat stays	1. Defective 74° duct thermostat	1. Replace
	2. Open series resistor	1. Replace
	3. Open DR relay coil	1. Replace
1. No hall floor heat	1. Selector switch not in heat	1. Select heat
	2. Defective HCR relay	1. Replace
	3. Defective selector switch	1. Replace
2. Hall heat stays on	1. Defective 74° hall thermostat	1. Replace
	2. Open series resistor	1. Replace
	3. Open HCR relay coil	1. Replace
1. No roomette and bedroom floor heat	1. Selector switch not in heat	1. Select he
	2. Defective 70° outside thermostat	1. Replace
	3. Defective selector switch	1. Replace
1. No layover heat	1. Defective selector switch	1. Replace
2. Layover heat stays on	1. Defective 50° layover	1. Replace
	2. Open series resistor	1. Replace
	3. Open HCR relay coil	1. Replace
	4. Defective selector switch	1. Replace
1. No A/C	1. Selector switch not in cool	1. Select cool
	2. Defective 50° outside thermostat	1. Replace
	3. Defective 74° cool thermostat	1. Replace
	4. Open series resistor	1. Replace
	5. Open HCR relay coil	1. Replace
	6. Defective HCR contacts	1. Replace
	7. Defective selector switch	1. Replace
2. Car cools, no full cool	1. Defective 76° cool mod thermostat	1. Replace
	2. Open series resistor	1. Replace
	3. Defective CMR contacts	1. Replace
	4. Open CMR relay coil	1. Replace

Figure 7.1
Trouble Shooting Chart
(Continued)

Symptom	Probable Cause	Correction
1. Day & Night settings of selector produce no temperature change (should be 2°)	1. Open setdown resistor(s)	1. Replace
1. "Temperature Control" breaker on panel trips	1. Fault in external contactors or wiring	1. Repair
2. "Control" breaker on panel trips	Internal fault:	
	1. Shorted varistor	1. Replace
	2. Shorted bridge rectifier	1. Replace
	3. Shorted TDR	1. Replace
	4. Defective thermostat wiring-ground or short	1. Repair

7.2 Shop Repairs

Major panel repairs are best done in a shop where adequate tools, parts and test equipment is available.

7.3 Factory Repair

If shop repairs cannot be made, or parts are required contact:

Vapor Corp.
6420 West Howard St.
Chicago, IL 60648
312-631-9200

8. Tools and Test Equipment

Screw Driver, 1/4" blade
Screw Driver, Phillips

Volt-ohmmeter, 0-200VAC, 20,000 ohms/volt such as Simpson 260 or 270

Amtrak Test Unit, per PQ-79-1 test spec.

3.3 Shunt Trip Pilot Lamp

A blue shunt trip pilot light is located adjacent to the temperature control panel. It is important that this light be illuminated whenever the car is on power, because it indicates availability 120V AC required for operation of the overheat protection of the overhead heater. Should the light not be on, check the cause and correct it.

ITEM	DESCRIPTION	MANU	MANU #	AMT #	AMMS #
1	Lamp, 6W, 120V, S6, Cand	-	6S6/3	25D9011698	
2	Lens, Blue	Chicago Miniature	78A436 Blue		
3	Socket, Candelabra, Screw Term.	Chicago Miniature	5786-523 435		
4	Resistor, 250 ohm, 5 watt	Ohmite	Style 995-5B 250-Ohm		

3.4 Air Vaporizer

N/A

3.5 Fans

Refer to Main Manual

3.6 Heating - General

The HEP converted cars are electrically heated through a combination of floor and overhead heat. The two systems are independent, and are controlled by the temperature control panel.

Overhead heat is generally used to warm the fresh air taken into the car to about 74°. It is not intended to do much of the car heating, and thus the delivery air will not feel very warm.

The floor heat is intended to do most of the car heating. Since warm air (not heat) rises, using baseboard floor heat causes natural air convection, keeping the car a uniform temperature.

Fig. 3.21 Car Heating Capacity

FUNCTION	CONTACTOR	KW
1st Stage Overhead	HC1	10
2nd Stage Overhead	HC2	10
Bedrooms	FH1	6.0
Roomettes, Toilet & Porter	FH2	8.8
Hall	FH3	4.5
Total Overhead Heat		20 KW
Total Floor Heat		19.3
Total Car Heat		39.3

3.6.1 Overhead Heat

The overhead heat operates from 480 volts, 3 phase, and is divided into 2 equal stages of 10 KW each, fed by contactors HC1 & HC2. The heater is bolted to the downstream side of the evaporator. This heater is similar to but not the same as the heater used on the NON-2900 cars, and must not be interchanged - the car will not heat properly with the wrong heater. (Likewise do not use a 2900 overhead heater on a non-2900 car - it will not perform properly either).

A Klixon thermostat is mounted on top of the heater to protect against overheating. If this thermostat should rise above 200°, it will close and actuate the shunt trip circuit breaker cutting off the overhead heat. See Section 3.2.5 for a more detailed explanation of the protective circuitry, and test PQ-79-1, test 3.4. Refer to figure 3.22 for heater element replacement. Some of the heaters were wired delta, and some wye by the manufacturer - do not change this.

Note the importance of keeping air filters clean. Dirty filters restrict air flow and can cause the overhead heaters to get excessively hot. Be careful to install them facing the right direction - observe air flow arrows on the filters.

For tests of the heating system, refer to Specification PQ-79-1 Section 3.3, 3.4, 3.5 and 3.9.

Figure 3.22A

INSTRUCTIONS FOR FIELD REPLACEMENT OF RESISTANCE COILS IN BLAST COIL HEATERS

1. The replacement resistance coil is shipped prewound on the proper size arbor and with the terminals assembled to its ends. Insulators for the return bends made by the coil when strung through the heater and replacement terminal insulators are provided when required.

2. The enclosed diagrams must be followed when positioning the coils in the frame of the heater, installing the bus, locating supply connections, and reconnecting any built-in components which were disconnected to facilitate coil replacement.

3. It may not be necessary to remove the terminal pan if the first bracket is spaced 3-1/2" behind it. Otherwise the pan may be removed by drilling out the spot-welds by which it is attached. It will be necessary, likewise, to remove the back pan if insulators are to be installed at the return bends of the resistance coils. The terminal pans which have been removed may be reassembled to the heater and attached with sheet metal screws after all terminals have been inserted through their insulator bushings.

4. The replacement coil is shipped close-wound, and must be stretched by the electrician to the proper length before placement in the heater is attempted. This proper stretched length is determined by the width of the heater and by the number of passes which the coil makes through the heater, and is found by the formula:

   Stretched Length = Number of Passes X (Heater Width Minus 1")

   It is important that the coil not be over-stretched.

5. The stringing of the properly stretched resistance coil commences with the determination of its mid-point. Both ends are passed through the heater frame simultaneously. Care must be taken to insure that these passes are made through the correct location, and in the direction that will place the center return bend at the proper end of the heater. For example, if the coil is to make four passes, the mid-point of the coil must bend across the front bracket (i.e. at terminal end).

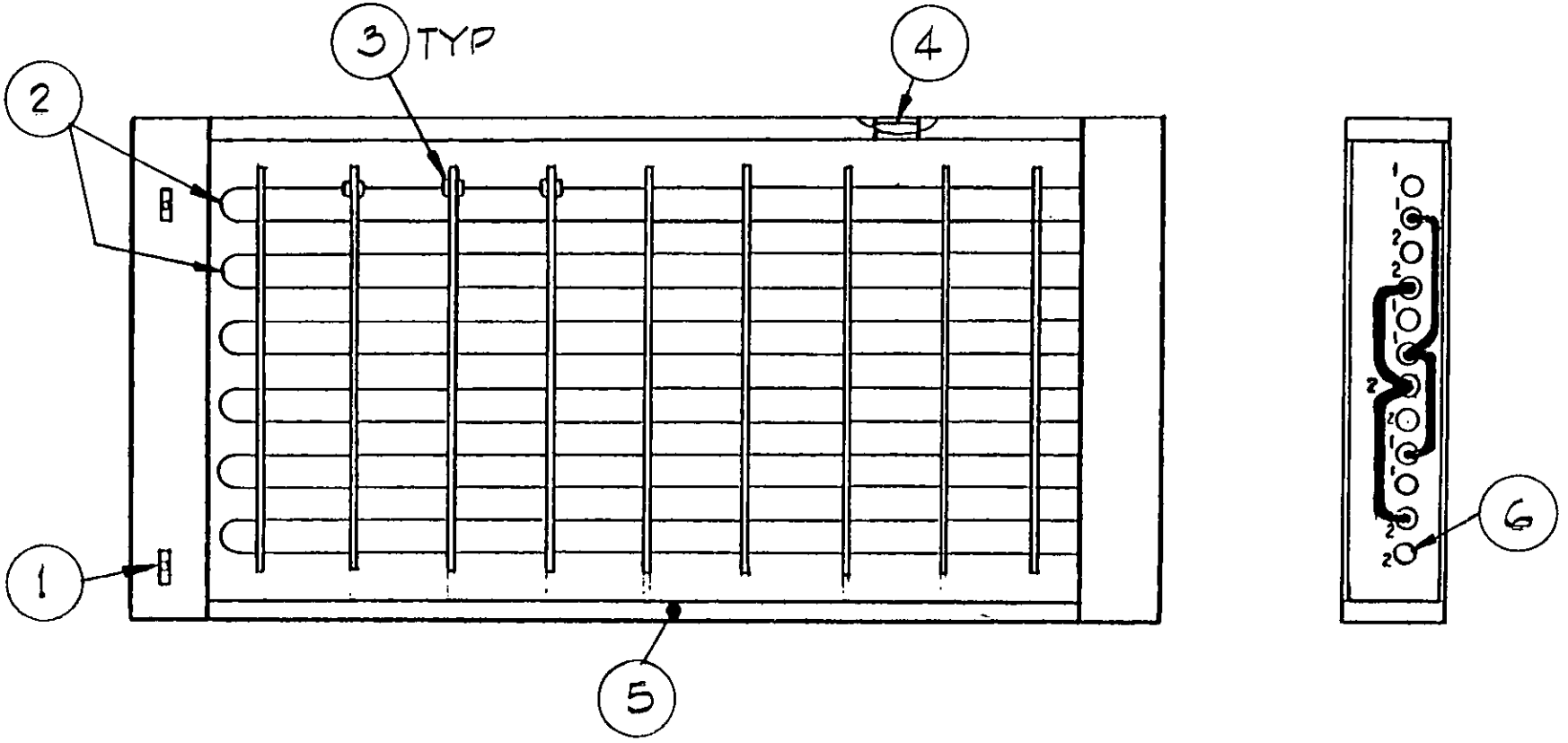
6. If the return bends of the coil are to be insulated, the center insulator must be carefully positioned in the coil before it is passed through the heater. The insulator should be placed on the straightened section of coil, so that the resistance wire lays in the groove of the insulator, and the wire must then be bent down sharply through the grooves at the ends of the insulator. It is important that the wire passing through the end groove of the insulator be centered on the adjacent windings of the coil. If the coil is to receive additional return bend insulators, it should be similarly formed about them before the return pass of the coil through the heater is commenced.

7. The male half of the phenolic terminal insulator bushing must be placed in the terminal pan from the side internal to the duct, before the coil terminal is passed through the terminal pan. (If the terminal pan has been removed, all of the coils should be strung before this phase of the job is attempted). Care must be taken that the terminal is completely seated into this section of the insulator bushing, so that the terminal is prevented from rotating when its hardware is installed.

8. The terminals are fastened into their insulator bushings by a nut tightened* down against a washer on top of the female section of the bushing. It is essential to insure that the terminal is completely seated into the bushing so that it is prevented from turning.

*Bushing may be cracked if over-tightened.

FIGURE 3.22b
OVERHEAD HEATER



DO NOT SUBSTITUTE A 8/12 KW HEATER, THE CAR WILL NOT OPERATE PROPERLY

*HAND IS DEFINED LOOKING THROUGH HEATER IN DIRECTION AIR FLOWS. RIGHT HAND TERMINALS MEAN RIGHT HAND HEATER.

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1	1	Overhead Htr. Bank, Complete, 480V, 10/10 KW	Safety	B4319-1	25P9011518	
2	6	3.3-KW Heating Element 480V	Safety			
3	156	Insulator, Porcelin	Safety			
4	1	HI Temp Limit Thermostat, 200° Close on Rise	Texas Inst.	C4391S7442-06A	25D4013801	
5	18	Duct Clip	Safety	T-7744		
6	6	Lug High Temp (For Car Wiring)	Amp	323680	25D9000660	

3.6.2 Floor Heat

There are two general approaches used on the floor heat system. (Also refer to Section 3.2)

Room Heat

Each of the 18 rooms of the car (10 roomettes, 6 bedrooms, public toilet and porter's room) has a 240 volt, individually thermostatically controlled heater. The thermostat is in-line with the element. Each room is separately protected with its own circuit breaker, mounted inside the wall between room and hallway. (See fig. 3.23), which is accessed from the hall outside the room. In addition, each room has an OFF-AUTO switch, which is merely an OFF/ON switch to turn the heat off should the room thermostat fail.

Each room heater is equipped with a high temperature cutout, set to 135°F, to turn it off should it get excessively hot.

The contactors FH1 (bedrooms) and FH2 (roomettes, toilet and porter's room) control the 240 volt feed to the busses feeding the room heat, and are energized if the outside car temperature is below 70°. Room Floor heat power comes from the secondary of 3 delta connected 480/240 volt transformers.

Hall Heat

The hall is equipped with single stage 480 volt 3-phase floor heaters, fed from the FH3 contactor. This contactor is controlled by the hall heat thermostat.

Heater Construction

The floor heater assemblies consist of 2 of the familiar strip heater elements, connected in series. These are in turn housed behind a grill assembly. Room heaters are also equipped with a high limit thermostat to prevent excessive grill temperatures should air flow be blocked. Refer to Fig. 3.24.

Thermal Characteristics

Strip heaters are constant wattage devices which produce the same heat output regardless of surrounding air temperature. On these heater assemblies, if the grill is covered, the temperature will continue to climb and can become dangerously high. For this reason, each of the room heaters is equipped with a high limit thermostat, (set at 135° for Beech Grove units and 200° for Vapor units) to prevent excessive grill temperatures if the grill should be covered and stop air flow. Placement of this thermostat is critical; IT MUST NOT BE MOVED NOR ADJUSTED.

Mounting

Strip heaters are high temperature devices and accordingly are mounted on porcelain secondary insulators. These provide both electrical and thermal insulation. Be careful, the element body can be live.

Wiring

Strip heater elements are wired either single or in series-connected groups of two to obtain the necessary wattage. This connection must not be disturbed. Jumping out an element in a series connection will greatly increase the heat output of the assembly, and is likely to damage the interior car finish from overheating. Strip heater assemblies operate on either 480 or 240 volts; each assembly is single phase. Refer to figure 3.24.

Terminals

Because of the high element operating temperatures, of strip heaters, care must be taken when servicing the heater to only use high temperature silicone wire, high temperature lugs and insulating tape. Regular components must not be used since they will either melt, or weaken from the heat. See figure 6.1 and 6.3 of the main manual.

Maintenance

In the periodic checks of the heating system for grounds, as described in the maintenance section chapter 15, the system must read at least 3 MEG to ground with all heater elements in service. Before MEG tests, operate car heat for at least 2 hours. This is necessary to drive moisture from the elements, which might otherwise give erroneous low meg readings.

Strip heaters are easily changed in the field. Use an exact replacement; the wrong element will cause the heater assembly to overheat or underheat. Never jumper out an element: the remaining elements will get very hot, will damage the heater and side wall of the car, and could cause a fire. Likewise, never jumper out or adjust the high limit thermostat.

For tests of the complete heating system, refer to test spec PQ-79-1 test 3.3, 3.4, 3.5 and 3.9

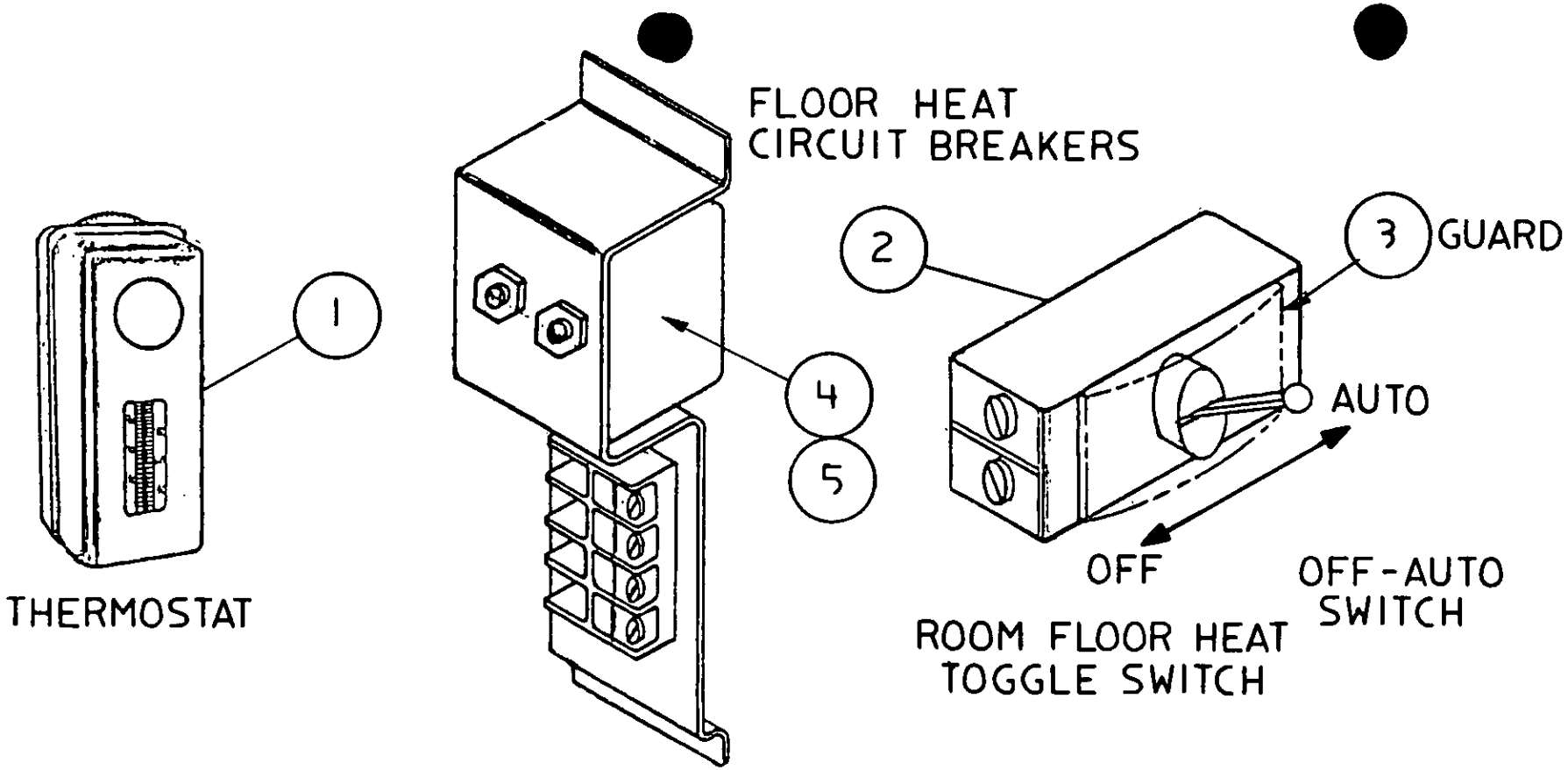
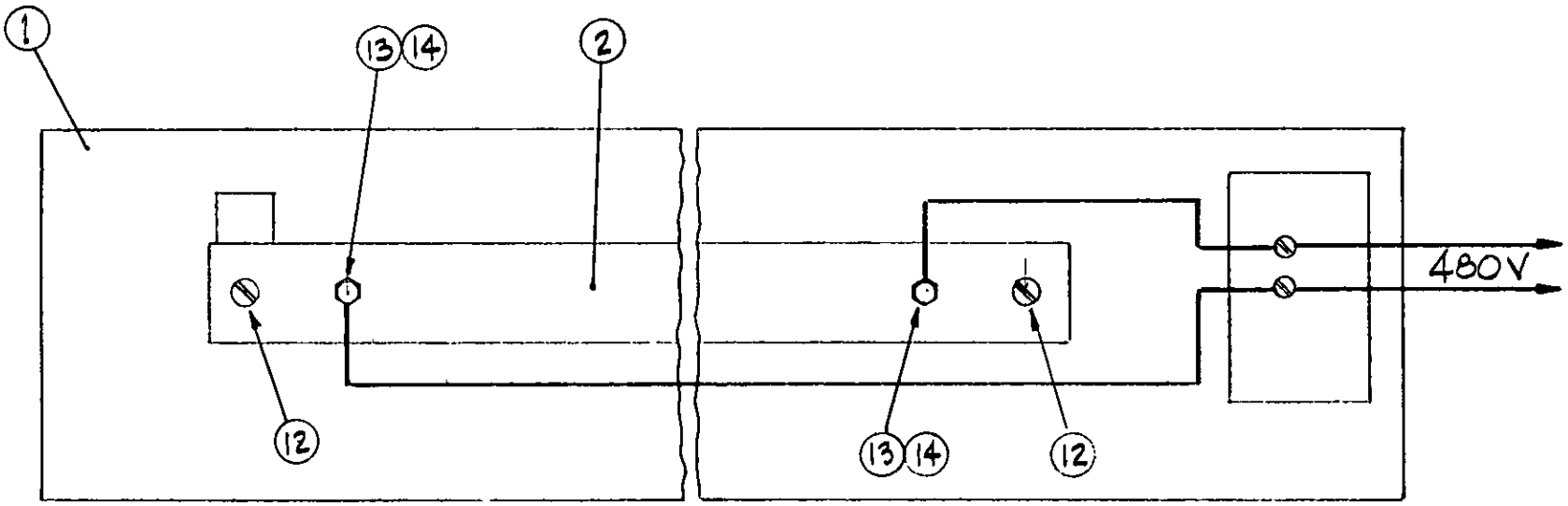
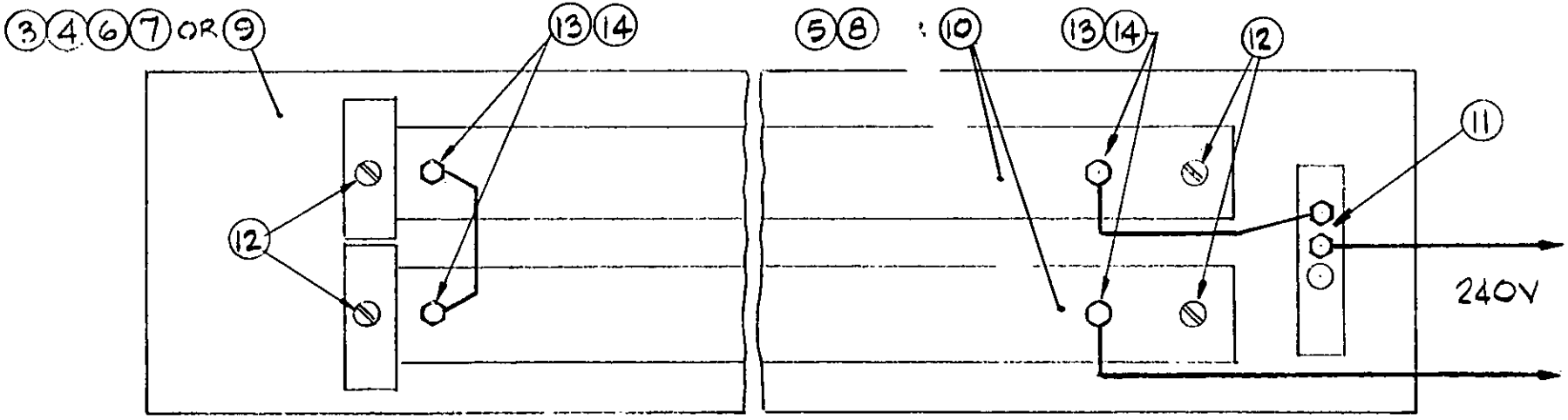


Figure 3.23
ROOM HEAT LOCAL CIRCUIT BREAKERS & CONTROL PARTS

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1	1	Room Thermostat	Chromolox	WR-80	25K9011822	
2	1	Room Floor Heat Off/Auto Toggle Switch DPDT	Arrow Hart	80421	25L9011567	
3	1	Guard For Item 2 Switch Lever	Cutler Hammer	8492K1		
4	2	Push-Pull Circuit Breaker - 1 Pole 3.0A (Porter room and Toilet)	Potter Brumfield	374-203-101		
5	2	Push-Pull Circuit Breaker - 1 Pole 5.0A (Roomette and Bedroom)	Potter Brumfield	449-205-101		
6	1	Sign "Off-Auto"	----	----	23T5005140	
7	1	Sign - Room Feature Instructions - Bedroom	----	----	23K5005139	
8	1	Sign - Room Feature Instructions - Roomette	----	----	23N5005138	



HALL HEATER



BEDROOM, ROOMETTE, TOILET & PORTER ROOM HEATER

FIG. 3.24A
TELEWELD FLOOR HEATERS

Figure 3.24B
TELEWELD FLOOR HEATERS

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1		Floor Heater Assby., Hall, 500W, 480V	Teleweld	325-054-1	25P6003522	
2		Element for Item - 1, 500W, 480V, 30 1/2"	Chromalox	S-3075VW		
3		Floor Heater Assby., Roomette, R.H. Term 650W, 240V	Teleweld	325-052-1 RH	25B6003520	
4		Floor Heater Assby., Roomette, L.H. Term 650W, 240V	Teleweld	325-052-1 LH	25B6003520	
5		Element for Item 3 or 4: 325W, 120V, 25 1/2"	Chromalox	S-2575W		
6		Floor Heater Assby., Bedroom R.H. Term 900W, 240V	Teleweld	325-053-1 RH	25X6003518	
7		Floor Heater Assby., Bedroom L.H. Term 900W, 240V	Teleweld	325-053-1 LH	25X6003518	
8		Element for Item 6 or 7: 450W, 120V, 30 1/2"	Chromalox	S-3075VW		
9		Floor Heater Assby., Toilet and Porter Room, 400W, 240V	Teleweld	325-055-1	25P6003519	
10		Element for Item 9, 200W, 120V, 12"	Chromalox	S1225W		
11		Thermostat, High Limit, 135° for item 3, 4, 6, 7 or 9	Teleweld	30002-000		
12		Insulator, Element	Chromalox	PCN 255716	25X9012240	
13		Insulator, Electrical Stud	Chromalox			
14		Lug, High Temperature Electrical	AMP	323680	25P9000660	

3.6.3 Antifreeze Protection

The cars are equipped with an antifreeze protection system similar to that of the later series cars. The only difference is in the location of the antifreeze circuit breakers, which on the 2900's are located in the electric locker. Refer to Section 6.7 of this manual for contactor and circuit breaker details, and section 3.6.3 in the main manual for heat tape installation details.

3.7 Air Distribution Dampers

3.7.1 Fresh Air Intake Damper

The cars are not equipped with fresh air intake dampers.

3.7.2 Annemostats

Refer to the main manual, section 3.7.2 for details.

Section 3.8 Drawing List

Function	Drawing Number
A/C & Temperature Control Schematic	D-04-440-Sht. 6
Fans & Auxiliaries Schematic - 2900-41	D-04-440- 9
Fans & Auxiliaries Schematic - 2980-97	D-04-440- 10
Floor Heat Schematic - 2900-41	D-04-440- 7
Floor Heat Schematic - 2980-97	D-04-440- 8
Antifreeze Schematic - 2900-97	D-04-440- 5
Temperature Control Panel Schematic	D-01-473
Temperature Control Panel	E-00-474

Chapter 4 Lighting

List of Illustrations

Chapter 4 Lighting

4.1 General

The HEP converted cars are equipped with both incandescent and fluorescent lighting. While most fixtures are original to the cars, many have been replaced as part of the HEP upgrade. Whenever possible, standard Amtrak fixtures were used in these new installations, using both Amfleet and Superliner parts.

Convenience receptacles were replaced as required in each room. They are not GFCI protected, unlike later series cars.

4.1.1 Power Source

All car lighting power comes from either of two sources, 120 VAC or 75/64 VDC. When the car is on 480V power, most lighting operates on 120 VAC, a few miscellaneous lights operate from the 75/64 VDC source. When the 480V power is off, emergency lighting is powered from the 64 VDC battery.

Three 480V to 120V 5KVA transformers supply the 120 VAC lighting power. The battery charger supplies about 75 VDC (ranging from 60 - 80V depending upon outside temperature and state of battery charge) to the DC circuits when the car is on 480 power, and 64 VDC when trainline power is off and the battery is still fully charged. Refer to Chapter 6.4 for details.

Lighting and convenience outlet circuits are individually protected by circuit breakers on the lighting switchboard. The 120V transformer primary and battery charger circuit breakers are on the 480V switchboard.

4.1.2 Controls and Operation

In normal operation of the car, all lighting circuit breakers are to be on. Switches are provided for turning OFF the car consist signs and alternate passageway lights. They are located in the switch locker on the 2900-41, and in the passage near the annunciator panel on the 2980-97.

To shut down a car at the end of a run, turn off only the 2 circuit breakers: Main AC Lighting and Main DC Lighting, located at the top right of the lighting switch board. See figure 4.1. All other breakers should remain on at all times.

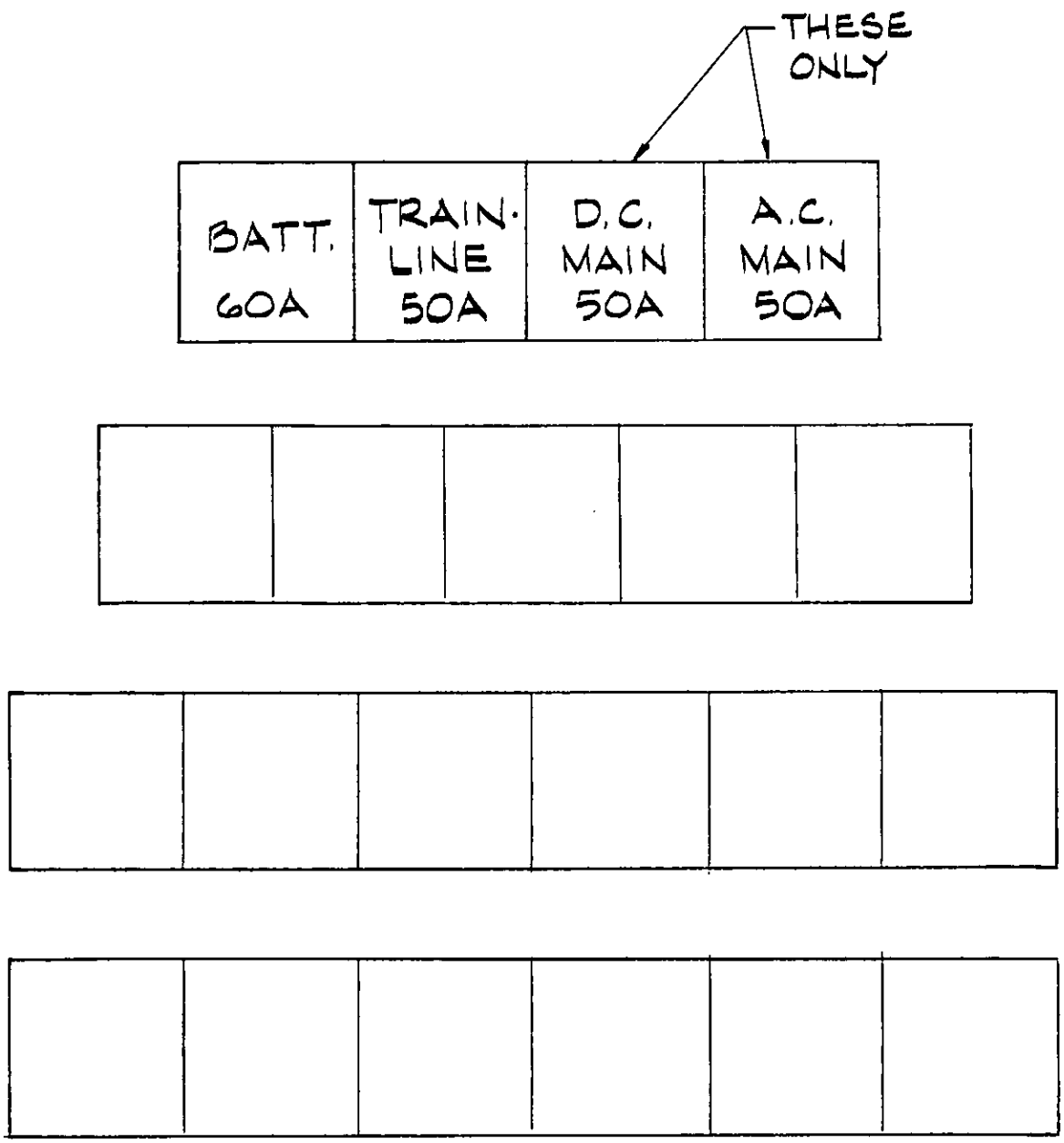


FIGURE 4.1
CAR LIGHTING SHUTDOWN

TO SHUT DOWN CAR, TURN OFF ONLY MAIN D.C. AND MAIN A.C. LIGHTING BREAKERS.

4.1.3 Night Lights

All cars are equipped with night lights: see figure 4.2. Alternate passage lights can be switched off; some bedroom and roomette fixtures are equipped with 6 watt blue bulb in addition to the main lamp. This can be switched on to give a low level of light. Note that the passage night lights are activated by merely flipping one toggle switch at the lighting switchboard; no breakers are involved. Refer to test 4.1 of PQ-79-1 for night light system tests.

4.1.4 Emergency Lights

All cars are equipped with emergency lights (see figure 4.3) which will stay on for several hours after HEP power goes off. Two approaches were used: 1) separate set of emergency lamps which are used only if AC power is off, or 2) a transfer contactor circuit in which if 120 VAC is lost, the circuit is reconnected to the 64 VDC battery. Two transfer contactors (TR1, TR2) are used to provide the emergency lighting switching.

A load shed relay is incorporated into the lighting circuitry of the cars. Its purpose is to disconnect some of the less essential lighting loads from the battery during a prolonged power outage, thus extending the length of time the critical lighting loads will stay on. Passage and vestibule lights as well as marker and electric locker lights stay on after other loads are disconnected. The load shed relay is part of the battery charger, and is explained in section 6.4.

Refer to PQ-79-1 section 4.1 for emergency lighting tests.

Figure 4.2
NIGHT LIGHTS

SERIES	LIGHTS	SWITCH LOCATION
2900-41	Passage (Alternate Fixtures)	Switch in Switch Locker
2980-97	Passage (Alternate Fixtures)	Switch near Annunciator
2900-41 & 2980-97	Bedrooms A,C,E 2 sofa, + Upper Berth Bedrooms B,D,F Reading, Upper & Lower Berths, Roomette Berth	Switch part of each fixture

Figure 4.3
EMERGENCY LIGHTS

SERIES	LOAD SHED LIGHTS	NON LOAD SHED
2900-41 & 2980-97	Bedroom Ceiling, Roomette Ceiling	Passage, Vest., Toilet, Number Signs, Blind end

4.2 Lamp Schedules

HEP connected cars use an assortment of lamps for the lighting system. Refer to figure 4.4 in the main manual for a lamp and part number list, and figure 4.5 for lamp schedule by car:

2900-41: See 2880-94 & 2900-41
2980-97: See 2457-60 & 2980-97

Do not substitute lamps unless absolutely necessary. The wrong lamp can damage a fixture, especially if it has a plastic lens. Fluorescent Lamp starters are also listed on figure 4.4 and 4.5. Use only the correct starter for a given lamp.

4.3 Interior Fixtures

Refer to main manual:

2900-41: See 2880-94 & 2900-41
2980-97: See 2457-60 & 2980-97

4.4 Marker Lights

The cars are equipped with the standard HEP marker lights; see main manual for details.

4.5 Interior Consist Signs

These signs are non-illuminated and are located on the body end doors. They are the type which uses cardboard number-bearing cards for displaying the car number.

4.6 Exterior Consist Signs

The cars are equipped with illuminated car consist signs, located one in the general toilet, and one in the porter room. Some of the signs are original while some are new Translite #FH4579-1, for replacement details, refer to the main manual.

4.7 Switches

Refer to the main manual.

4.8 Convenience Outlet

Each roomette, and each bedroom annex is equipped with a convenience outlet. Most of them are original to the car. These receptacles <u>are</u> <u>not</u> GFCI protected, unlike later car series.

Should a receptacle require replacement, use a grounding-type receptacle as described in the main manual.

4.9 Drawing List

Function	Drawing #
AC Lighting Schematic, 2900-41	D-04-440-Sht 11
AC Lighting Schematic, 2980-97	D-04-440-Sht 12
DC Lighting Schematic, 2900-97	D-04-440-Sht 13
Razor and Auxiliaries, 2900-41	D-04-440-Sht 9
Razor and Auxiliaries, 2980-97	D-04-440-Sht 10

CHAPTER 5 COMMUNICATIONS AND PUBLIC ADDRESS

CHAPTER 5 COMMUNICATIONS, PUBLIC ADDRESS SYSTEM

5.1 General

Several different types of communication systems are employed on the HEP converted cars, including conductor signal, annunciator and call buzzer. The conductor signal is a new installation, while the others are original to car. These cars are not equipped with a PA system, though they will operate in a train so equipped.

5.1.1 Conductor Signal

Each car is equipped with 2 conductor signal pushbuttons, one at each end of the car. They allow a communicating signal to be given the locomotive cabs. Power is from the DC main breaker, via a fuse pair on the loop relay panel, and finally a diode on the loop relay panel. The number 22 wire of the 27 point trainline cable carries this signal to the locomotives. Refer to test spec PQ-79-1 test 2.4, and section 6.6.4 for loop relay details.

If the conductor signal button should weld closed and/or the CS diode fail (short or open, with evidence of heat) the likely cause is 1) shorted trainline wires 22 to 2, and 2) shorted suppressor diode on locomotive magnet valve. Locate the fault before replacing the diode or signal button.

DESCRIPTION	MANU	MANU #	AMT #	AMMS #
Conductor Signal Pushbutton	Per Amt. Drawing	SK-A-120980	23P9007473	
Conductor Signal Diode 6A 800 P1V	Inter-national Rectifier	60S8	25H9008685	

5.1.2 Public Address and Intercom

These cars are not equipped with a public address - intercom system. However they can be operated in a train which is equipped - these cars will carry the signal through.

5.2 Tape Player

N/A.

5.3 Public Telephone

N/A.

5.4 Operating Instructions Audio System

N/A.

5.5 Instruction Manual Safetran System

N/A.

5.6 Annunciator

The annunciator system on these cars is similar to that of the standard installation as described in the main manual. However, these cars use a different power supply. The transformer and rectifier are the same, but they are mounted within the lighting switchboard, and only the transformer primary is protected with a fuse. This small cartridge fuse is accessed from the front of the lighting switchboard.

Cartridge Fuse, 1A, 250V Fusetron - Slow Blow	Bussman	MDL-1

5.7 Drawing List

Function	Drawing #
27 Point Trainline Schematic	D-04-440-Sht 14
Annunciator and Auxiliaries, 2900-41	D-04-440-Sht 9
Annunciator and Auxiliaries, 2980-97	D-04-440-Sht 10

CHAPTER 6 ELECTRICAL SYSTEM

CHAPTER 6 ELECTRICAL SYSTEM

LIST OF ILLUSTRATIONS

CHAPTER 6 ELECTRICAL SYSTEM

6.1 General

These cars have the standard HEP electrical system. Refer to the main manual for general details, such as wire, lugs, terminal blocks, etc.

6.2 480 Volt Main Power Distribution and Cable System

See main manual for details.

6.3 27 Point Trainline Circuits

The 27 point trainline cable system is the basic HEP system with 3 exceptions:

1. No PA unit is used.
2. The ground for the shielded cables is in the B-end 27 point J-box, rather than at the PA unit, as in later series cars with PA units.
3. No pressure switches are used in the brake applied and released wires, #20 and 19 respectively. Refer to the main manual for all other details.

6.4 Battery and Battery Charging System

The standard HEP battery and charger are used either McGraw Edision or NiFe. One system difference is that these cars (2900) are not equipped with a Low Voltage Relay (LVR), unlike later series cars.

6.5 Transformers

On all types of HEP converted cars, transformers are used to convert 480V, 3 Phase power to the proper voltages as required. Efforts have been made to use standard transformers as much as possible. Refer to figure 6.1 for transformer usage, 6.2 for connections, and Section 6.9 (of main manual) for trouble shooting procedures.

6.5.1 External Transformers

The larger transformers are mounted under in groups of 3. They are safety hung, resting on a cradle, with the bolts in from the top.

Each car has 3 delta/delta connected 480/120, 5 KVA lighting transformers. Car lighting, antifreeze systems, and water cooler are fed from them.

In addition, each car has 3 delta/delta connected 480/240 5 KVA floor heating transformers.

These undercar mounted transformers require little maintenance. However, it is extremely important to keep them dry inside. RTV is used to caulk all joints of the transformer cases, as well as all conduit entry points. Should water get into a transformer, after a time the bottom of the transformer will be blown off by the steam formed. See figure 6.28 for sealing procedures.

In replacing transformers of a delta (or wye) connection, all 3 transformers must be identical. Do not mix manufacturers. The slight differences between "equal" transformers of different manufacturers will make one run hot, and fail.

6.5.2 Internal Transformers

Small control transformers are mounted inside the car in the electric locker. Refer to figure 6.1 and 6.2. In addition, a control transformer is used in the water heater (see Chapter 12.3) and a filament transformer is used in the lighting switchboard for the annunciator system (see Chapter 5.6).

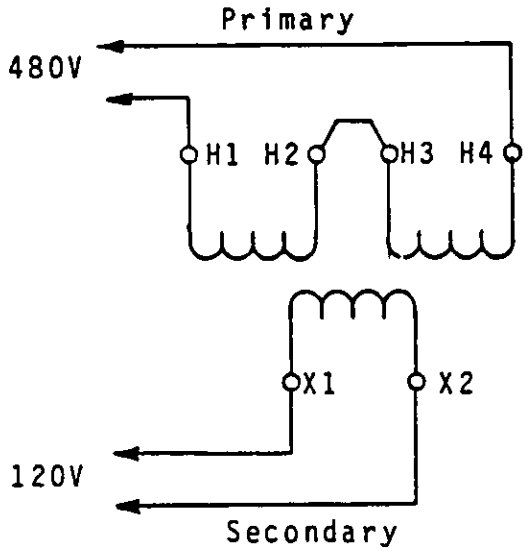
Figure 6.1
TRANSFORMER USAGE

ITEM	DESCRIPTION			MFG	MFG #	AMT #	AMMS #
	VOLTAGE	RATING	USE				
1	480/120	5 KVA	Lighting	Westinghouse	6E5657	25L9011682	
2A	480/240	5 KVA	Floor Heat	Westinghouse	6E5658	25E9011546	
2B	480/240	5 KVA	Floor Heat	Acme	T-1-53014		
3	480/120	250 VA	Temp. Controls and Shunt Trip	Acme	TA-1-81213	25D9008669	
4	480/120	150 VA	Water Heater Control	Micron	B-150BTZ13		
5	120/6.3	10 A	Annunciator and Buzzer	Stancor	P6464	25D9010468	

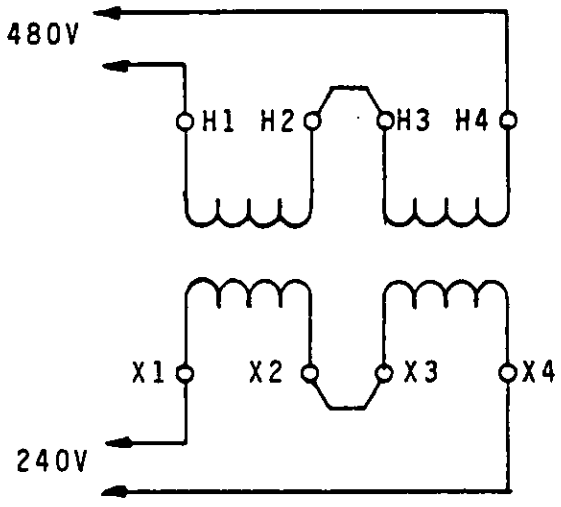
DO NOT SUBSTITUTE MOUNTINGS ARE DIFFERENT; ELECTRICAL DIFFERENCES AS WELL.

NOTES:

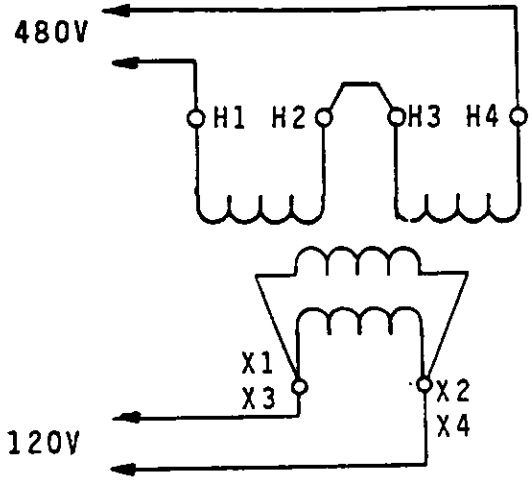
1. 2B was the original transformer installed. 2A can be used as a substitute provided all 3 transformers are changed over. Do not mix; they are a different shape and are not electrically identical. New mounting holes may be required as well.



ITEM 1



ITEMS 2A & 2B



ITEMS 3 & 4

NOTE:

H - ARE ALWAYS PRIMARY
X - ARE SECONDARY

FIGURE 6.2

TRANSFORMER CONNECTIONS

Fig. 6.3 Undercar Transformer Sealing Procedures

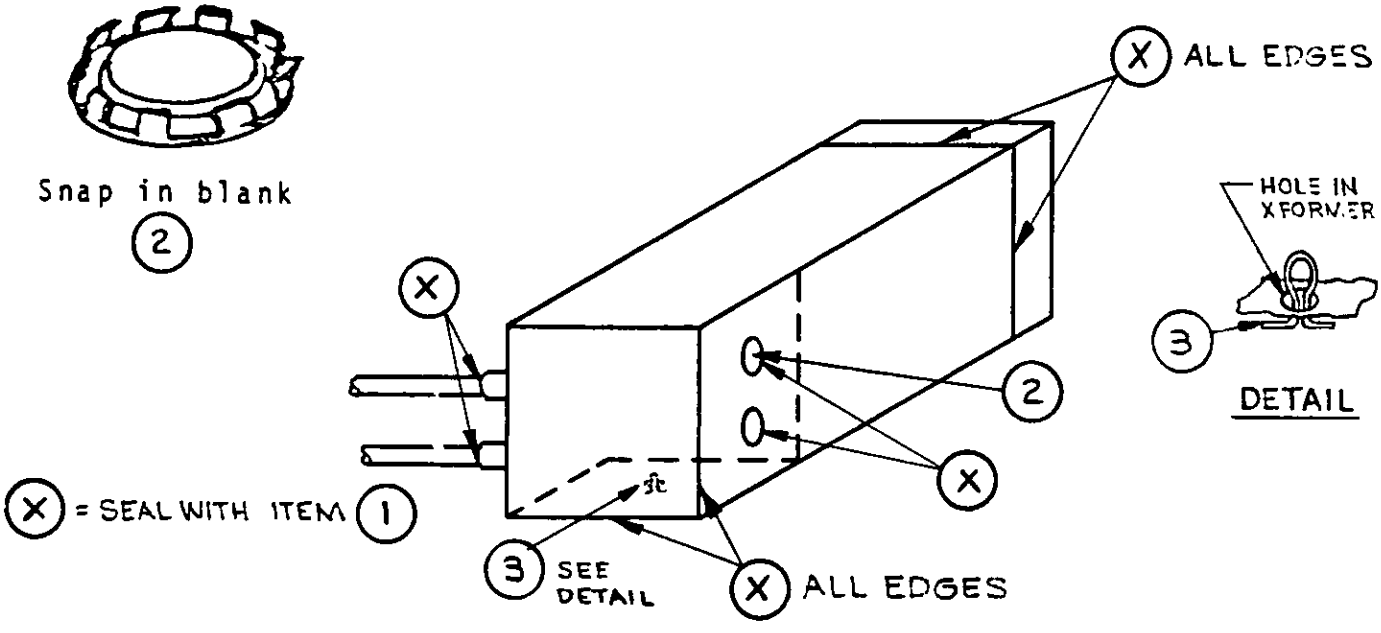
The transformers used undercar are not inherently watertight. If moisture enters the enclosure, it can cause a ground or phase to phase fault at the connections or cause a winding to fail. To prevent this, several things are required:

1. Drill 1/4" drain hole-apply cotter key in bottom of wire compartment.
2. Seal all seams, knockouts, and wire entries with RTV or equivalent (clean before applying) to prevent entry of water marked (X).
3. If knockouts are missing, close holes with snap in blanks (bend back pronts), then seal with RTV.

This procedure should be followed whenever a transformer is replaced, or the terminal box opened. In addition, the transformer should be resealed whenever existing seals are ineffective or damaged.

Materials

Item	Description	Manu	Manu #	Amt #
1A	RTV Caulk, White	GE	RTV-102	
1B	RTV Caulk, Black	GE	RTV-103	
1C	RTV Caulk, Translucent	GE	RTV-108	
2	Snap-in Blank, 3/4"	Thomas & Betts	1452	
3	Cotter Key, 3/16" x 1"	McMaster	98311A510	



6.6 Switch Locker

The switch locker contains the daily - used controls of the car including: 120/64 volt lighting switchboard, temperature control panel and associated shunt trip pilot light. In addition, 2900-41 cars have toggle switches to operate car loading number signs and passage night lights.

The loop relay panel is located in the bottom of the switch locker.

6.6.1 Lighting Switchboard

The lighting switchboard consists mostly of lighting controls but also includes breakers for razor receptacles, fans, etc. The marker light selector switch is located on this panel. The AC main and DC main breakers are located at the top right of the panel.

All circuit breakers except the battery trainline should be on at all times when the car is on power.

NOTE: when a car is laid up after the end of a run, the only breakers to be turned OFF are 2: The DC MAIN and AC LIGHTING MAIN. These are the top breakers at the right. No other breakers need to be turned OFF at layup.

For circuit breaker names and part listing refer to figures 6.4 and 6.5.

For switchboard tests, refer to test PQ-79-1, number 4.1.

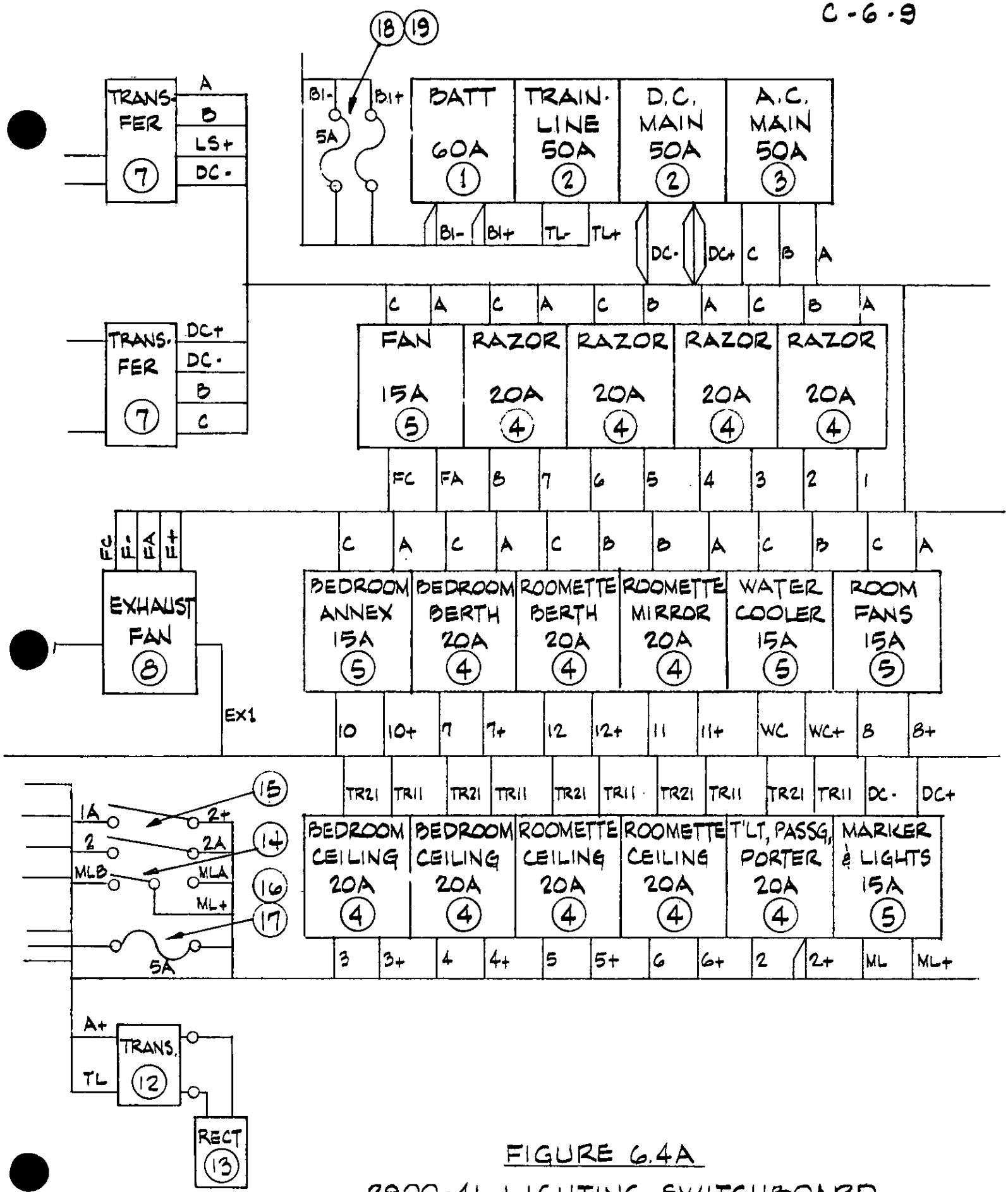


FIGURE 6.4A

2900-41 LIGHTING SWITCHBOARD

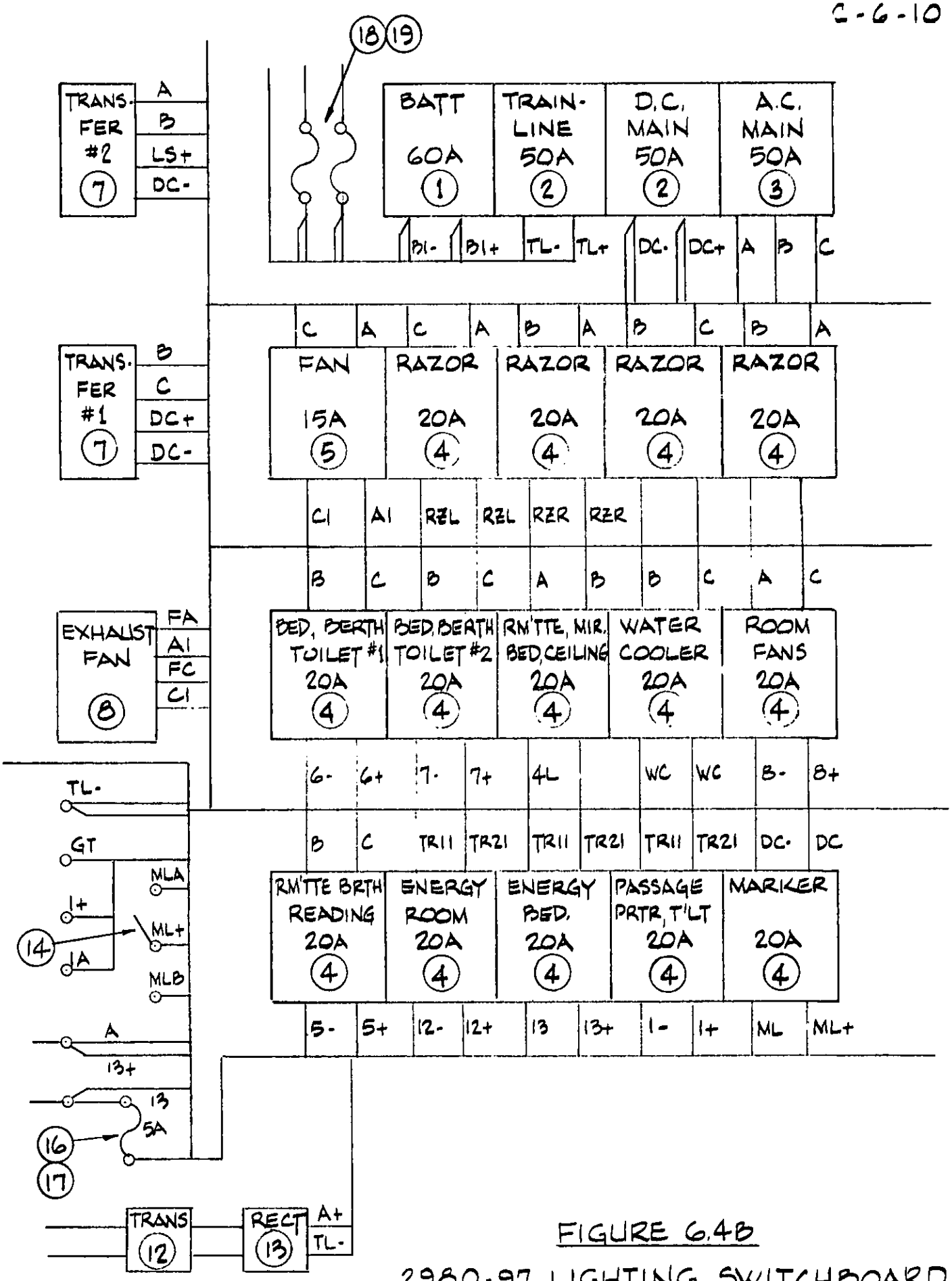


FIGURE 6.4B

2980-97 LIGHTING SWITCHBOARD

Figure 6.5
LIGHTING SWITCHBOARD PART LIST

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1		Circuit Breaker, 60A, 240V, 2 Pole	Westinghouse	EB2060	25L4010715	
2		Circuit Breaker, 50A, 240V, 2 Pole	Westinghouse	EB2050	25H9009075	
3		Circuit Breaker, 50A, 480V, 3 Pole	Westinghouse	EHB3050	25X4010821	
4		Circuit Breaker, 20A, 240V, 2 Pole	Westinghouse	EB2020	25D9008672	
5		Circuit Breaker, 15A, 240V, 2 Pole	Westinghouse	EB2015	25N6003545	
6		----				
7		Contactor, Transfer, DPDT w/120V Coil (for parts, refer to main manual figure 6.44)	Vapor	37741141	25H4013800	
8		Contactor, 3 Pole, 480V, NEMA-1	GE	CR205C022	25B9011693	
9		Coil, Contactor for Item-8	GE	15D21G22		
10		Contacts, for Item-8	GE	546A301 G2		
11		----				
12		Transformer, Filament, 120V to 6.3 VAC 10 Amps	Stancor	P-6464		
13		Rectifier, Bridge, 600 PIV, 10 Amp	Westinghouse	MB12A10V60	25N9010944	
14		Switch, DPDT Center Off	Arrow Hart	80638D		
15		Switch, SPST	Cutler Hammer	82600		
16		Fuse, 1A, 250V SLO BLO Cartridge	Bussman	MDL-1		
17		Fuse Holder, Panel Mount Space Saver 1/4 x 1 1/4 Fuse	Bussman	HTA	25P9008666	
18		Fuse, 10A, 250V, Cartridge, Type Non	Bussman	NON-10		
19		Fuse Holder, 0-30A, 250V, 2 Pole	Bussman	2604	25P9008667	

6.6.2 Temperature Control and Shunt Trip Pilot Light

The temperature control panel is located below the lighting switchboard. It has only one control; the heat-off-cool selector which selects temperature control setup.

NOTE: The selection between heating or cooling is not automatic - this switch must be in the correct position. In the off position, the car fans are shut off and the car is in layover and enables floor heat to maintain 50°F. Day position is 2° cooler than night position.

The pilot lights illuminate to indicate a specific function is requested by the temperature control panel. Refer to Chapter 3.2 and 3.3 for details.

The temperature control panel is equipped with 30 minute cool override feature and a high pressure/low pressure (HP/LP) warning light which lights and stays on when the A/C system has shut down due to a problem. For further explanation of heating and A/C control, see Chapter 3.2.

The thermostat plug on the temperature control panel is intended for test purposes. When used in conjunction with the "BRUSS BOX" quick and complete tests of the thermostats and the heating, cooling and systems can be effected.

The shunt trip pilot light, located adjacent to the temperature controls, lights to indicate power is available for the shunt trip circuit on the overhead heater. This is important for passenger safety, and should the light not be lighted, the cause should be located and corrected. Refer to Chapter 3.2 for details.

6.6.3 GFCI Receptacles

N/A.

6.6.4 Loop Relay Panel

This panel provides power for the door control and brake applied and released trainline to the locomotive. It is the power source for the conductor signal push button. The 3 diodes on the panel prevent backfeed between cars; one is for the conductor signal, and one each for the loop relays.

Power for the panel is provided by the battery charger system, via the 2 fuses located on the panel. The negative fuse of the pair provides the route for the car battery negative to the 27 point #2 wire.

Refer to figure 6.6 for the loop relay parts, and test spec. PQ-79-1 test 2.4 for tests.

6.6.5 Food Service Switchboards

N/A.

FIG. 6.6
LOOP RELAY PANEL

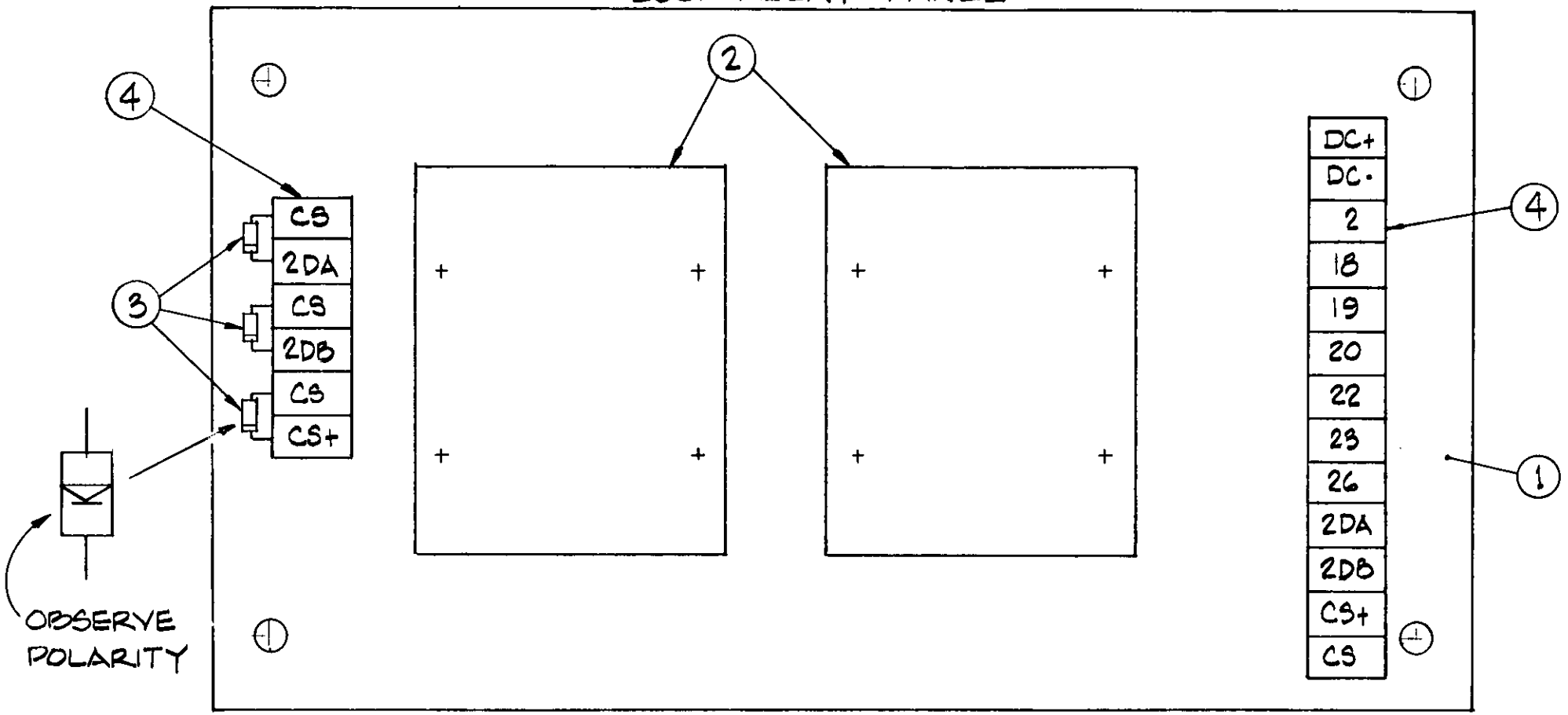


Figure 6.6
LOOP RELAY PANEL PART LIST

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1		Loop Relay Panel, Complete	Beech Grove	---	---	
2		Relay, 4 Pole, 64 VDC Coil	Struthers Dunn	8DXX183	25L4010779	
3		Diode, 6 Amp, 800 PIV	International Rectifier	60S8	25H9008685	
4		Terminal Block Strip, Series B, 600V	Allen Bradley	1492CD3-130	25A9003953	

6.7 Electric Locker

The electric locker contains the high power electrical controls for the car, including the 480V switchboard, A/C starter panel, heating and antifreeze contactors. Also located there are the antifreeze circuit breakers, and the temperature control and shunt trip transformers.

The general approach used in electric locker panel construction is the "super panel", incorporating the 480 switchboard and all contactor panels on one assembly. Refer to figure 6.7.

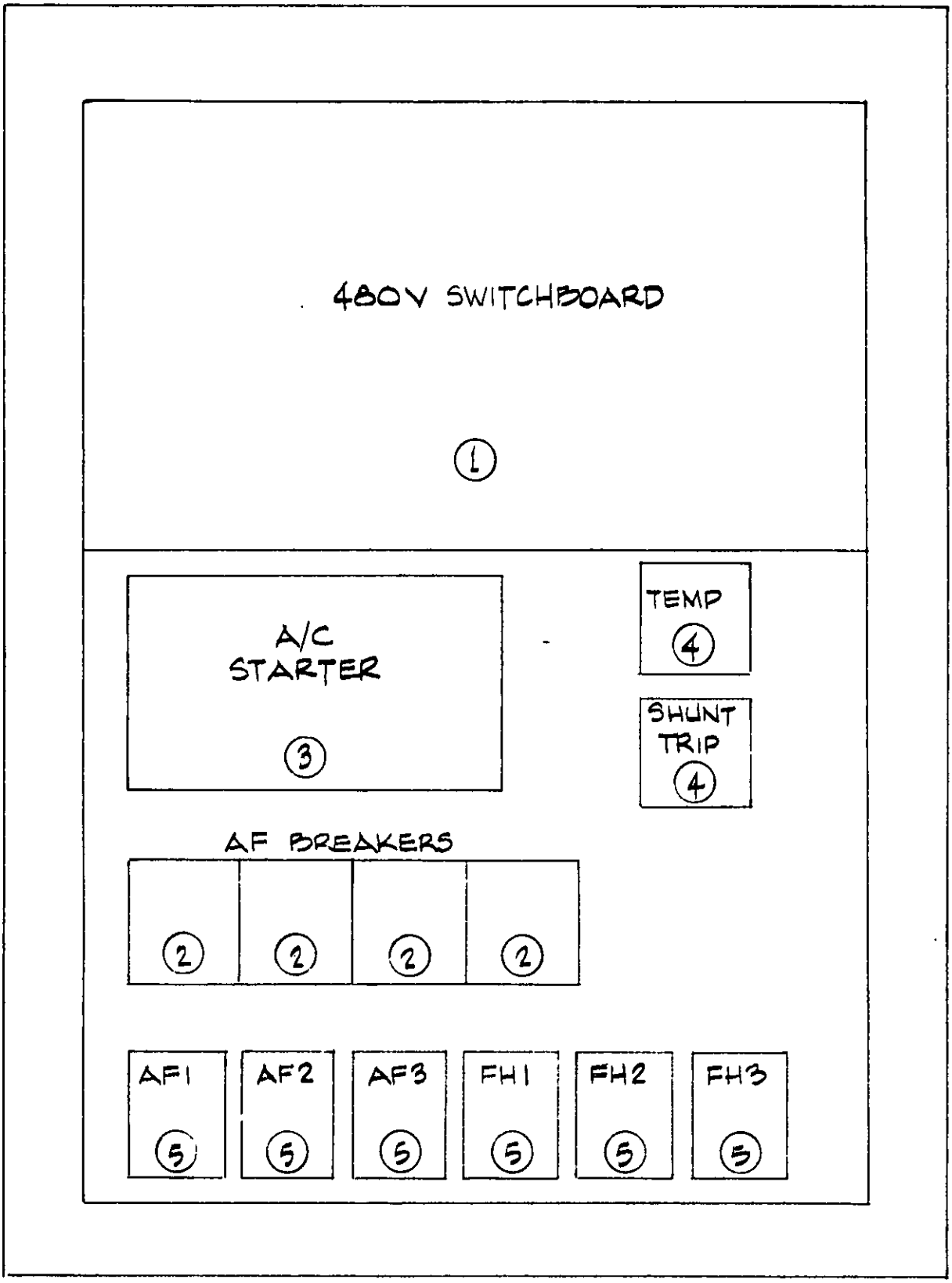


FIGURE 6.7A

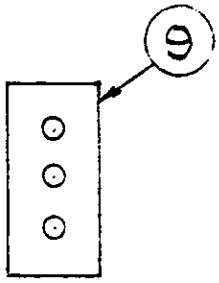
ELECTRIC LOCKER COMPONENTS

Figure 6.7B
ELECTRIC LOCKER COMPONENTS

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1		480V Switch Board (See Figure 6.8)	Beech Grove	---	---	---
2		120V Antifreeze/Temp Control Bkr. Panel (See Figure 6.8)	Beech Grove	---	---	---
3		A/C Starter Panel	Safety	B-4290-1	25D9011510	
4		Control Transformer, 480V to 120V 250VA	Acme	TA-1-81213	25D9008669	
5		Antifreeze/Heat Contactor Panel (See Figure 6.11)	Beech Grove	---	---	---

MAIN	F. H. MAIN	WATER HEATER	LIGHTING
150A	20A	15A	20A
(1)	(4)	(5)	(4)

BATT. CHARGER	FLOOR HEAT-1	FLOOR HEAT-2
10A	20A	20A
(6)	(4)	(4)



COMP.	EVAP.	VAPOR	FL. HEAT HALL	O.H. HEAT
30A	5A	5A	15A	30A
(2)	(7)	(7)	(5)	(3)

AF 1	AF2	AF3	VAPOR	SHUNT TRIP
25A	25A	25A	15A	15A
(10)	(10)	(10)	(11)	(11)

FIGURE 6.8

480V SWITCHBOARD

Figure 6.9
480V SWITCHBOARD PART LIST

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1		Circuit Breaker, 600V, 3 Pole, 150 Amp	Westinghouse	FB3150	25L4010748	
2		Circuit Breaker, 480V, 3 Pole, 30 Amp with 120VAC Shunt Trip	Westinghouse	EHB3030	25K6003515	
3		Circuit Breaker, 480V, 3 Pole, 30 Amp	Westinghouse	EHB3030	25L4010913	
4		Circuit Breaker, 480V, 3 Pole, 20 Amp	Westinghouse	EHB3020	25D4010820	
5		Circuit Breaker, 480V, 3 Pole, 15 Amp	Westinghouse	EHB3015	25H4010749	
6		Circuit Breaker, 480V, 3 Pole, 10 Amp	Westinghouse	EHB3010	25X4010844	
7		Circuit Breaker, 480V, 3 Pole, 5 Amp	Westinghouse	EHB3005	25A9004029	
8		Circuit Breaker, ---				
9		Terminal Block	Marathon	143356	25A7004463	
10		Circuit Breaker, 240V, 3 Pole, 25 Amp	Westinghouse	QC-3025H	25X9011556	
11		Circuit Breaker, 240V, 2 Pole, 15 Amp	Westinghouse	QC-2015H	25P5000198	
12		Clip, Circuit Breaker Holddown	Westinghouse	624B100-G14	25X9010469	

6.7.1 Main 480 Volt Circuit Breaker Panel

Located at the top of the electric locker, this panel contains all the major power circuits of the car. The 480V main breaker can be locked off with a padlock for servicing the car. Refer to figures 6.7 and 6.8 for panel information.

Summary of circuits controlled by this "typical" panel are:

A. Main Supply - 150 Amp. 480 V.
Supplies trainline 480 V power to all the various car services. This breaker must be "ON" for car operation.

B. Heating Transformer Primary - 480 V.
Supplies the 480 to 240 volt heating transformer for floor heat.

C. Water Heater - 15 Amp. 480 V.
Supplies 480 V to Water Heater.

D. Transformer Primary - 30 Amp. 480 V.
Supplies 480 V to the three 5 KVA transformers which convert 480 V 120 V for Lighting Circuits.

E. Battery Charger - 10 Amp. 480 V.
Supplies 480 V power to the battery charger.

F. Floor Heat #1.
Supplies 240 V power to bedroom floor heat.

G. Floor Heat #2.
Supplies 240 V power to roomette floor heat.

H. A/C Compressor and Condenser 30 Amp, 480 V.
Supplies 480 V to Air Conditioning Equipment.

I. A/C Evaporator Motor 5 Amp 480 V.
Supplies 480 V to Blower Motor.

J. Temperature Controls 5 Amp 480 V.
Supplies 480 V to temperature control transformer primary.

K. Hall Heat
Supplies 480 V power to Hall Heat.

L. Overhead Heat - 30 Amp 480 V with 120 VAC Shunt Trip.
Supplies 480 V to O.H. Heating Unit. The shunt trip feature trips the breaker off if the O. H. Heater gets too hot.

6.7.2 Contactor Panels General

Most contactors and contactor panels are located in the electric locker. Exceptions include:

	Function	Location
1.	Exhaust fan contactor EFC	To left of lighting switchboard
2.	Transfer relays TR1 & TR2	
3.	Water heater contactor WHC	water heater

Effort were made to use the minimum number of different contactor types; only six types are used for the entire Heritage fleet.

Refer to figure 6.10 for a list of all contactors, and their function.

A summary of contactor group functions follows:

A. A/C starting panel: (BFMS, RCMS, HC1, HC2)
This panel controls the blower fan, A/C compressor and condenser fan, as well as overhead heat. Refer to figure 6.13, 6.14 here and; sections 6.7.4 and 3.2 in main manual.

B. Other Heating Contactors: (FH1, FH2, FH3)
These contactors are used to accommodate all floor heating requirements. Refer to figure 6.11, 6.12 here and section 6.7.4 and 3.2 in main manual.

C. Antifreeze Contactors: (AF1, AF2, AF3)
A group of 3 contactors controlling the electric heat tape providing freeze protection for the water tanks and under car piping. Refer to figure 6.11, 6.12 here and sections 3.2 and 3.6 and 6.7.4 in the main manual.

D. Exhaust Fan Contactor (EFC)
A contactor used to control the exhuast fans. Refer to figure 6.11, 6.12 here and sections 3.2, 3.5, 6.7.4 in the main manual.

E. Water Heater Contractor (WHC)
This contactor controls the 6KW water heater, and is located nearby. Refer to figure 6.11 and section 12.3 here, and section 6.7.4 in the main manual.

F. Lighting Transfer Relays (TR1, TR2)
These contactors are used to switch on emergency lighting when A/C power goes off. Connections on different car types differ, but must generally connect their lighting loads to 120 VAC when picked up and battery when dropped out.

Contactor TR2 is fed from non-load shed, and feeds vital emergency light loads such as vestibule and passage. Contactor TR1 is used to feed load-shed loads such as roomette and bedroom ceiling lights on 2900-41, and bedroom and roomette emergency lights on 2980-97. Refer to section 6.7.4 of the main manual for maintenance details, and figure 6.10 and 6.11 here for parts.

6.7.3 A/C Starting Panel (Figure 6.13 and 6.14)

This panel controls the blower fan, A/C compressor and condenser fan, as well as the 2 stages of overhead heat.

Overload Relays are used in each of 3 motor circuits. They measure the motor current, and if it exceeds the motor rating, it will cause the corresponding contactor to drop out and prevent motor burnout.

OL1 Blower Fan Motor - Thermal Overload Reset by pressing white button.

OL2 Compressor Motor - Thermal Overload Reset by pressing white button.

OL3 Condenser Fan Motor - Thermal Overload reset by pressing white button.

NOTE: If either OL2 or OL3 trips, RCMS will drop out.

6.7.4 Contactor and Overload Relays

Standard HEP components are used. Refer to the main manual.

Figure 6.10

CONTACTOR FUNCTIONS

BFMS	Blower Fan
HC1	1st Stage Overhead Heat
HC2	2nd Stage Overhead Heat
RCMS	A/C Compressor and Condenser Fan
FH1	Bedroom Floor Heat
FH2	Roomette Floor Heat
FH3	Hall Floor Heat
AF1	Antifreeze-1 Tanks
AF2	Antifreeze-2 Tanks
AF3	Antifreeze-3 Pipes and Fill Valves
EFC	Exhaust Fan
WHC	Water Heater
TR1	Bedroom and Roomette Ceiling Lts., 2900-41 Bedroom and Roomette Ceiling Emg. Lts., 2980-97
TR2	Vestibule, Blind End, Passage, Number Signs, Porter Room and Plenum Lts.

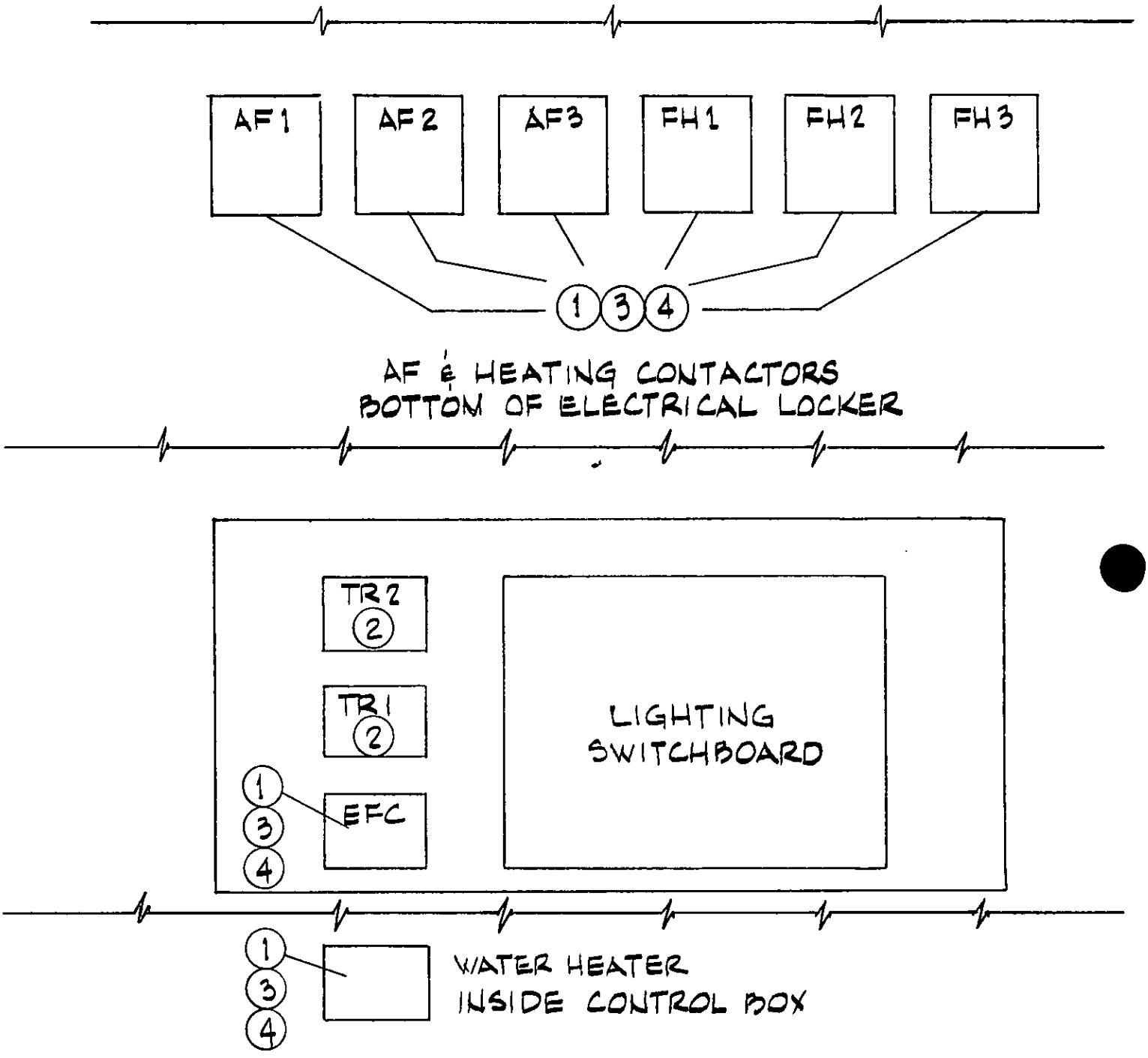


FIGURE 6.11

ANTIFREEZE, HEATING, LIGHTING AND MISC. CONTACTORS

Figure 6.12
ANTIFREEZE, HEATING, LIGHTING AND MISCELLANEOUS CONTACTOR PART LIST

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1		Contactor, 480V, 3 Pole, NEMA-1	GE	CR205C022	25B9011693	
2		Contactor, Transfer, DPDT (for parts, refer to main manual, Figure 6.44)	Vapor	37741141	25H4013800	
3		Coil, for Item-1, NEMA-1, 120VAC	GE	15D21G22		
4		Contacts, for Item-1, NEMA-1	GE	546A301-G2		

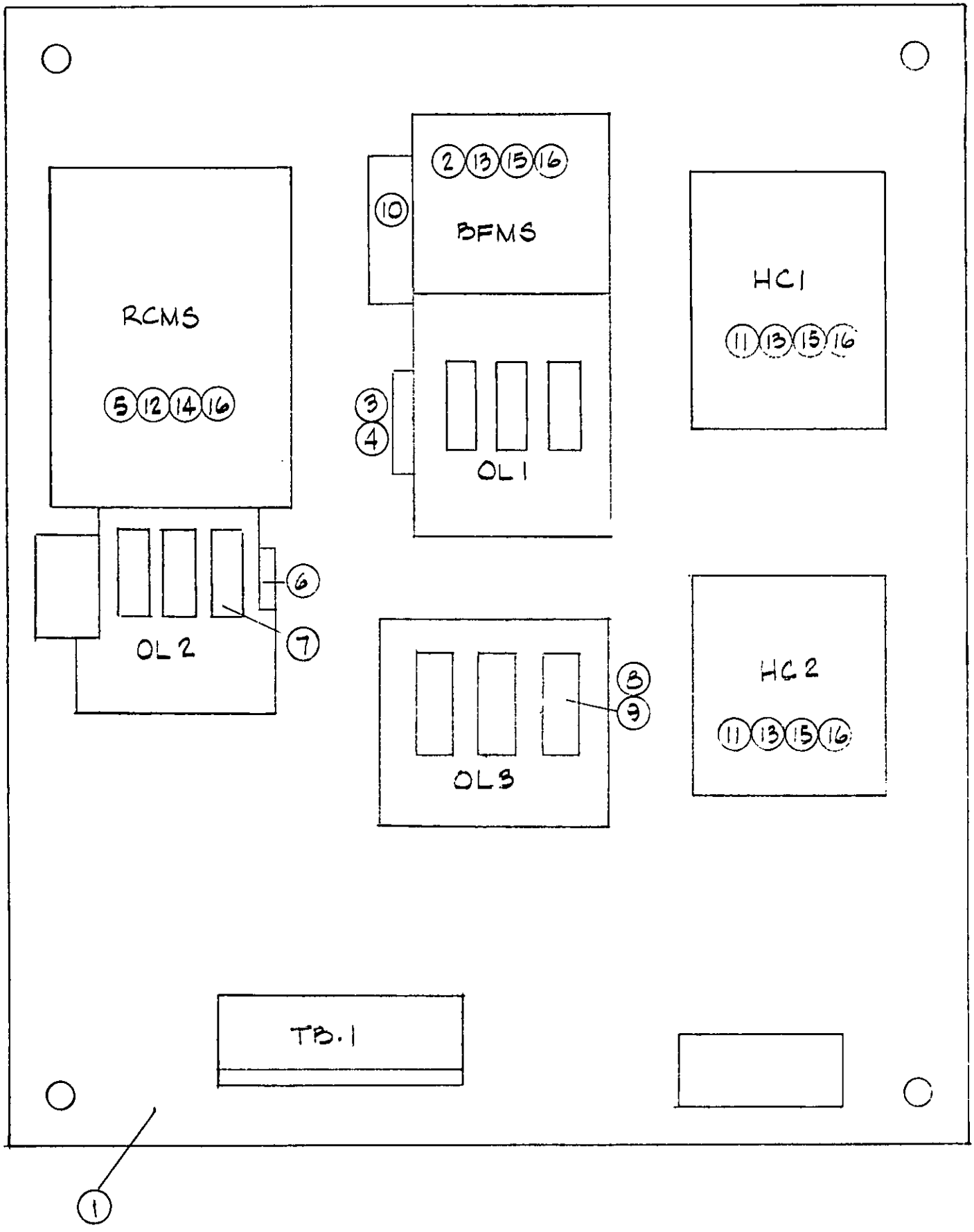


FIG. 6.13
A/C STARTING PANEL

Figure 6.14
AIR CONDITIONING STARTER PANEL PART LIST

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1	-	A/C Starter Panel, Complete	Safety	B4290-1	25D9011510	
2	1	Motor Starter, BFMS NEMA-0	GE	CR206B022	25P9011521	
3	1	Overload Relay (for Blower Fan Motor, OL1)	GE	CR224C310A		
4	3	Overload Heater (for OL1)	GE	CR123C2.39A	25X9612120	
5	1	Motor Starter, RCMS NEMA-2	GE	CR206D022	25L9012119	
6	1	Overload Relay (for Compressor Motor, OL2)	GE	CR224C310A		
7	3	Overload Heater (for OL2)	GE	CR123C21.4B		
8	1	Overload Relay (for Condenser Fan Motor, OL3)	GE	CR224C310A		
9	3	Overload Heater (for OL3)	GE	CR123C03.56A		
10	1	Auxiliary Contact Set for BFMS	GE	CR205X100D		
11	2	Contactor, HC1 & HC2, NEMA-1	GE	CR205C022	25B9012116	
12	(1)	Contact Set Main for RCMS	GE	546A780G2		
13	(1)	Contact Set, Main for BFMS, HC1, HC2	GE	546A301G2		
14	(1)	Coil, Contactor for RCMA, 120V 50/60 Hz	GE	15D22G22		
15	(1)	Coil, Contactor for BFMS, HC1, HC2, 120V, 50/60 Hz	GE	15D21G22		
16	4	Suppressor Contactor Coil	Safety	T-22010		

6.7.5 E-5 Decelostat

These cars are not equipped with E-5 Decelostats, since the cars have the original pneumatic units.

6.7.6 Maker Light Resistors

The marker light resistors are mounted in the overhead near the car ends, unlike later car series.

They are used to set down the battery charger voltage to 35 volts as required for the marker lights. These resistors must be adjusted to give 35 volts at the marker light (not the resistor). See test spec section 4.2 for the adjustment procedure.

Part	MANU	MANU #	AMT #	AMMS #
Resistor, 30 OHM, 100W with Slider	Ward-Leonard	100A30	25X4010780	
Insulator, Teflon	----	----	11N9004105	
Bracket, Mounting	Ward-Leonard	805	33K7000596	

6.7.7 Annunciator Power Supply

The annunciator and room buzzers are powered from a 6.3 volt filament transformer combined with a bridge rectifier to produce about 8 VDC. These components are located to the left side of the lighting switchboard, behind the cover. A 1-amp slow blow fuse protects the transformer and is contained in a surface-mount holder on the lower left on the lighting switchboard. Refer to figure 6.4 for part information.

6.8 Food Service Electric Locker Panels

N/A.

6.9 Service Procedures

Refer to Main Manual.

6.10 Drawing List

Function	Drawing Number
Single Line Power Schematic, 2900-41	D-04-440-Sht. 2
Single Line Power Schematic, 2980-97	D-04-440-Sht. 3
480 Main Trainline Power Schematic	D-04-440-Sht. 4
Water Heater and Antifreeze Schematic	D-04-440-Sht. 5A
A/C and Heating Controls Schematic	D-04-440-Sht. 6
Floor Heat Schematic 2900-41	D-04-440-Sht. 7
Floor Heat Schematic 2980-97	D-04-440-Sht. 8
Auxiliaries Schematic 2900-41	D-04-440-Sht. 9
Auxiliaries Schematic 2980-97	D-04-440-Sht. 10
Lighting Schematic 2900-41	D-04-440-Sht. 11
Lighting Schematic 2980-97	D-04-440-Sht. 12
DC System Schematic	D-04-440-Sht. 13
27 Point Communication Trainline Schematic	D-04-440-Sht. 14

CHAPTER 7 AIR BRAKE SYSTEM

LIST OF ILLUSTRATIONS

CHAPTER 7 AIR BRAKE SYSTEM

7.0 General

The cars are equipped with the standard HEP automatic air brake system. Both car series use a D-22 schedule and disc brakes.

Differences between the 2900's and other HEP converted cars include:

1. 2900's use CF disc brake arrangement.
2. 2900's use AP-3 pneumatic Decelostat wheel slide protection rather than electronic E-5.
3. 2900's 27-point trainline does not have brake applied and released pressure switches.

All other aspects of the brake system are detailed in the main manual.

7.1 Brake System Operation

Refer to Main Manual.

7.2 Carbody Components

Refer to Main Manual.

7.3 Truck - Mounted Components

These cars are equipped with CF disc brakes, unlike later series cars which have TFM. Refer to section 7.6 for details.

7.3.1 Tread Brake Components

N/A.

7.3.2 Disc Brake Components

Air flows between the carbody and trucks via a semi-metallic hose, armoured to protect against road damage. Extra heavy iron pipe and hose is used to distribute air to the 4 brake cylinders on each truck, one per disc.

One size of brake cylinder is used as required by car weight. Refer to figure 7.1 of main manual for cylinder size. The correct cylinder size must be used or braking will be inadequate or excessive.

Air entering the brake cylinder forces the piston out, forcing the brake pads against the disc. On release, a large spring retracts the piston and releases the brakes.

These cars are equipped with the original C-frame mounted disc brakes. The brake cylinder and caliper assembly is suspended from the truck and supported by a C-shaped arm which rests on the bearing adapater. This causes the brake caliper to follow up-down motion of the axles and properly follow the discs. The caliper assembly can move laterally to follow the lateral axle-to-truck motion, and can also swivel vertically to follow truck frame-to-axle roll.

The brake lining is a high friction composition material, wired to the brake shoe. The complete pad assembly is attached to the brake heading with the spring retainer, spring and brake shoe key.

ITEM	DESCRIPTION	AMT #	AMMS #

The brake discs are wheel mounted, bolted to the hub of the wheel. The discs are self-ventilated.

The handbrake applies the brakes on the B-end truck by pulling on the handbrake lever of one brake unit per axle, forcing the pads against these 2 discs. Refer to section 7.6 for WABCO instructions on these truck brake parts.

Disc brake cars are equipped with speed sensors for use with an anti-wheel slide system. One sensor is used on each axle, bolted to the journal bearing adapter. Refer to section 7.4.

Figure 7.1
TRUCK DISC BRAKE COMPONENTS

To be supplied

Figure 7.2
TRUCK BRAKE DISC BRAKE COMPONENTS

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1		Frame Assby. See Wabco Manual	WABCO			
		Bolt (Bridge to Brake Frame)	WABCO	86 04923		
		Lockwasher (Bridge to Brake Frame)	WABCO	71A40M		
		Nut (Bridge to Brake Frame)	WABCO	21J26M		
2		Pin, Tong at Cylinder	WABCO	8604173		
3		Pin, Handbrake Crank at Cylinder	WABCO	8604191		
4		Pin, Handbrake Crank Lever at Cylinder	WABCO	8606654		
5		Pin, Handbrake Crank and Lever	WABCO	8605691	18A2300254	
6		Cotter Pin, 3/8" x 2" for Item 5	WABCO	576246		
7		Cover, Spring	WABCO	8605061	23X9009665	
8		Spring, Tong Pin	WABCO	8605060	22A9000519	
9		Washer, Flat, 3/4"	WABCO	575988	22P9003935	
10		Nut, Slotted Hex 3/4" - 10"	WABCO	576065	22A9000204	
11		Crank, Handbrake	WABCO	8609717	20A0100174	
12		Lever, Handbrake	WABCO	8605023		
13		Gasket hose to brake cylinder, 3/4"	WABCO	93841	22A9000108	
14		Brake Head Assby., Outside	WABCO	8604912		
15		----				
16		Brake Head Assby., R.H. Inside	WABCO	8604913		
17		Brake Head Assby., L.H. Inside	WABCO	8604914		
18		----				

Figure 7.2
TRUCK BRAKE DISC BRAKE COMPONENTS
Page 2

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
19		Tong Assby., R.H.	WABCO	8605688	18A2300252	
20		Tong Assby., L.H.	WABCO	8605689	18A2300253	
21		Bridge Assby.	WABCO	8605791		
24		Brake Shoe and Lining R.H.	WABCO	8605116	23E4003457	
25		Brake Shoe and Lining L.H.	WABCO	8605117	23B4003458	
26		Spring, Brake Shoe	WABCO	8604586		
27		Key, Brake Shoe	WABCO	8604901		
		Brake Head Assemblies		---	---	---
14		Brake Head Assby., Outside	WABCO	8604912		
16		Brake Head Assby., R.H. Inside	WABCO	8604913		
17		Brake Head Assby., L.H. Inside	WABCO	8604914		
28		Stop Pin	WABCO	8605114		
29		Wear Plate	WABCO	8604578		
30		Bushing, Flanged	WABCO	8606516		
31		Bushing, Plain for Guide Pin	WABCO	8601577		
32		Pin, Guide	WABCO	8605114		

Figure 7.2
TRUCK BRAKE DISC BRAKE COMPONENTS
Page 3

	Brake Cylinder Assemblies			---	---	---
33	Brake Cylinder, Complete, 6½"		WABCO	8605080		
34	Brake Cylinder, Complete, 7"		WABCO	8605050		
35	Brake Cylinder, Complete, 7½"		WABCO	8605047		
36	Washer		WABCO	524387	22A0100233	
37	.CLAMP, Piston End		WABCO	8611983		
38	.CLAMP, Cover End		WABCO	8611984	25L9005915	
39	.BOOT, Dust		WABCO	8504186	18A2300225	
40	.COVER, Assby.		WABCO	8605162		
41	.BUSH, Cover		WABCO	8604181	22X9003626	
42	.LUBRICATOR, Felt		WABCO	8604182		
43	.GASKET, Cover		WABCO	8605157		
44	.SPRING, Piston Return		WABCO	8605088	23E9008845	
45	.GUIDE, Spring		WABCO	8606339	22T9004316	
46	Cup, Packing	6½" Cylinder	WABCO	531244		
47	Cup, Packing	7" Cylinder	WABCO	531328	22A2300137	
48	Cup, Packing	7½" Cylinder	WABCO	531329	22A2600006	
49	Piston Assby.	6½" Cylinder	WABCO	8605738		
50	Piston Assby.	7" Cylinder	WABCO	8606419		
51	Piston Assby.	7½" Cylinder	WABCO	8606428	22P9003627	
52	Bushing		WABCO	8504172	18A2300222	
53	Cylinder Body	6½" Cylinder	WABCO	8605122		
54	Cylinder Body	7" Cylinder	WABCO	8605161		

Figure 7.2
TRUCK BRAKE DISC BRAKE COMPONENTS
Page 4

55	Cylinder Body	7½" Cylinder	WABCO	8605163	22A0100104
	Tong Assemblies		---	---	---
19	Tong Assembly, R.H. Complete		WABCO	8605688	18A2300252
20	Tong Assembly, L.H. Complete		WABCO	8605689	18A2300253
56	Pin, Shoe		WABCO	8605087	18A2300241
57	Pin, Fulcrum		WABCO	8604163	18A2300220
58	Key		WABCO	8604901	
59	Retainer		WABCO	8604899	18A2300233
60	Spring		WABCO	8604586	
	Bridge Assembly		---	---	---
21	Bridge Assembly (w/bushing)		WABCO	8605791	
61	Bushing		WABCO	8605635	
62	Cap Screw		WABCO	8602190	
63	Fulcrum Cover		WABCO	8605079	
64	Gasket		WABCO	8604921	
65	Lockwasher		WABCO	71A24M	
66	Hanger Box Cap		WABCO	8605601	
67	Rubber Segment		WABCO	8604469	
68	Bolt		WABCO	8605603	

Figure 7.2
TRUCK BRAKE DISC BRAKE COMPONENTS
Page 5

69	Nut	WABCO	21L18M	
70	Lockwasher	WABCO	71A32M	
71	Hanger Box Assembly	WABCO	8604471	
72	Hanger Box	WABCO	8605083	
73	Hanger Box Cap	WABCO	8605085	
74	Rubbber Segment	WABCO	8604469	
75	Bolt	WABCO	8601883	
76	Lock Washer	WABCO	71A34M	
77	Bolt	WABCO	E860198	
78	Lockwasher	WABCO	71A32M	
79	Nut	WABCO	21L18M	
	Brake Frame	---	---	---
1	Brake Frame Complete (See WABCO Manual)	WABCO		
2	Bushing	WABCO	8605637	
	Air Hose Assembly-Cylinder	---	---	---
80	Fitting, Elbow Air Hose to Cylinder	WABCO	8609735	23T9011465
81	Fitting, Elbow Air Hose to Cylinder	WABCO	8609736	22X9003732
82	Fitting, Elbow Brake Line to Air Hose	WABCO	8609749	23X9011464
83	Fitting, Elbow Brake Line to Air Hose	WABCO	8609750	23H9010280
84	Clamp, Hose, 2 3/4" ID Open End	Punchlock	#11	45A9000322
85	Gasket, 3/4"	WABCO	93841	22A9000108

Figure 7.2
TRUCK BRAKE DISC BRAKE COMPONENTS
Page 6

86	Hose, to Brake Cylinder	WABCO	8609753	
87	Lock Washer	WABCO	514281	
88	Cap Screw for Item 72 & 73	WABCO	8605598	
89	Cap Screw for Item 70 & 71	WABCO	8602190	
	Brake Disc	---	---	---
90	Disc, Brake, 28"	WABCO	8609370	20A0100179
91	Cap Screw, 3/4" 1 3/4" Grade 5	WABCO	8606154	18A2300255
92	Locking Plate	WABCO	8610859	23X9007317
	Brake Relining Fixture	---	---	---
93	Brake Lining Assembly Fixture	WABCO	8610476	22N9004124
94	Lock Washer	WABCO	514415	22A9000205
	Brake Shoe and Lining Assemblies	---	---	---
24	Brake Shoe and Lining Assby., R.H.	WABCO	8605116	23E4003457
25	Brake Shoe and Lining Assby., L.H.	WABCO	8605117	23B4003458
95	Brake Shoe and Stud Assby., R.H.	WABCO	8605139	20A0100456
96	Brake Shoe and Stud Assby., L.H.	WABCO	8605140	
97	Stud	WABCO	8605177	23X9009262
98	Pad, Rubber	WABCO	8605137	22A9000511
99	Lining	See Page C-7-4	---	---
100	Wire, Brake Shoe	WABCO	8608990	

7.4 Decelostat Wheel Slide Protection System

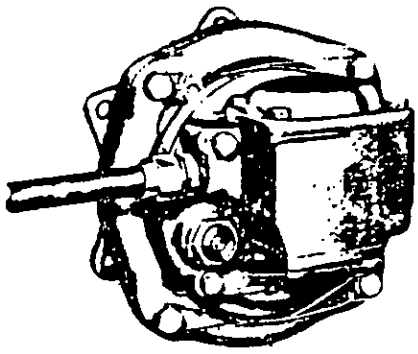
7.4.1 System Operation

During the HEP upgrade, the original 3-AP Decelostat system use maintained on these cars.

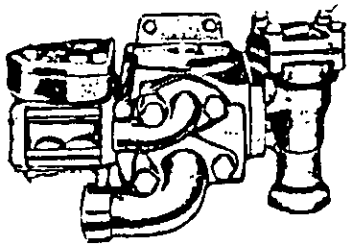
The 3-AP Decelostat is an anti-wheel slide system used to keep the occurrence of spalled and slid flat wheels low. During heavy braking, especially on slippery rail, the brake system is capable of sliding the wheels. This is especially true of disc brake cars; tread brake cars are less susceptible because the brake shoes have a cleaning effect on the wheel treads making them less likely to slide.

The 3-AP system uses a "P3" speed sensor mounted on one journal of each axle to measure axle speed. It does this with a loosely - coupled flywheel which tries to turn at the same speed as the axle. If the wheel speed changes quickly, the flywheel turns at a faster speed than the axle, a slide is detected, and the brakes released on that truck.

Before a wheel goes into a slide, it creeps along the rail. The P3 sensor senses this creep before a slide occurs, and activates the A-end or B-end dump valve as required. This reaction must be quick, because the creep condition does not last long before a slide occurs. The 3-AP system will respond only when it senses excessive wheel deceleration rate. While the B3 dump valve is activated, the brake cylinders on the corresponding truck are vented to the atmosphere. The P3 controller will deactivate the dump valve and thus reapply that truck's brakes whenever it senses the wheels are no longer sliding (neither axle on a truck can be sliding).



P-3 DECELOSTAT
CONTROLLER



B-3 DUMP VALVE

FIG. 7.3

3-AP DECELOSTAT SYSTEM COMPONENTS

The 3-AP Decelostat system operates under all braking conditions, including emergency. Variations in wheel size within the allowable range for a 36 inch multiple wear wheel will not effect the system.

Using a decelostat system to control wheel slide does two important things:

1. Reduces train stopping distance over that of sliding wheels (contrary to the common belief).
2. Greatly reduces wheel spalling and flat wheels caused by sliding.

Spalling is caused largely by sliding wheels. Small slides produce great temperatures over very small areas of the wheel tread, high enough to cause local heat treating. This heat treating causes these small areas to become brittle, and the constant pounding over the affected spot on the wheel endures causes these areas to fall out, which is spalling. Since the Decelostat prevents serious or large wheel slides, it prevents most spalling.

Most flat and spalling wheels have been shown to be related to a defective wheel slide system. When wheel defects of this type occur, try to determine why they occurred -- wheel spalling is very costly to correct, especially if it reoccurs. The brake system itself - especially control and relay valves - is the second most likely cause of wheel slide defects.

7.4.2 Decelostat System Components

The 3-AP Decelostat system consists of:

1. 4 -- P-3 speed sensors, one per axle.
2. 2 -- B-3 dump valves, one per truck mounted on the truck.
3. Interconnecting air lines.

Refer to figure 7-4 for component location.

The P-3 Decelostat controllers are mounted on the journal box adapter, one per axle. A spline drives the unit from the axle. The unit is purely pneumatic, drawing air from the brake cylinder line.

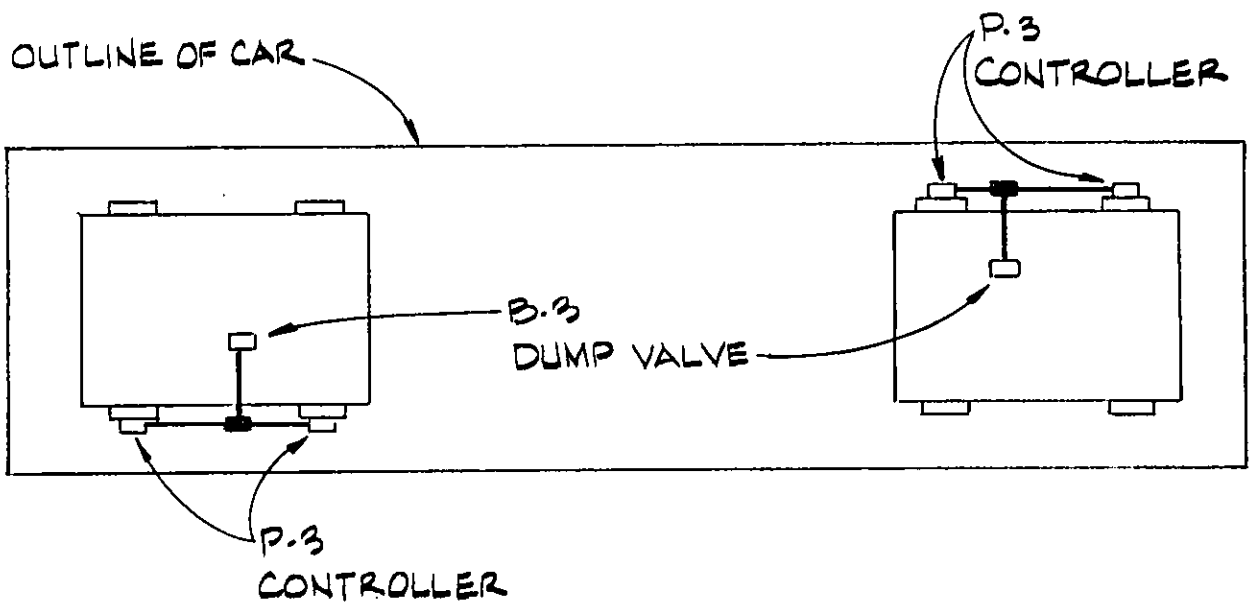


FIG. 7.4

3·AP DECELOSTAT SYSTEM COMPONENT LOCATION

Figure 7.5
3-AP DECELOSTAT SYSTEM PART LIST

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
	P-3	Decelostat Controller, Complete	WABCO			
	B-3	Dump Valve, Complete	WABCO			

The P-3 has a self test feature which should be checked monthly to ensure proper operation. To test, spin the internal flywheel by rotating the knob - the brakes on that truck should release. Refer to test spec PQ-79-1 test 7.2 for details of the procedure.

It is important to check periodically that the P-3 unit is bolted tightly to the journal, and properly lock wired.

The B-3 dump valves are installed in the brake cylinder line on each truck. When activated by one or both of the P-3 speed sensors, the valve immediately opens, venting the brake cylinders on that truck to the atmosphere. When both the P-3 are turned off, air is restored to the cylinders, gently through a choke to prevent a jolt which might start a new wheel slide.

The dump valves rarely fail, but there have been occurrences of sluggish action, caused by foreign matter in the brake system piping or pipe brackets at the dump valves.

Refer to test spec PQ-79-1 test 7.2 for system tests. Refer to WABCO instructions which follow in section 7.6 for further details on components.

7.4.3 General Maintenance

The truck inspection is effectively the only maintenance item of the system. Care must be taken to inspect the truck areas upon arrival of the train at the terminal. Any loose, damaged or leaking P-3 sensors should be repaired before dispatching the car. An inopeative wheel slide system can easily cause wheel spalling, which is very expensive maintenance item. A few minutes of inspection and repair will save many thousands of dollars in wheel costs.

If a car is found with badly spalled or flat wheels, check the decelostat system to determine if it is functioning properly. If the 3-AP is functioning, the problem is likely to be the brake system itself, the control or relay valve.

The P-3 controller should be periodically checked for proper operation, as described below in section 7.4.4.

Dump valves require little maintenance, however, one may occasionally become sluggish. It is imperative that the valve react quickly for the decelostat system to be effective. Should a sluggish valve be found, remove and examine the valve. If foreign material is found, it is likely that the entire car's brake system is contaminated and must be cleaned. Check the strainers on the control valve, etc. to see. If much contamination is found:

1. Dismount all brake valves (control, relay, dump) and the A-1-A water system governor-reducing valve.
2. Blow out the entire air system.
3. Reinstall the valves removed.
4. Fully test the brake system using the test sequence in test spec PQ-79-1 tests 7.1 and 7.2.

7.4.4 Periodic Maintenance

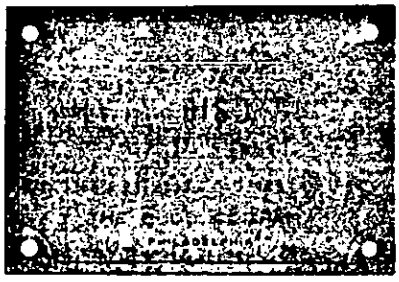
On a monthly basis, do the following:

1. Inspect the P-3 installation on all 4 axles, checking for loose bolts, air leaks, and proper lock wiring.
2. Perform the self test on each P-3 speed sensor (refer to test spec PQ-79-1 for details).

Figure 7.6
WABCO REPAIR AND TEST SPECIFICATIONS

Figure 7.21 WABCO Repair and Test Specification Index

PAGE	COMPONENT	WABCO PART NUMBER	INTRODUCTION #	REPAIR PROCEDURE #	TEST PROCEDURE #
	Budd Disc Brake Manual and Part Catalog Model CF		D8-54		
	3-AP Decelostat		G-g-5067-3	2612-1	



Model—CF

BUDD DISC BRAKE

MANUAL

AND

PARTS CATALOG

THE BUDD COMPANY
Customer Service Department
Red Lion Plant
Philadelphia 15, Penna.

WABCO CF DISC BRAKES

Westinghouse Air Brake Division
Westinghouse Air Brake Company
Wilmerding, Pa. 15148

FOREWORD

This manual was prepared for the information and guidance of the Mechanical and Stores Department personnel responsible for the ordinary maintenance of the BUDD DISC BRAKE. It is divided into two sections:

Section 1 briefly describes the main components, their functions and maintenance procedure.

Section 2 is the PARTS CATALOG portion covering the normal maintenance items. This section identifies the parts by illustration, giving the PART NUMBER and NAME of each replacement item. Where similar appearing parts vary in size or make-up, select the proper part from the tabulation or illustration covering the item desired.

Where more detail data is desired than shown in this manual, consult "Disc Brake Schedule" drawing and "Disc Brake Assembly" drawings specifically applicable to the car in question. These drawings are obtainable from the office of your Chief Mechanical Officer or your Mechanical Engineer.

Because of the many variations in trucks under many different types of cars to which BUDD DISC BRAKES are being applied, this brochure would become too cumbersome should we attempt to fully illustrate and list the application to every car.

The Budd Company reserves the right to alter or improve the design or construction of parts described in this manual and to furnish the parts when so altered without reference to the illustrations or descriptions herein. Where interchangeability of parts would be affected by such alteration, the change shall be publicized by a bulletin.

LIST OF CONTENTS FOR SECTION 1

LIST OF CONTENTS FOR SECTION 2

DESCRIPTION OF BUDD DISC BRAKE

Briefly, the BUDD DISC BRAKE per axle unit consists of:

(a) Two brake discs securely attached, one to each wheel.

(b) Brake Assembly. This unit is composed of the Brake Frame, Cylinders, Brake Tongs, Brake Heads and Brake Shoes.

(c) Hanger Box Assembly which attaches to the truck transom.

A typical installation is illustrated on Page II of Section 2, where the simplicity of the disc brake is readily apparent. To maintain proper alignment between brake shoes and brake disc, the braking units are mounted on a three-point rubber supported frame with one point at the hanger box on the truck transom and the other two at the journal box. Thus the brake remains in the same plane as the axle and the discs at all times, regardless of truck frame tilting incident to track curves or spring deflections.

Basically the brake consists of a disc, or heat exchanger, mounted to the inner hub of each wheel and braked by composition lined brake shoes. Each pair of shoes is actuated by an air cylinder exerting force on a simple tong-lever system producing shoe pressure on the disc which creates the friction needed to retard the car.

With this design, the car wheels are restored to their prime function of supporting and guiding the car as it moves along the rails. Their secondary use, that of acting as brake drums, has been transferred to a disc precisely engineered to perform only that function.

The brake disc is cast integrally to a deep-dished stamping. The stamping is radially flexible to permit expansion as the brake heats, thus minimizing distortion of the braking faces of the disc casting. The braking face on each side is separated by a double row of radiating fins and structural ribs. These create a simple but efficient "Sirocco" type blower which forces the cooling air over 7,000 square inches (in the 28" disc) of radiating surface as the disc and wheels revolve.

These cast iron braking faces together with the composition brake lining material provide the best possible combination of frictional materials. Micrometer measurements taken after years of service prove that the disc wears very little. The easily replaceable shoe linings take the wear.

The fundamental characteristics of this arrangement provide a constant coefficient of friction irrespective of speed or inertia loads. Torque, therefore, is always proportional to brake cylinder pressure, providing controlled, uniform braking without the need for speed governor control or manual graduation of brake cylinder pressure.

BRAKE SHOE AND LINING ASSEMBLY

Each Brake Shoe and Lining Assembly is composed of a replaceable Brake Lining Assembly mounted over studs on a reusable Brake Shoe. The six composition segments of the lining assembly are firmly attached to a thin flexible steel stamping. This lining assembly is mounted to the shoe over three rubber pads and retained by the four locking wires.

The combination of the friction materials used and the uniform unit pressure obtained by the flexible backing make high thermal capacity and long shoe life possible.

The Shoe and Lining Assembly is held in position by the Shoe Pin of the Tong, a Stop Pin on the lower end of the Brake Head and secured at the top with Retainer Spring, Retainer and self-locking wedge type Key. (See Fig. 2, Page 23).

CONDEMNING LIMIT OF BRAKE LINING

The need for changing brake shoes is governed by Brake Lining wear. The recommended condemning thickness of the Brake Lining is ¼ inch at which time the Brake Lining should be changed to avoid damage to the Brake Shoe and to the Disc.

It is recommended that a ¼ inch thickness gauge be used by inspectors to eliminate guess work and to make available to the railroad the maximum mileage from each Brake Lining Assembly. This gauge can be made from ¼ inch steel stock. It is used as a GO-NO-GO gauge, by applying the brakes, then inserting the gauge between the Disc and the brake lining Backing Plate next to one of the Brake Lining Segments. (See Fig. 1, Page 22).

The accurate measurement of the brake lining is important as each 1/32 inch brake lining thickness is equivalent to over 4000 miles of service in normal operation.

RENEWING BRAKE LINING

While only the brake lining normally wears out and requires replacement, the following replacement method experience proves most economical in making this change-out:-

1. Remove complete brake shoe with worn lining.
2. Replace with another brake shoe assembly having new brake lining assembly.
3. The removed brake shoe assembly should then be returned to store or brake shop for change-out of lining, described later.
   CAUTION: Brake Shoe and Lining Assemblies are R.H. and L.H.

REMOVAL OF BRAKE SHOES

1. For safety reasons shut off air supply to the truck.
2. To free the brake shoe for removal:
   a. With the use of a hammer remove the self-locking Brake Shoe Key.
   b. Remove Spring Retainer and Spring from the Shoe Pin.
3. Remove Brake Shoe Assembly by raising it vertically off Shoe Pin.

Note: Care should be taken to avoid a brake application while brake shoe is removed to prevent damaging brake heads.

INSTALLATION OF BRAKE SHOES

Brake shoe is applied in reverse order of above.

Note: **Be certain the brake shoe engages the Stop Pin at the lower end of the brake head. Care should be taken when reapplying Brake Shoe Key. The notched surface must engage the spring retainer. (See Fig. 2, Page 23).**

Particular attention should be used to verify that the Brake Shoe Key is driven "home" and when Key is in position it must be tight, indicating good compression of Retainer Spring. Where there is any looseness, this will subsequently result in unnecessary and destructive wear on the Shoe Pin slot, the Brake Shoe Key, the Retainer, the Retainer Spring, the Brake Shoe and the Brake Head. Where insufficient tightness is found, remedy by replacing the worn part or parts. A temporary relief may be achieved by shimming with a washer between the spring and the spring retainer. Free height of the retainer spring when new is about 1-1/32" — when this height is 7/8" or less, due to wear, permanent set or breakage, replace with new spring.

Misalignment of the Brake Shoe with the Brake Disc may be caused by:-

1. **Excessive wear, chafing or breakdown of Bearing Arm Rubber Backed Bearing. Remedy — replace Rubber Backed Bearings. (See Fig. 3, Page 24).**

2. **Excessive play in Hanger Box Assembly. This may be due to loose Hanger Box Bolts. It may also be due to Rubber Segment either broken down or worn excessively by chafing. A gap of less than 1/4" between Rubber Segment and the Hanger Tube of Brake Frame may be continued in service or be remedied by cutting off one end of Rubber Segment about 1 1/2" at outside diameter edge and 1 1/4" at I.D. edge, then adding a 1/4" thick x 3 1/2" wide x 29 1/2" long rubber shim between the Rubber Segment and the Hanger Box Castings. If gap exceeds 1/4", rubber segment should be replaced.**

RELINING BRAKE SHOES

For economy in maintenance, the Brake Shoe Assembly is designed so that only the worn out Brake Lining portion requires replacement, which should be handled as follows:

DISASSEMBLY AND INSPECTION

Remove the worn Brake Lining Assembly by cutting the wires which hold the lining assembly to the brake shoe, then pull wires out of the brake shoe studs.

Lift off and discard the worn lining assembly.

Remove the three rubber pads, clean off by brushing, examine, and discard any that may not be in good condition.

Brush off and inspect the Brake Shoe for flatness, and carefully examine the 8 studs for looseness in shoe or wear, particularly at the wire hole. Replace all worn studs with new ones and tighten any remaining ones which are loose.

To remove defective studs, cut off the riveted-over head in the counterbored hole of brake shoe, using a ½" drill ground almost flat at point. Take care that drill does not cut into brake shoe. Punch stud out of brake shoe.

In applying a new stud, take care that its wire hole is in alignment with the hole in the mating stud. (An easy way is to insert and keep a wire through the two mating studs while riveting). Rivet studs in place using a rivet set, such as shown in Fig. 4, Page 25.

ASSEMBLING LINING TO BRAKE SHOE

Fixture T86-06224, illustrated on Page 24 in Section 2, was designed to easily install the Brake Lining on the Brake Shoe.

To mount Lining on Brake Shoe —

1. Lay Brake Lining assembly face down on bench.
2. Set one Rubber Pad in each of the three recesses, or pockets, of the Lining Back Plate.
3. Place the Brake Shoe on top so Studs fit into the stud holes of the lining back plate.
4. Grasping the above parts firmly, turn them over as a unit and place on the sliding Carriage of Fixture T86-06224.
5. Slide carriage along fixture base to position first pair of brake shoe studs in line with center of pressure spindle.
6. Place Key over studs.
7. Screw down Handwheel just enough to allow inserting Iron Wire through the holes of that pair of studs.

Note: It is important that this compression travel be limited so as to prevent bending of lining back plate which would result in loose wires. Wire size used MUST be #10 gauge (.135 dia.) 5-7/16" long for 28" disc Shoes and 5-1/16" long for 26" disc Shoes. If smaller wire is used, the lining will chatter on the brake shoe resulting in destructive wear on the stud body by the lining back plate, also elongation of holes in studs and breaking of lining back plate.

8. Lock in place by bending both ends of wire downward over edge of shoe and away from lining.
9. Repeat 6, 7 and 8 for each of the remaining 3 pairs of studs.

BRAKE HEADS

Installation of Brake Heads on the brake tongs utilizes the tong and its shoe pin for support. They become anchored and held in position by the installation of brake shoe assemblies and their retainer springs, retainers and keys.

REMOVING BRAKE HEADS

To remove Brake Heads first remove the brake shoe assemblies as outlined under Brake Shoes. Then lift brake heads vertically off shoe pin in pairs. This must be done in pairs because of interlocking of outside and inside heads by the guide pin which is an integral part of the inside head.

BRAKE HEAD OVERHAUL — SEE BULLETINS NO. 11 & 16.

INSTALLATION OF BRAKE HEADS

Before installation, clean and lubricate with graphite lubricant (See LUBRICATION, Page 19) the guide pin, guide pin bushing, shoe pin bushings and wear plates on the brake heads; also the shoe pin head and shank portions protruding out of the tongs.

Assemble the outside and inside brake heads in pairs by engaging the guide pin. The inside brake heads are R.H. and L.H. — care must be taken that proper hand brake head is used at the location worked on. This because inside brake heads have offset guide arms to obtain maximum clearance at center sill, if wrong hand is applied the offset would ride brake disc when brakes are in applied position, also if wrong hand inside brake head is used some difficulty may be experienced in applying brake shoes.

Brake heads should be removed and wear parts lubricated at least once a year — some railroads find it advantageous to do this each time brake shoes are changed.

BRAKE CYLINDERS

Brake Cylinders used on BUDD DISC BRAKES are light and compact yet rugged to withstand with long life the amazing amount of abuse encountered in high speed service. One cylinder is used for each disc location.

Brake cylinders are made in several sizes. The size used on each truck is in proper proportion to the weight carried by that truck. All cylinders on one truck are the same size diameter. On some type cars, like diners or observation cars, a truck on one end may have one size cylinders while the truck at other end may require larger or smaller cylinders. In this manner proper "braking ratios" are obtained without special "brake lever drilling". The same tongs, which are in effect brake levers, are used in all locations.

The cylinder is a sealed unit that does not breath to the outside atmosphere. The air in the non-pressure area is displaced into the bellows-type boot which extends as the brakes are applied. This air is moved through the hollow-rod portion of the piston which is packed with rubberized filter material which provides added protection against dirt and moisture. The cylinder is self-lubricated by oversized swabs.

Most Railroads keep a few reconditioned cylinders on hand for speedy replacement at air dating (accomplished by disconnecting one air fitting and removing two pins, and due to the light weight of cylinder requires one man). Removed cylinders may then be cleaned and reassembled in groups inside a building at considerable savings in time and material.

REMOVAL OF BRAKE CYLINDER ASSEMBLY

To remove a Brake Cylinder Assembly from the complete Brake Assembly refer to Fig. 2, Page 23, and proceed as follows:-

1. Close cut-out cock in brake cylinder line to the truck being worked on. This is a safety precaution.

2. Break the air connection at the Cylinder by removing the two Cap Screws. CAUTION: Do not lose the Ring Gasket between the Fitting and Cylinder.

3. Remove Nut, Washer, Spring and Spring Cover from the bottom of each of the two Tong Pins.

Note: To hold pin while removing nut insert a drift or punch in the hole at the top of the tong pin.

4. Release Cylinder by raising both Tong Pins.

5. Remove the Cylinder.

Note: Due to clearance restrictions on some trucks, it may be desirable to remove the brake shoes and spread the tongs. This would allow cylinder to be lowered or raised vertically.

INSTALLING CYLINDER ASSEMBLY

1. Clean and lubricate tong pins and bushings. (See Lubrication, Page 19).

2. Place the Cylinder between the Tongs with the "air connection" toward the center of the truck.
   Be sure proper size cylinder is used for each truck.

3. Apply the guide points (See Section 2, Page 23) to the end of the tong pins.

4. After aligning the holes in the outboard end of the cylinder assembly with the holes in the tong apply the first tong pin.

5. The guide point will serve to line up the holes at the inboard end of the cylinder and permit the second tong pin to be applied with the use of a hammer.

6. Apply the Spring Cover, Spring and Washer in this order on the end of each Tong Pin, then apply the Nut and Cotter Pin.

7. Remove the masking tape covering the air inlet and install air fitting, taking care that the gasket is in good condition and seated correctly, the cap screws are tight and locking wire is added.

OVERHAULING CYLINDER ASSEMBLY

DESCRIPTION OF CYLINDER MAKE-UP

Fig. 5 is a sectional sketch of the Cylinder. This sketch shows the packing cup and lubricating swab used with the piston head and the hollow piston rod which slides within the replaceable bronze bushing which is pressed into the cylinder cover (non-pressure head). The cylinder cover groove holds an oil saturated felt ring which lubricates the piston rod in conventional manner.

The Cover is attached to the cylinder body with three bolts, and (with its spring guide) retains the piston return spring. A cork composition gasket is used to seal the joint between cylinder and cylinder cover against dirt and water.

A bellows type rubber boot protects the piston in extended position from dirt and water, thus preventing corrosion of the piston, reduces wear of the bronze bushing of the cover, and prevents dirt or water being pulled into the cylinder on release stroke. One end of this boot is attached by a stainless steel clamp to the grooved piston and the other end by a stainless clamp to the cylinder cover.

The cylinder breather feature is a matter of displacing the air from the non-pressure side of piston into the boot. This air is forced via the breather ports through the large volume hair type filter in the hollow piston rod each time piston moves on brake application or release.

The stainless steel Spring Guide placed over the bushing boss of the cylinder cover guides the return spring and prevents spring wearing the boss.

The two flanged bushings for the tong pin holes at the outer ends of cylinder and piston provide easily replaceable long-life wearing surfaces for the tong pins. When only the bottom flanges of these bushings are worn thin, additional wear service can be obtained from these bushings by changing cylinder over to opposite side of brake frame which revolves the cylinder 180°.

CYLINDER DISMANTLING AND OVERHAUL

1. Remove Boot from piston and cylinder cover.
   Examine boot and clamps. Usually these are in suitable condition for several reapplications. If boot is torn, discard and replace with new one.

2. Remove the three cylinder bolts. Suitable fixture for clamping cylinder cover to cylinder should always be used when removing or installing cylinder bolts as safety against injury from spring action of return spring which has approximately 180 lbs. compression force.

3. Remove cylinder cover assembly.

4. Remove return spring and piston assembly.

5. Clean and examine all parts. Particular attention should be given to condition of Felt Ring Lubricators, Tong Pin Bushings in cylinder and in piston, Bronze Bushing in cylinder cover, Piston Packing Cup, and the Rubber Boot. Replacement of defective parts should be arranged for.

Cylinder — Thoroughly clean cylinder of all dirt and old lubricant. Be careful not to scratch or otherwise damage cylinder wall.

Replace tong bushings if condition so requires. A convenient way to remove worn bushings is with use of a "Bushing Extractor" or puller. A very efficient and inexpensive one is "Crozier Model 86-RR Bushing Extractor" made by:-

Crozier Machine Tool Company
684 North Prairie Avenue
Hawthorne, California.

New bushing should be pressed in with a press. Driving in these bushings with a hammer may damage bushing or distort bushing seat in the aluminum cylinder.

Cylinder Cover (Non-Pressure Head).

Remove felt piston lubricating ring. If not worn, wash out in suitable solvent to dissolve and remove old dirty grease, then brush to remove surface dirt and hang in clean place to dry out. After dry and before again installing, soak in warm light machine oil, then let excess drain off.

Wash off all old grease and dirt and thoroughly dry the Cover Assembly.

Inspect bronze bushing in Cover for wear. If worn beyond 3.65" along largest inside dia., remove worn bushing and replace with new bushing. Old bushing may easiest be removed by slitting with hacksaw in two places and "peeling" out. Press new bushing into cover.
Finish machine new bushing on inside dia. to 3.604"-3.607", finish to be 63 Micro inch, *after bushing is pressed in place.*

Piston Release Spring. — Thoroughly clean spring of all dirt and old grease to prevent dirt falling on cylinder wall and later causing scoring. If in good condition reuse; if corroded and pitted, apply a coat of approved rust preventive. If broken, taken permanent set or other condemnable defect, replace with new spring.

Piston Assembly:-

(a) Piston Packing Cup — follow standard practice in cleaning and condemning, replace any questionable cups.

(b) Felt Swab — remove, carefully clean and brush off any surface dirt, thoroughly dry out any cleaning solution, then saturate with light machine oil. If visual inspection indicates that the swab would not have full contact with cylinder wall (such as if the felt does not extend above the slot in piston head), the swab should be replaced.

(c) Piston — In cleaning the Piston Assembly, care must be taken to avoid saturating the hair filter inside of piston tube with cleaning solution.

If dirt or corrosion sticks on the hollow piston rod, place the piston in a rotating fixture and using a fine grit cloth, remove dirt or corrosion as the piston is rotated. The hair type filter, located in the hollow rod of the piston, can be replaced, but it is not recommended unless the cylinder is excessively dirty and the filter is so clogged that it does not permit air to pass freely through the filter when blowing out the breather ports.

If it is necessary to change the filter, the piston head will have to be removed from the hollow rod by drilling out the rivets.

Remove the hair filter and discard. Clean individual parts in solvent solution. Replace the hair filter with new hair. Assemble the head to the hollow rod and rivet in place.

Examine tong pin bushings at end of piston rod. If bore of bushing (tong pin fit) is worn excessively, or if the flanged collars (supporting cylinder on tong) are worn thin, bushings should be replaced. Use puller to remove old bushing and press to install new ones. IMPORTANT — The corners of bushing flanges on the piston must be ground off at four places to 3-9/16" dia. after new bushings are pressed in place. See section A-A of Fig. 7. This is to permit piston assembly passing through the cylinder cover assembly without forcing and without damaging the bronze bushing.

CYLINDER ASSEMBLING

Wipe inside of cylinder dry and clean. Swab cylinder wall over entire surface with generous coat of approved brake cylinder lubricant.

On the clean reconditioned piston assembly apply the felt lubricating swab well saturated with oil, also the packing cup, and insert into cylinder after coating all over with brake cylinder lubricant.

To a clean good condition cylinder cover assembly, apply the oil saturated piston felt lubricator, the cork cylinder cover gasket, the stainless spring guide and the piston return spring. Holding these parts as a unit slide over piston rod into place against cylinder.

Using the same clamping fixture as for dismantling, with the three bolts, bolt cylinder together making sure all parts fit properly. (Do not let cylinder cover gasket kink or get out of place).

Remove cylinder from fixture and make leakage test. To air test, put cylinder in a wood block or by some other means restricting piston stroke to 3¾". In this position, leakage should not exceed 2 lbs. per minute from 50 lbs. pressure.

After cylinder passes leakage tests, apply the boot. Boot should be so turned that the 1/16 vent holes are at top and bottom of cylinder as cylinder is under car. The large clamp (on cylinder cover) preferred position is with screw on bottom of cylinder, while the smaller clamp (on piston) preferred position is with screw on horizontal centerline nearest to bolster and farthest from disc when installed on car.

Cover the Air Inlet Boss on the cylinder with masking tape to avoid dust and foreign articles from entering the cylinder or tapped holes when it is stored.

The tong pin bushings at each end of the air dated cylinder assembly should be coated with graphite lubricant for protection. (See Lubrication, Page 19).

GENERAL NOTICE ABOUT CYLINDERS

The foregoing discussion on Brake Cylinders and their component parts covers these as furnished from 1952 to the present time. Several revisions were made at various times between the initial "CF" style and 1952 to improve the operation and reduce maintenance requirements.

It is recommended that existing older style Cylinders be reworked at air dating or general brake overhaul to incorporate changes described below and illustrated in Fig. 6.

(a) Piston Assembly. Some of the earlier aluminum piston heads had an integral extension sleeve which served as a guide for the piston return spring. Experience has proved that the return spring wore excessively into this aluminum extension, in some instances actually breaking off small pieces. These aluminum particles became imbedded in the rubber packing cup, scoring the cylinder walls and causing air blow-by.

Remedy — (1) Machine aluminum piston head by cutting off extension as shown in Note #1, Fig. 6. (2) Install E86-06339, Stainless Steel Spring Guide, as shown on Note #2, Fig. 6. No machining is required on aluminum Cylinder Cover, but if casting is not smooth it may be necessary to file off burrs or roughness for spring guide to seat properly.

(b) Lubricator Swab. Examine lubricator swab while in place on piston. If steel grease retainer or swab retainer project beyond O.D. of aluminum piston, this may cause cylinder wall scoring or cutting.

Reduce O.D. of lubricator swab steel part to slightly less than O.D. surface of aluminum piston. Install new swab felt. See Note #3, Fig. 6.

This applies to 7" and 7½" Cylinders only.

(c) Gasket E86-05157. See Note #4, Fig. 6. This gasket provides a weather seal in joint between Cylinder Body and the Cover Assembly. Formerly this gasket was of Neoprene Rubber which occasionally got distorted during application and resulted in water leakage. Replace any Neoprene gaskets with new cork composition gaskets (same piece number E86-05157). Neoprene gaskets are discontinued.

(d) Rubber Boot D86-04186
Boot Clamp Assembly E86-08777 (for Piston end).
(1) In all cases apply new Boot Clamp Assembly (E86-08777) at piston connection of boot as shown in Note #6, Fig. 6. This clamp assembly makes and holds a water tight seal of boot to piston, thus reducing corrosion dirt products on the piston. This clamp is an improvement over the obsolete F86-06258 Garter Spring.

Any accumulation of rust or other corrosion should be removed from the piston rod with fine grit cloth.

(2) If torn, replace Cylinder Boot, D86-04186. If present boots do not have the 1/16" vent holes as shown in Note #5, Fig. 6, punch these vent holes in boot before reapplication to cylinder. These holes vent pressure build-up caused by any small air leakage or blow-by past the cylinder packing cup.

Attach boot firmly to cylinder cover with clamp, F86-05699.

(e) Piston and Bushing Assemblies (See Fig. 7 for illustration.)

D86-05739 for 7" Air Cylinder.

D86-05740 for 7½" Air Cylinder.

Above piston and bushing assemblies are no longer furnished and all future orders for replacement assemblies must give the part number for the new improved assemblies as shown below:

Old Assemblies	*New Improved Assemblies*
Piston & Bushing Ass'y. 7"—D86-05739	Piston & Bushing Ass'y. 7"—D86-06419
Piston & Bushing Ass'y. 7½"—D86-05740	Piston & Bushing Ass'y. 7½"—D86-06428

The lubricator swab used with the new improved piston and bushing assemblies must be ordered as follows:

For 7" Air Cylinder use Part No. E86-06375
For 7½" Air Cylinder use Part No. E86-06378

Note: The lubricator swab is not furnished as part of the piston and bushing assembly and must be ordered as a separate part.

New piston heads may be ordered as follows:

For 7" Air Cylinder use Part No. D86-06377
For 7½" Air Cylinder use Part No. D86-06376

Rivets for the attachment of the new piston head to the piston tube, for all assemblies, may be ordered by specifying Part No. 60A1620.

TONGS

The Brake Tongs are the connecting link between the brake cylinder and the brake heads and operate as levers when the brakes are applied. A hardened wear resistant fulcrum pin is press fitted into the tongs and operates in a hardened wear resistant bushing, press fitted into the fulcrum support assembly, which is part of the main Brake Frame, and another hardened wear resistant bushing, press fitted into the Bridge Assembly, which is bolted to the fulcrum support.

REMOVAL

To remove the Brake Tongs from a complete brake assembly, first remove the brake shoes with brake lining assemblies, the brake heads, the brake cylinder and the bridge assembly. The tong may now be lifted vertically out of the fulcrum bushings, the latter being a part of the brake frame assembly.

To remove the bridge assembly, take off the nuts and lock washers and with a rawhide hammer drive down the bolts (bridge to brake frame) until bolts drop out.

INSPECTION AND REPAIR

Clean entire tong assembly and inspect for excessive wear or other defects.

The tong forging does not normally wear and, except for accidental damage, will seldom require replacement.

All wear normally occurs only on the replaceable parts of the tong assembly — these are the bushings, pins, wear plate and wear washers. See Fig. 8.

Replace worn or defective parts as required.

The tong pin bushings, the fulcrum pin, and the shoe pin are press fitted into the tong forging. To replace tong pin bushings or fulcrum pin, press out old and press in the new replacement part. To replace the shoe pin, first grind or chip off weld which safeties pin to tong at its head (take care not to damage tong in grinding or chipping weld) then press out old pin; press new pin "home" and safety with about 5/8" long arc-brazing along circumference of pin head to tong as shown in Fig. 8, taking care to properly line-up key slot.

The wear plate and three thrust washers are welded to tong. To replace, grind or chip off old weld and remove worn part. Apply new part as shown in Fig. 8, using stainless steel rod and bead size specified.

SPECIAL WARNING NOTE:

On cars using Free Lateral type journal boxes and having brake frames fitted with Stop Pin (Item #3 shown on Page 2, Section 2) it is important that a 1/8" depth flat is ground away from the edges of the fulcrum pin thrust washers, also the flanges of the bushings of the Bridge Assembly and the Fulcrum bushings in the Brake Frame. This is required only on the surfaces adjacent to the wheel, and assures ample clearance to prevent rubbing on rim of wheel when lateral displacement comes in that direction.

See sketch in Fig. 9.

INSTALLATION

Lubricate all exposed surfaces of pins, bushings and thrust washers with graphite lubricant. (See Lubrication, Page 19). Note: All pins and bushings should be so lubricated at least once each year.

Install using reverse procedure to that called for under removal.

BRIDGE ASSEMBLY

The primary reasons for this unit are: —

(1) to resist upward forces produced by brake reactions.

(2) to keep brake shoes in proper alignment with disc.

(3) to hold brake shoes and cylinder in proper lateral alignment.

(4) to resist lateral forces of cylinder and brake shoes.

(5) to provide readily accessible means of tong removal.

For illustration of component parts see Page 13, Section 2.

REMOVAL

To remove the Bridge Assembly, take off the nuts and lock washers, then with a rawhide hammer drive down the bolts (Bridge to Brake Frame) until bolts drop out.

MAINTENANCE

It is important that Bridge Assembly be bolted tight to Fulcrum Support on the Brake Frame Assembly.

In normal service, the only wearing parts are the two flanged bushings, which are pressed into the bridge body. These bushings should be cleaned and lubricated with specified graphite lubricant each time tongs are replaced, but not less than once a year.

SPECIAL WARNING NOTE:

On cars using Free Lateral type journal boxes and having brake frames fitted with Stop Pin (Item #3 shown on Page 2, Section 2) it is important that a 1/8" depth flat is ground away from the edges of the fulcrum pin thrust washers, also the flanges of the bushings of the Bridge Assembly and the Fulcrum bushings in the Brake Frame. This is required only on the surfaces adjacent to the wheel, and is desirable to assure that ample clearance exists to prevent rubbing on rim of wheel when lateral displacement comes in that direction. See sketch in Fig. 9.

On brake installations requiring Fulcrum Cover, care should be taken to insure proper fit and condition of the Fulcrum Cover Gasket to provide a good water and dirt tight seal.

BRAKE FRAME ASSEMBLY

The functions of the Brake Frame Assembly are: —

(1) to maintain proper alignment of the brake shoes and the brake disc, and

(2) a resilient, yet substantially rigid, means of transferring braking reactions to the truck frame and wheels without producing disturbing noises or affecting riding qualities.

A conventional type brake frame assembly is illustrated on Page 2, Section 2. This brake frame mounting in the truck is a three point rubber-backed suspension, with one point at the hanger box attached to the truck frame transom and the other two points one each on the rear enclosure of each journal box.

Another type is illustrated on Page 3, Section 2. The two outside points of this style are supported on the truck equalizer, instead of journal box as is accomplished on the conventional type.

REMOVAL OF BRAKE FRAME FROM TRUCK

This is seldom required, but when desired may be done by: —

(1) Drop wheel unit.

(2) Disconnect connection to cylinder brake hose.

(3) Remove hanger box cap.

(4) Entire brake assembly can then be removed.

MAINTENANCE

In normal service, the following parts of the Brake Frame Assembly require attention (Refer to illustration on Page 2, Section 2): —

(1) Rubber Backed Bearings, Item 6.

These are most important to assure proper brake shoe alignment. If missing, loose, the rubber torn, or the manganese wear liner worn excessively these Rubber Backed Bearings should be replaced.

It is not necessary to remove the Brake Frame from the truck for replacing this item. It can be made accessible by dropping the wheels and lowering brake frame.

First remove the defective rubber backed bearing by chipping or grinding off welds fastening this unit to the side bearing arm of brake frame. DO NOT BURN OFF with a torch or carbon arc!

Next grind off any remaining weld deposit. Failure to do this may prevent proper seating of new part.

Apply new rubber backed bearing, following method detailed in Fig. 3.

IMPORTANT CAUTION: It is very important that the Rubber Backed Bearings are accurately located on the side bearing arm. If located too far forward or backward, difficulty will be had in "snapping" the brake frame over the journal box rear enclosure when wheels are being installed in truck. In such cases the rubber backed bearings are forced, resulting in damage to, or even destruction of, this part.

For convenience in getting proper location of the rubber backed bearing when replacements are made, before clamping or welding, use a ¼" dia. pin through the rubber backed bearing hole and the hole in side bearing arm. After rubber backed bearing is welded in place, remove the pin.

(2) Fulcrum Pin Bushings, Item 2.
These should be replaced when worn excessively either in the pin hole or on thrust bearing surface of flange. These flanged bushings are a pressed fit in the fulcrum support of the brake frame assembly.

(3) Wear Plate, Item 5.
These wear plates control lateral of brake frame with respect to journal box, thereby controlling lateral clearance between wheel and brake frame side bearing arm. They are welded with ~~mild~~ 18-8 STAINLESS steel rod to the side bearing arm.
Replace as condition requires.

(4) Wear Plate (Item 7) where used or Stop Pin (Item 3) where used.
These maintain lateral travel limits of the tongs during released brake position, thereby preventing shoe linings "dragging" and wearing when brakes are released.
WELD ON WEAR PLATES WITH 18-8 STAINLESS STEEL ROD.
Maintain in suitable condition. REPLACE STOP PINS IF LESS THAN 6 3/16" LONG.

(5) Stop Pin Bushing, Item 4.
Maintain in suitable position and condition.

These bushings should be maintained in position shown on illustration. They are tack-welded to the fulcrum support to position them laterally so outside edge of bushing is flush with outside face of fulcrum support. If shifted, drive back to position and safety with about ½" long bead of weld.

(6) HANGER TUBE E86-04924, SEE BULLETIN NO. 15.

BRAKE DISC

The Brake Disc Assembly as used is an integral unit of special cast iron for the braking surfaces and a steel stamping to provide attachment to the wheel.

MOUNTING DISC TO WHEELS

The disc may be applied to the wheel either prior to pressing wheel on axle or it may be slid over the axle loose and fastened to the wheel after wheel is pressed on the axle. The type and style of wheel press used would govern the procedure used.

Application of Discs to Wheels:

Disc B86-04636 & B86-09370 (28" with 11½" bolt circle) to 36" wheel (Fig. 12)
Disc B86-05792 & B86-09360 (26" with 10¼" bolt circle) to 33" & 34" wheel (Fig. 13)
ALSO SEE BULLETIN NO. 17.

Heretofore, two different fasteners were used to secure the disc to the wheel and each used a different depth of tapped hole in the wheel hub. The Budd Company has now adopted as the standard fastener for all discs Bolt F86-06154. Use of Stud E86-01763 and Nut 21L18M or 21J18M will be discontinued.

Figures 12 and 13 illustrate dimensionally all wheel hub machining and bolt hole tapping requirements. To assure proper spacing of discs, satisfactory bearing of disc mounting face on wheel hub, and to assure that bolt fastener does not bottom in the tapped hole, it is important that machining be within limits specified on the sketches.

Some railroads have in some instances omitted Lock Washers 71A32M. This is not approved by The Budd Company. We strongly urge use of Bolt F86-06154 and Washer 71A32M and that these bolts be safetied as specified.

REMOVAL OF DISC

1. Cut and remove all safety wires from fasteners.
2. Remove fasteners.
3. Press wheel off axle and remove disc.
4. Disc should be cleaned and inspected to determine if suitable for re-application to another wheel for continued service, or condemned for scrapping.

   Where disc is reused, clean all cooling fins to assure unrestricted air flow.

   Under normal operating conditions, the service life of the disc is much greater than the service life of the wheel. Therefore, discs should be carefully examined before they are scrapped.

REASONS FOR CONDEMNING OF BUDD BRAKE DISC

NICKS

It is fairly common for the outside edges of the brake discs to become nicked occasionally in normal service. This is not cause for removal of the disc unless the nick is severe enough to interfere with braking. As long as the brake lining will not be damaged and will pass smoothly over the nick when the brakes are set, the brake will operate satisfactorily.

SCRATCHES

It is common for the braking surfaces of the discs to become scratched in normal service. Such surface scratches are not cause for removal and will not interfere with braking. We do not recommend machining to remove such scratches. We recommend that such discs be continued in service.

WEAR

There is very little wear on the disc braking surfaces. We do not recommend that discs be removed or machined for reasons of any wear that will be found in normal service.

THERMAL CRACKS

It is possible under conditions of unusual overload for a disc to be thermal cracked. In practically all cases, a thermal cracked brake disc will be preceded by abnormally rapid shoe lining wear. If this condition of rapid lining wear is noticed and corrective measures applied to the cause, it should be possible to prevent serious thermal cracks.

When they do appear, thermal cracks will usually be in small darkened clusters and have an appearance similar to thermal cracks in wheels and will develop radially. We recommend that a disc be condemned only when a crack widens to a point that it cuts the lining during a brake application. Cracks running out at the edges of the disc and opening up to more than 1/32" are reasons for condemning.

MACHINING

We do not recommend machining brake discs to remove thermal cracks. There are two reasons for this:

1. By reducing the thickness of the braking surface, it reduces the thermal capacity of the brake. Thus more harm than good may result even though some small thermal cracks may have been removed by machining.

2. Brake discs have continued providing satisfactory service for years after thermal cracks have appeared without the cracks necessarily progressing. The important thing is to correct the condition that caused the small thermal cracks.

In unusual cases, such as a badly scored disc resulting from a missing brake shoe, the disc face may be machined by taking a thin cut to return the face to a more satisfactory surface. Under this condition, the disc face does not have to be absolutely smooth as it will be smoothed ultimately by the action of the brake lining. In no case should the thickness of the disc face be made less than 7/16".

SEE FIG. 14 & 14A ON MACHINING WORN DISC SURFACES.

WELDING

The material of the Budd brake disc is not suitable for satisfactory welding. Repairing a brake di c by welding is not recommended.

RUST PROTECTION

While in service under the car, discs require no attention for preventing harmful corrosion.

When new discs are shipped from The Budd Company to the Railroad or Car Builder for mounting, the machined surfaces are protected against rusting by a coating of aluminum paint. Until Discs are mounted and put in service in a truck, no further rust protection normally is required.

After Discs are once in service and wheels are removed from trucks for handling, storage, or shipment, the disc braking surfaces should be completely coated with a rust preventive, such as a mixture of paint and oil or some proprietary product, which will not wash away but which may be wiped off easily.

Before placing wheels with coated disc under a car ready for service, the coating must be carefully removed with a suitable solvent.

If preferred, the protective coating used may be aluminum paint. In such cases, this coating need not be cleaned off when Discs are placed in service, but care must be taken not to coat the area of the fins between the braking surfaces of the Disc.

HAND BRAKES

A right hand or left hand hand brake crank and hand brake truck lever is provided as required to actuate the brakes manually.

These cranks are coupled to the conventional hand brake chain through an equalizer mechanism.

AIR "ON-OFF" INDICATOR ASSEMBLY

Where used, this indicator is attached to the car body, four to a car or one on each side for each truck.

It indicates presence or absence of air pressure in the brake cylinders on that particular truck. It indicates "brakes applied" or "brakes released" to train crews, inspectors and maintenance personnel in making air tests.

This indicator WILL NOT detect or indicate whether hand brake is set or released.

This indicator will not detect or indicate any mechanical failure or possible malfunctioning of the truck brake mechanism. A look at both faces of the disc immediately after a car comes off a run will show if brakes are functioning properly. Both braking faces of each disc should show a bright clean surface, free of rust or discoloration when brakes function properly.

LUBRICATION

(a) A good grade of AAR approved Brake Cylinder Lubricant meeting AAR Specification M-914, latest issue, is recommended for the Brake Cylinder Wall, Packing Cup, rubbing surface of Piston Head and the Piston Rod.

(b) A good grade of light machine oil is recommended for the Cylinder Felt Lubricator Swab and for the Piston Rod Lubricator Felt Ring.

(c) For all other metal-to-metal wearing surfaces a special QUICK DRYING GRAPHITE LUBRICANT should be used. This lubricant is mixed as required of ingredients in following proportions: —

1. 5 lbs. Dixon Crucible No. 1924 Graphite Paste.
2. 1 quart thinner (made of 60% Naphtha and 40% Carbon Tetrachloride).

   Where use of carbon tetrachloride is not permitted, Railroad may substitute any good quick evaporating thinner like lacquer thinner or one of the following: —
   FO-128 made by Geo. W. Hessington Co. of Lindenwold, N. J.
   Formula #602 made by Penetone Co. of Tenafly, N. J.
   Per-Trolene made by John B. Moore Corp. of Nutley, N. J.
   Glocosol made by Globe Solvents Co. Inc. of Philadelphia, Pa.
3. Mix only the quantity immediately required and keep in a closed container.
4. Apply with a brush, allowing sufficient time for drying before assembling parts, (3 hours if possible). If parts are assembled before Graphite Paste is dry, they will have tendency to "freeze" or stick together.

WHEEL CHANGES

(This is accomplished by using your normal methods making certain that attention is given to the following:)

REMOVAL PROCEDURE

Before proceeding with wheel removal

1. When Support Cables are required —
   a. Determine whether or not brake support cables are required. These are necessary if support cable lugs are on the truck frame over the journal boxes. Support cables must be attached both sides between the lug on the truck frame and the loop on the bearing arm of the brake frame.
   b. If provided, the safety hanger linkage must be disconnected by removing the bolt and nut that attaches it to the truck frame.
2. When Support Cables are not required —
   a. If provided, the safety hanger linkage must be extended by removing the upper pin that retains it in safety position at the truck frame.
3. Continue with your normal wheel removal procedure.
   Caution: While dropping the wheels care must be taken to avoid damage to the hose and fittings of the air supply line to the brake cylinder. This should be disconnected if necessary.

INSTALLATION PROCEDURE

1. **Before installing the wheel and axle assembly, apply a coat of graphite lubricant (see lubrication page 19) to the wear plates on each journal box that support and guide the brake frame.**

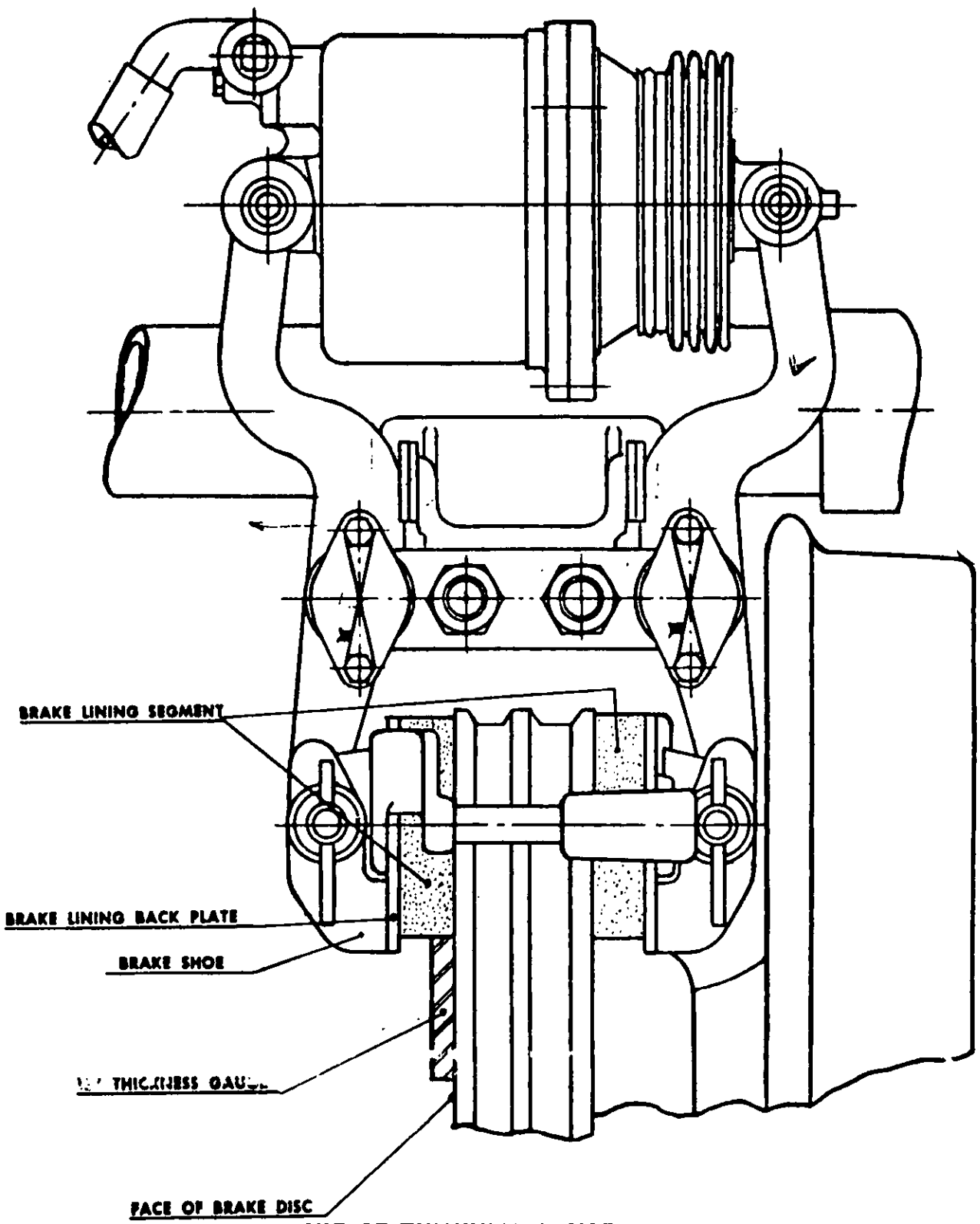
2. **When raising the wheels care must be taken to avoid damage to the Rubber Backed Bearings. When the wheel assembly is properly positioned, engagement of the rubber backed bearings with the journal boxes is easily accomplished.**

3. **Connect air supply line to the brake cylinder if it has been removed.**

4. **Remove brake support cables if used.**

5. **Reinstall the bolts or pins that were removed from the safety hanger linkage.**

   Note: **No adjustments of brake rigging necessary.**



USE OF THICKNESS GAUGE

To Determine Condemning Thickness of Brake Lining

Fig. 1

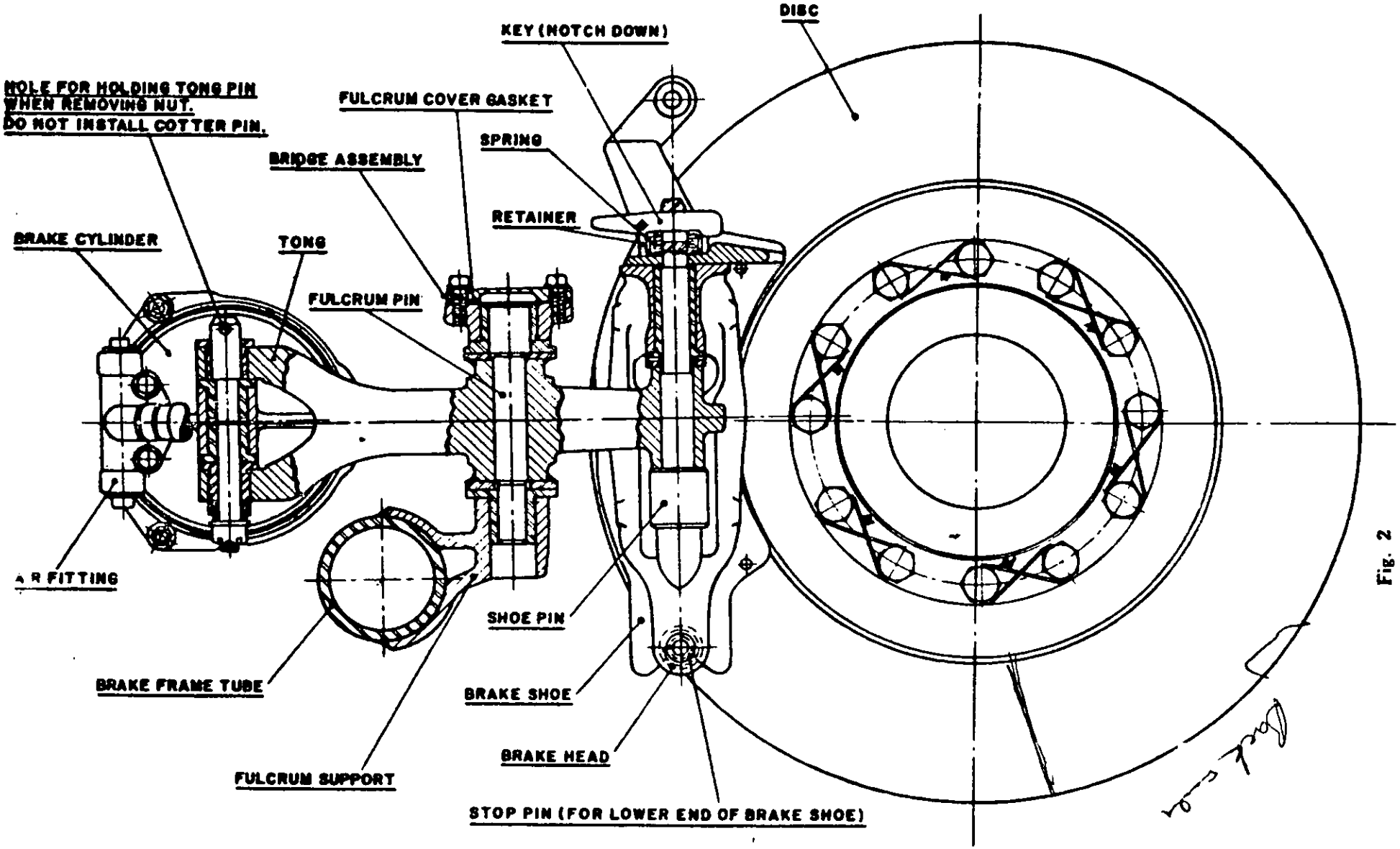
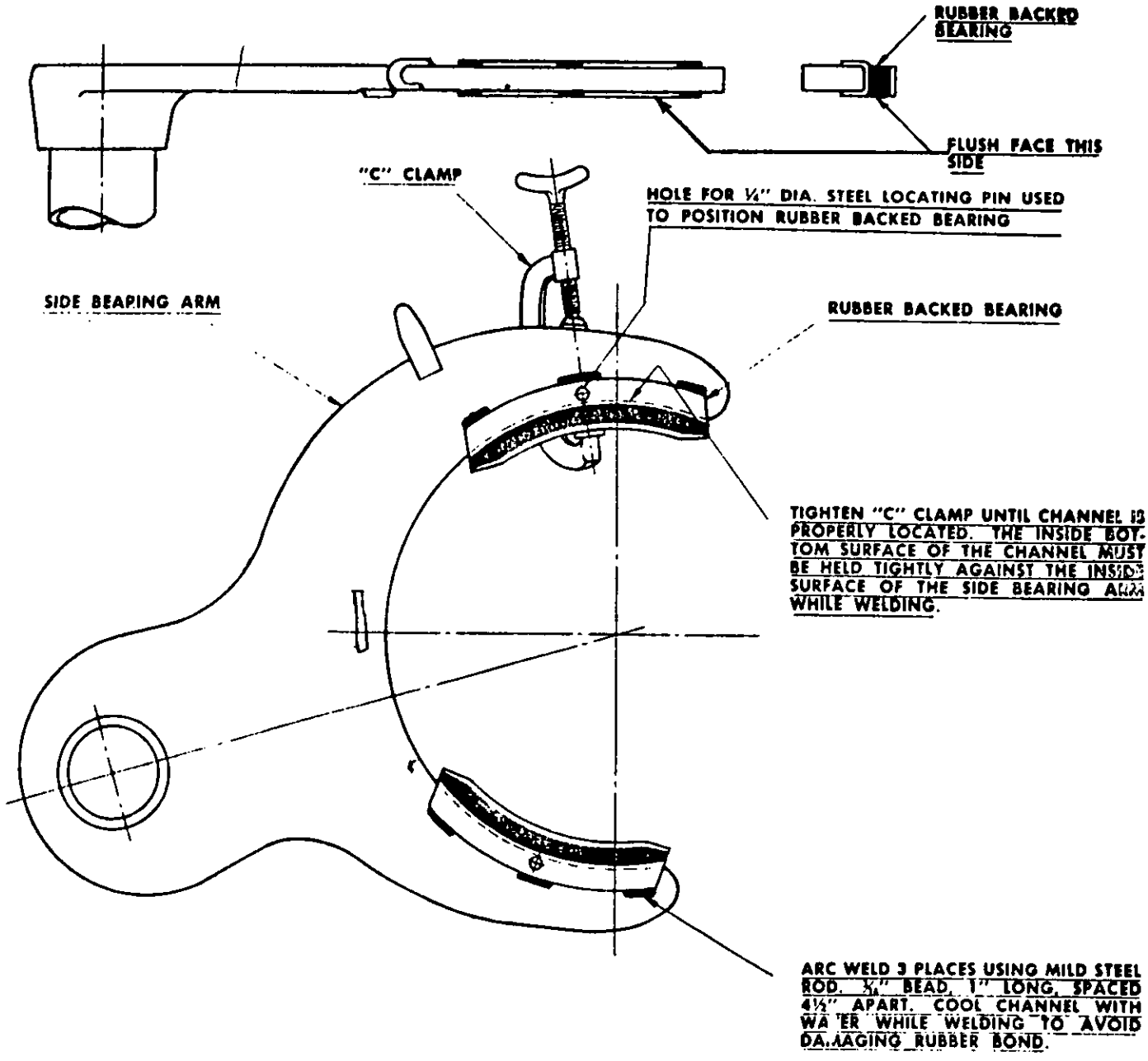


Fig. 2

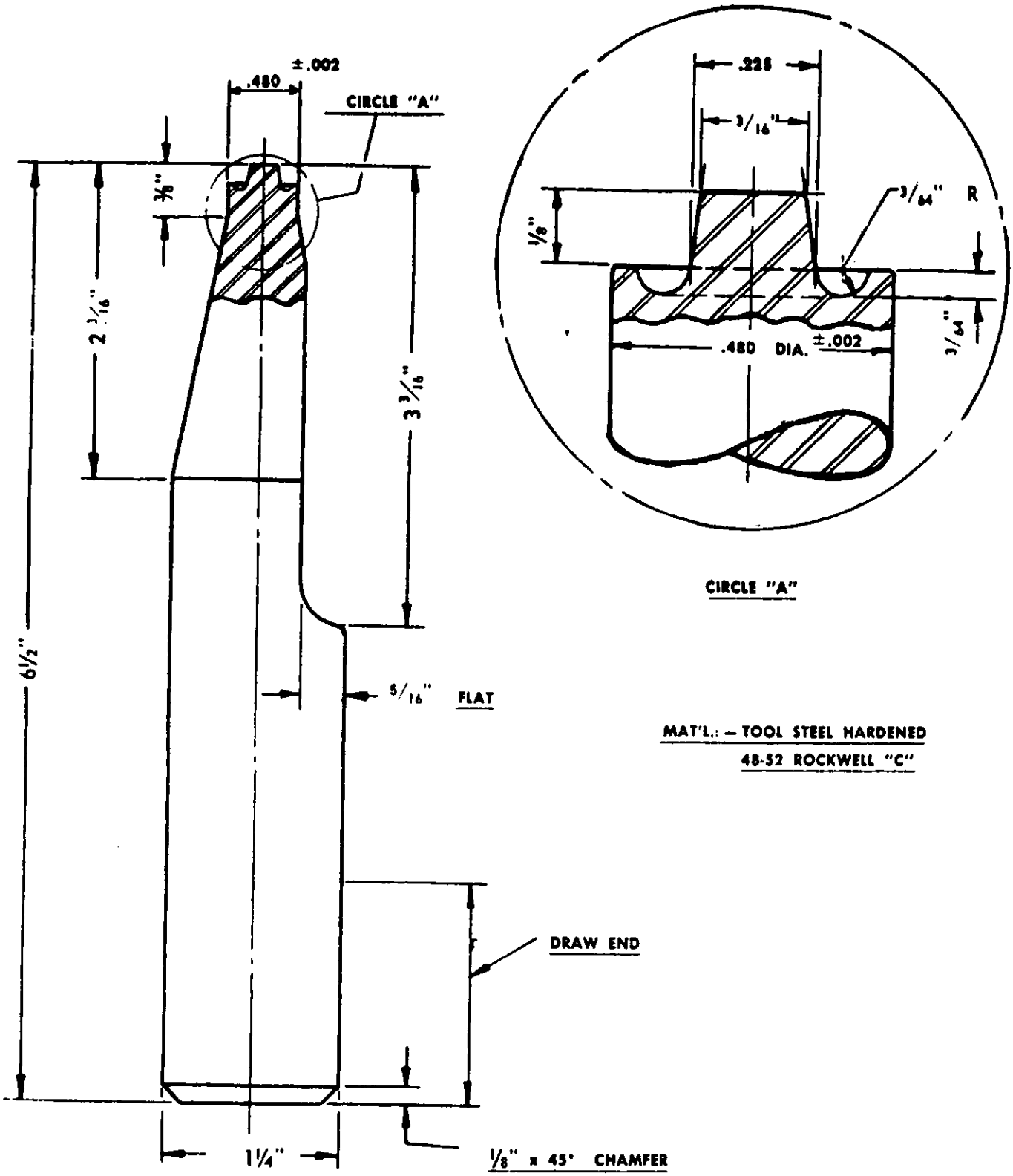
SECTIONAL VIEW OF BRAKE ASSEMBLY

Fig. 2



METHOD OF CLAMPING RUBBER BACKED BEARING FOR WELDING TO SIDE BEARING ARM

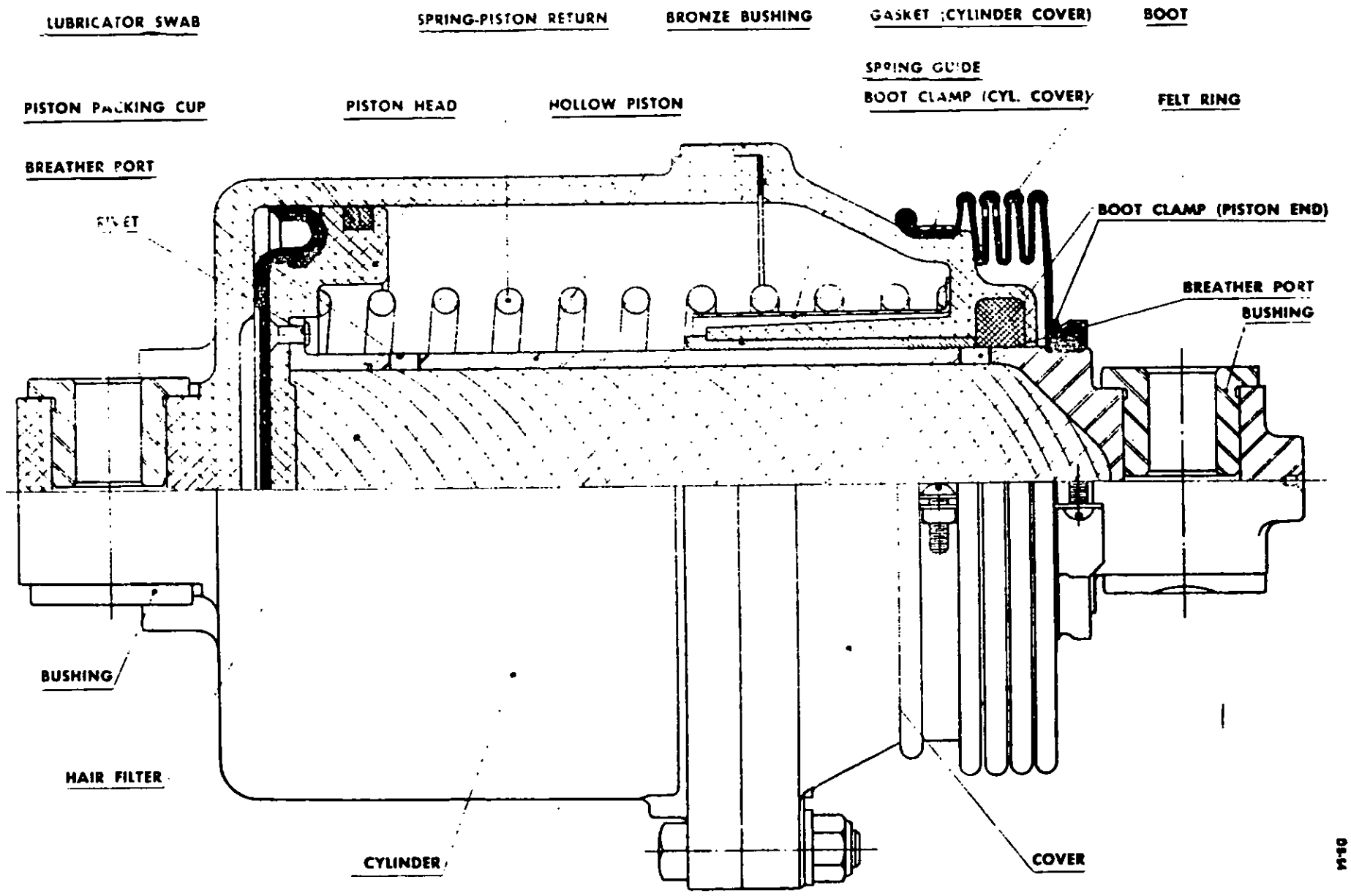
Fig. 3



HAND RIVETING SET

For Riveting Brake Shoe Studs

Fig. 4



HALF SECTION THROUGH AIR CYLINDER

Fig. 5

Fig. 5

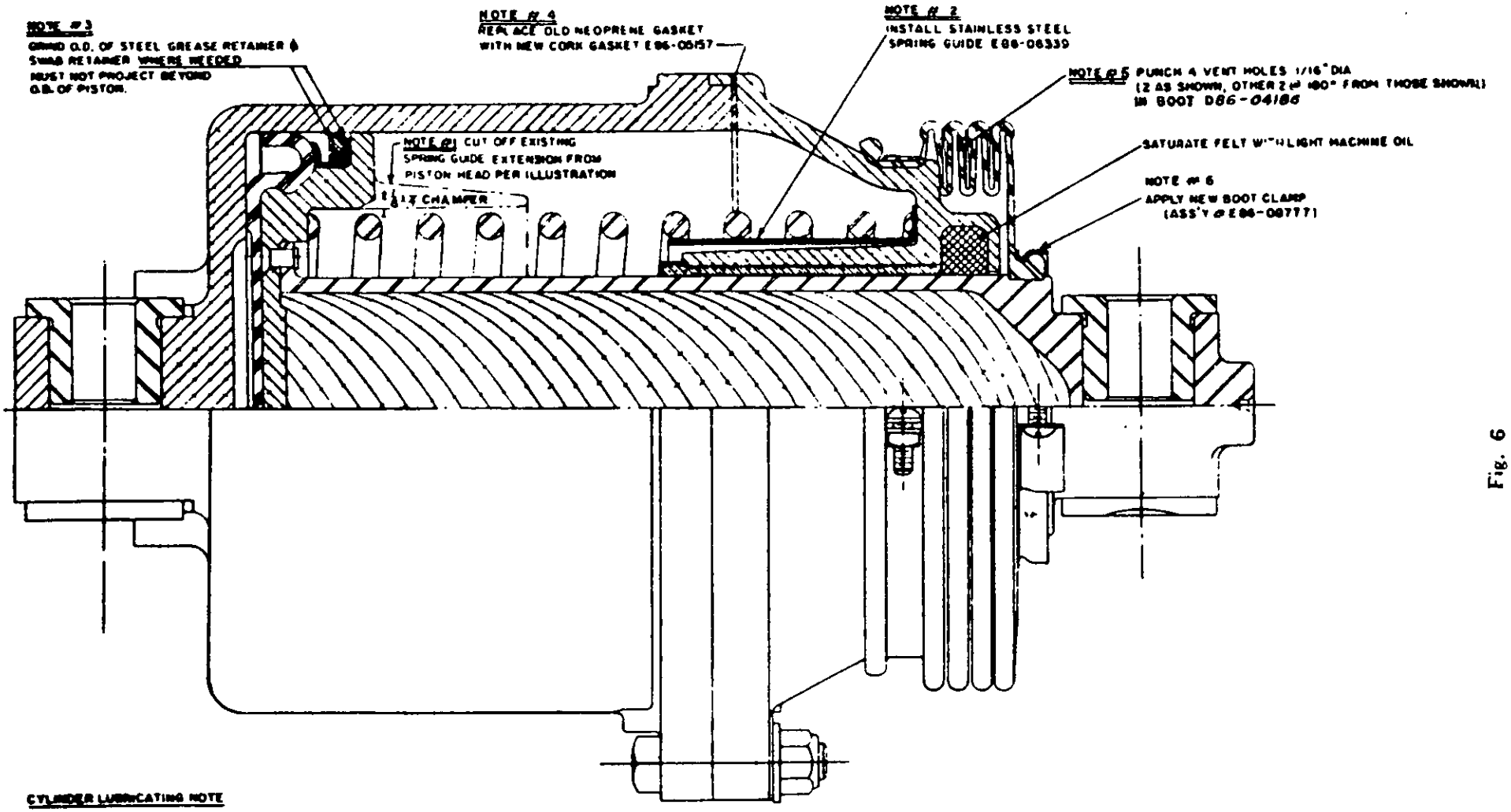
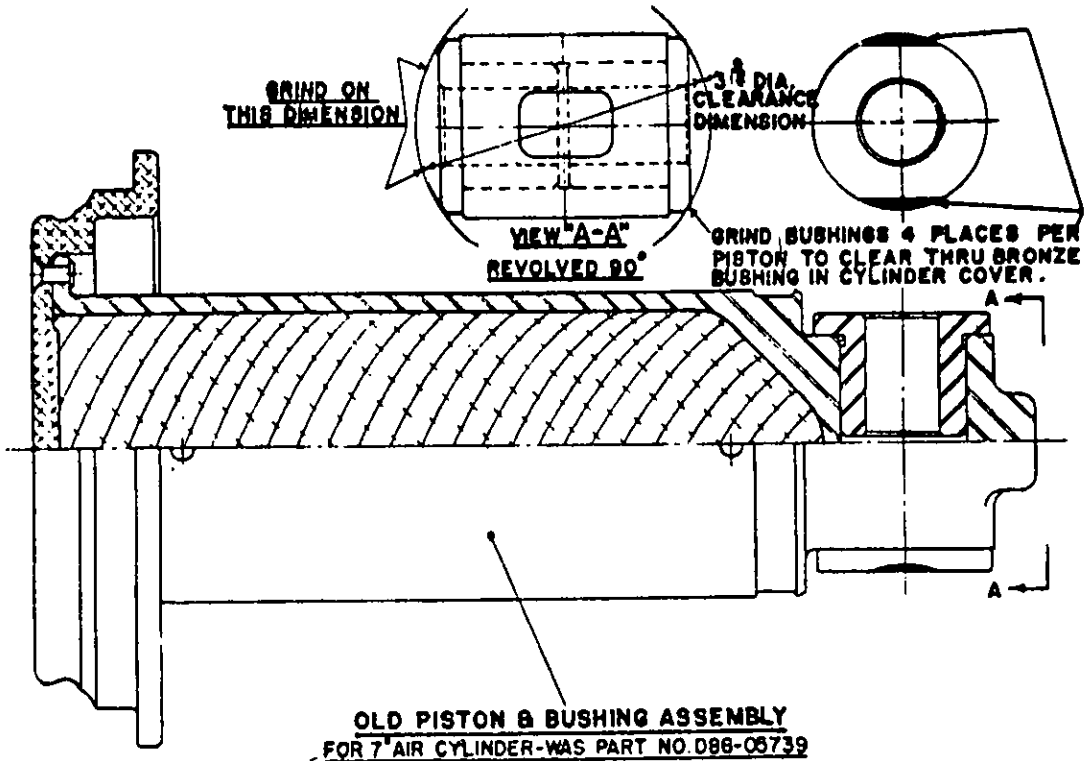


Fig. 6

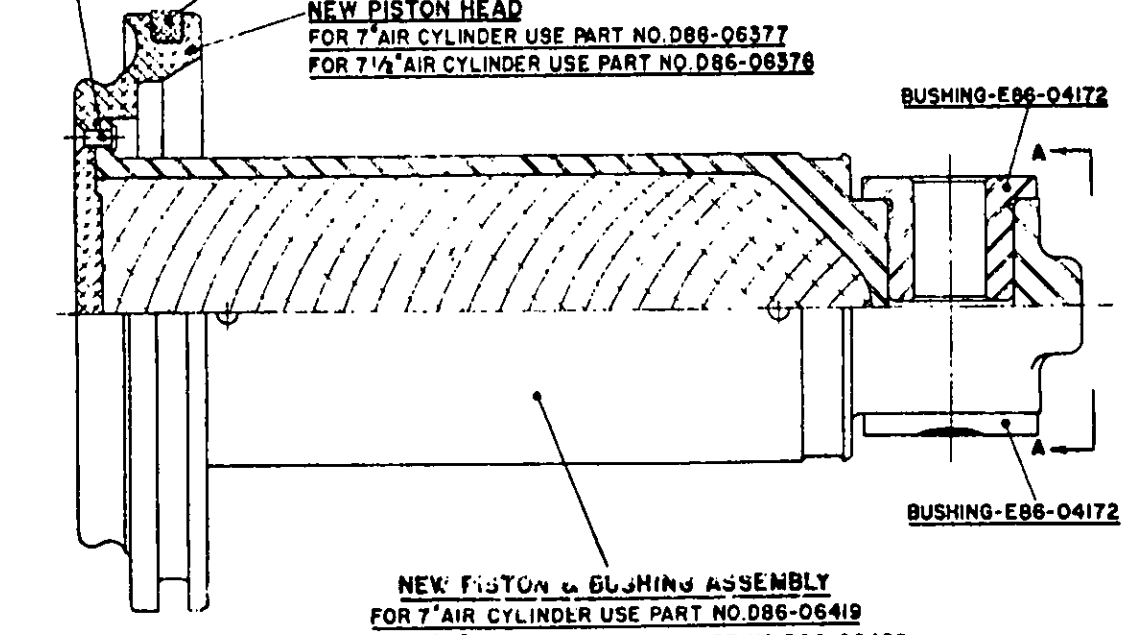
MODERNIZING
CF BRAKE CYLINDER

Fig.



OLD PISTON & BUSHING ASSEMBLY
FOR 7" AIR CYLINDER-WAS PART NO.D86-06739
FOR 7 1/2" AIR CYLINDER-WAS PART NO.D86-06740
(NO LONGER FURNISHED. REPLACED BY ASSEMBLY ILLUSTRATED BELOW)

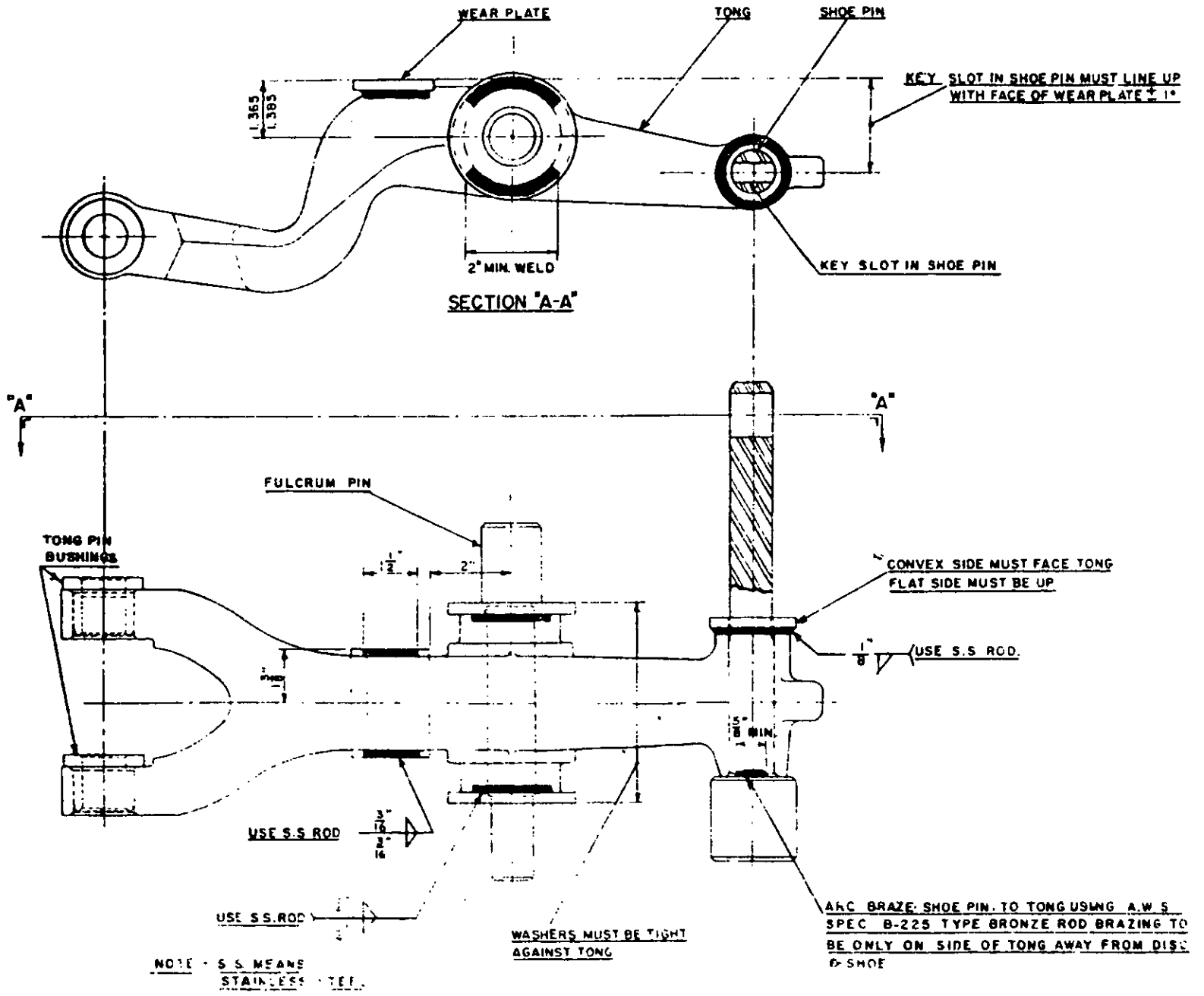
NOTE: NEW TYPE LUBRICATOR SWAB MUST BE ORDERED.
(NOT FURNISHED AS PART OF PISTON & BUSHING ASSEMBLY).
FOR 7" AIR CYLINDER USE PART NO.E86-06375
FOR 7 1/2" AIR CYLINDER USE PART NO.E86-06378



NEW PISTON & BUSHING ASSEMBLY
FOR 7" AIR CYLINDER USE PART NO.D86-06419
FOR 7 1/2" AIR CYLINDER USE PART NO.D86-06428

PISTON AND BUSHING ASSEMBLY

Fig. 7

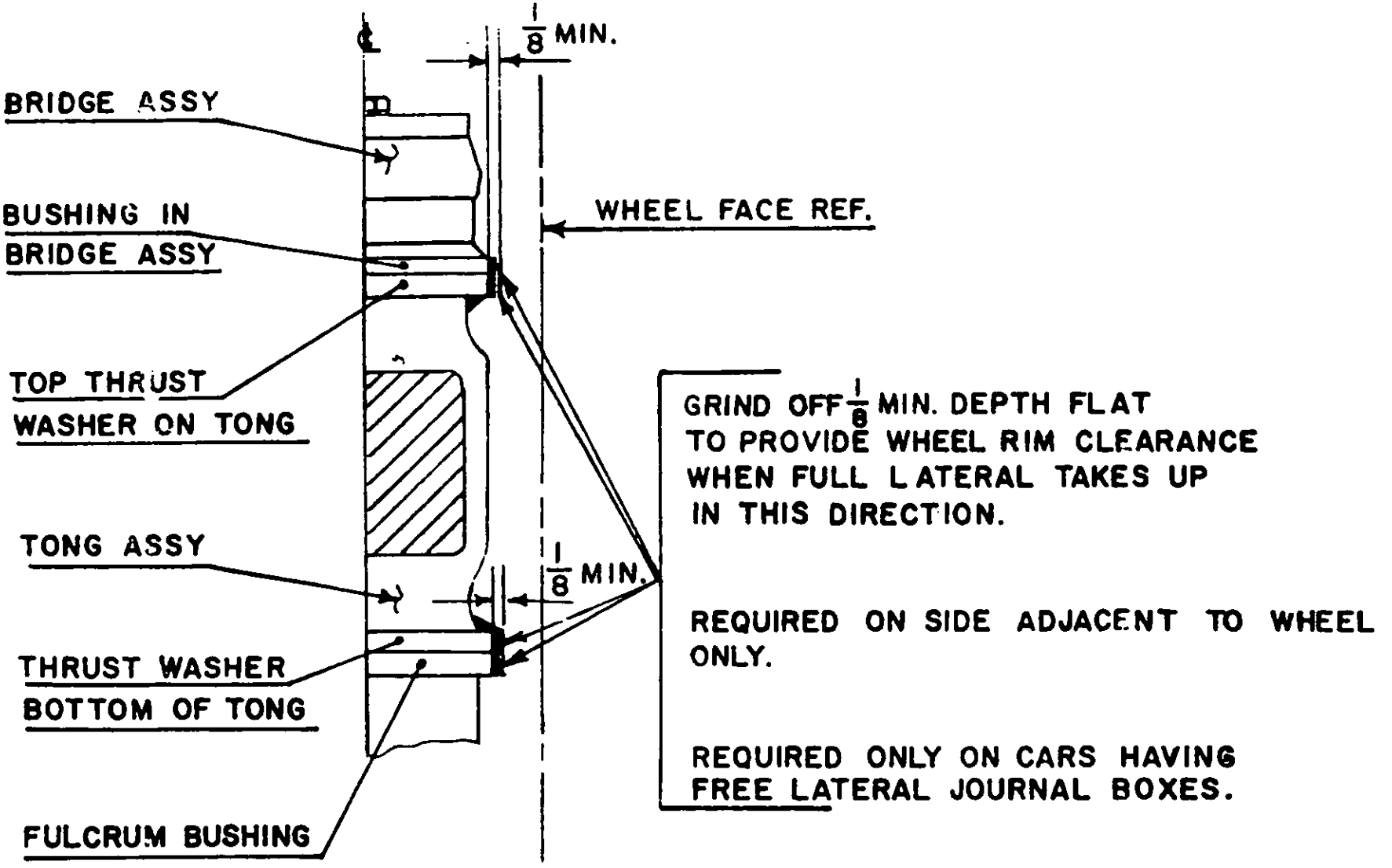


TONG A?

Fig. 8

Section 1
Page 29

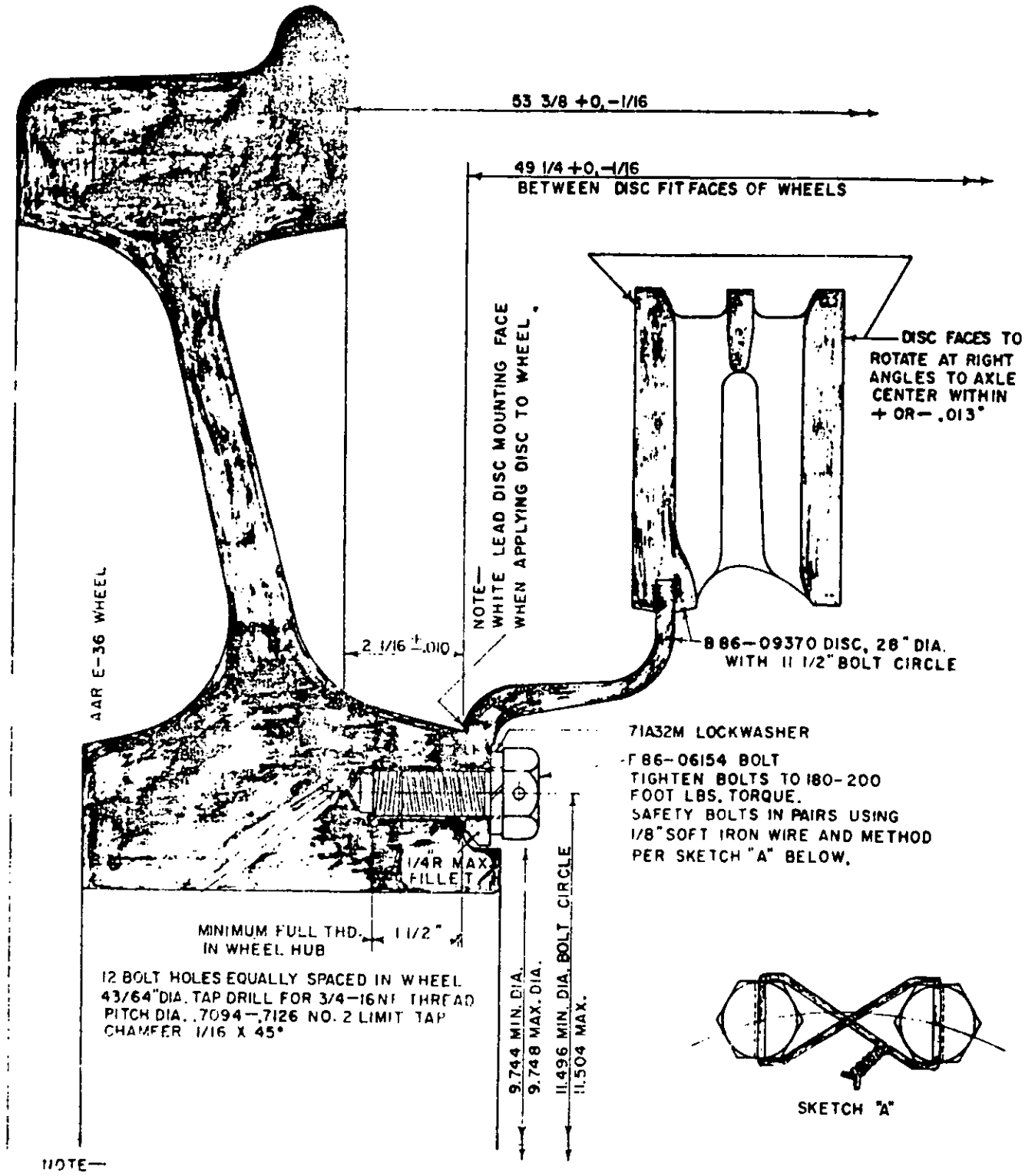
D8.54



CLEARANCE GRINDING OF THRUST WASHERS

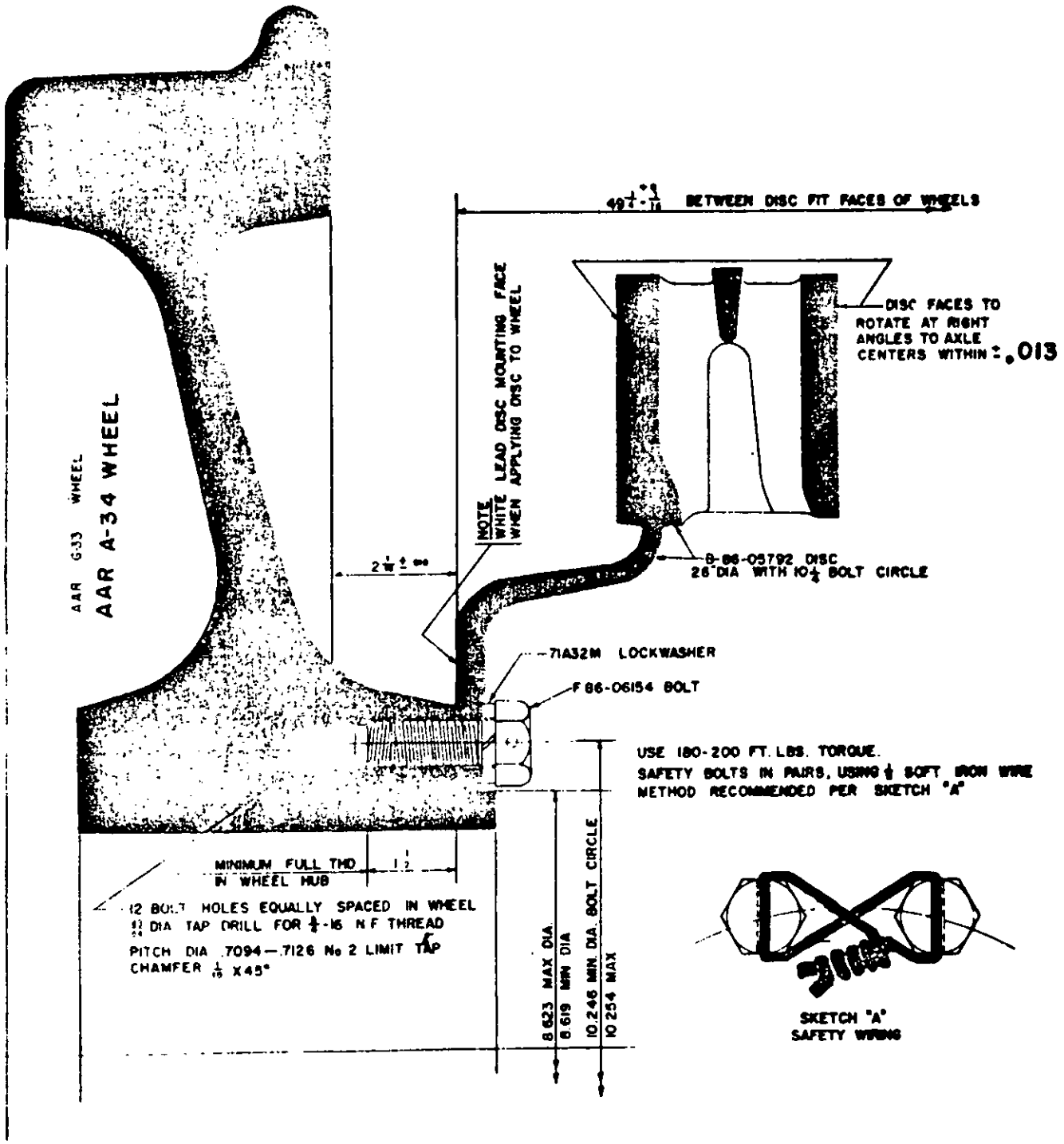
Fig.

Fig. 9



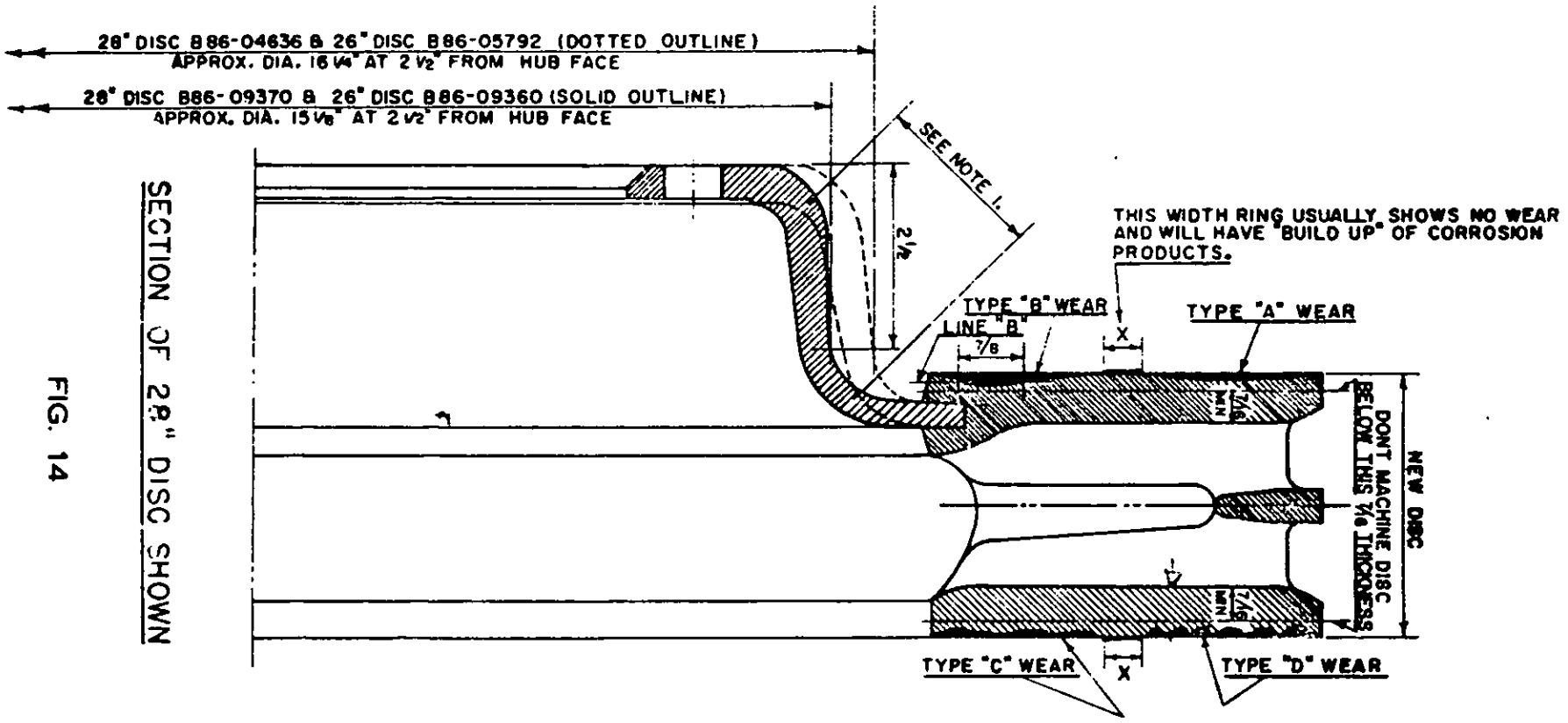
APPLICATION OF DISC B 86-04636
DISC B 86-09370
TO 36" WHEEL

Fig. 12



APPLICATION OF DISC B86-09360 / DISC B86-05792 TO 33" WHEEL

Fig. 13



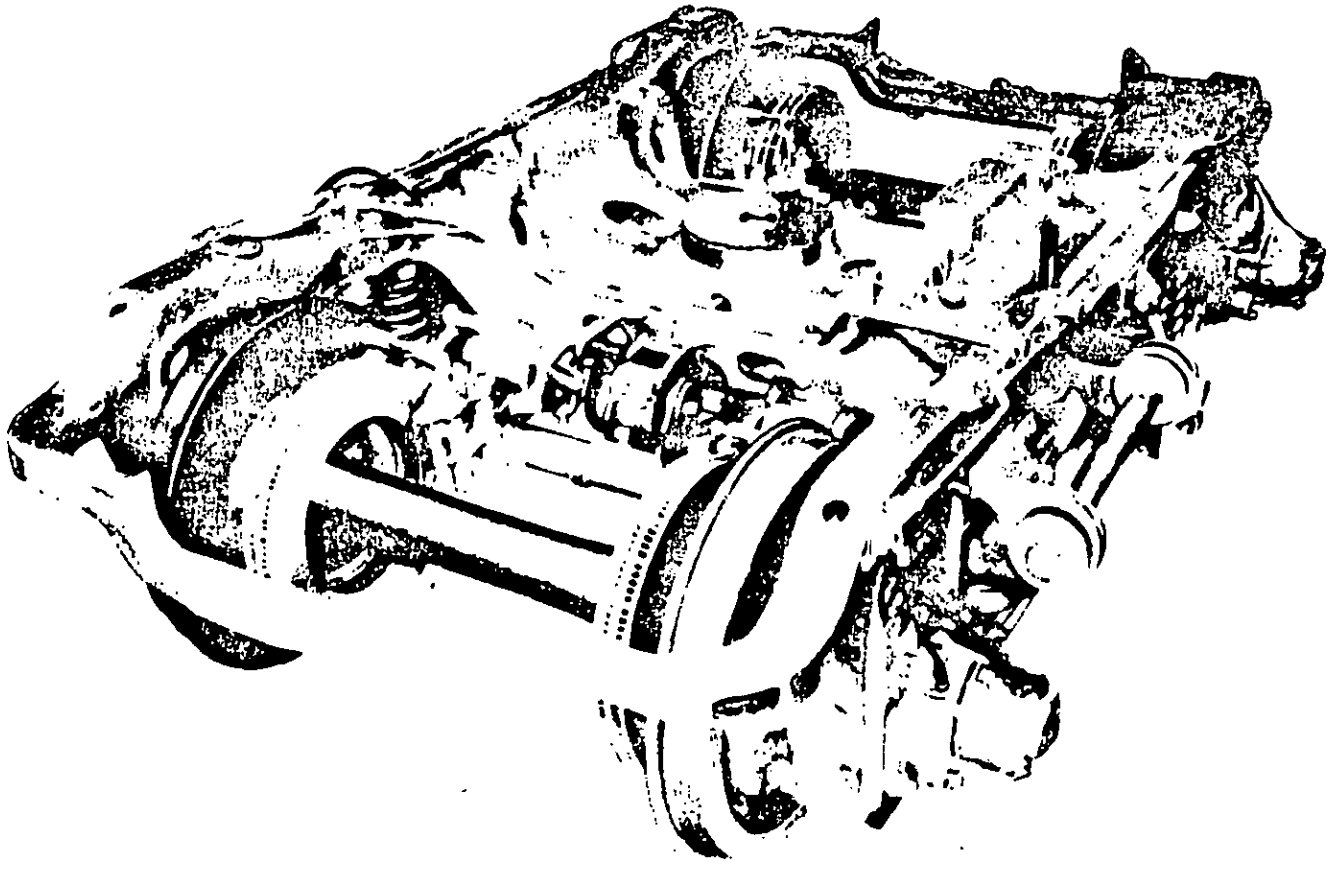
SECTION OF 28" DISC SHOWN

FIG. 14

SECTION 2

PARTS CATALOG AND ILLUSTRATION SECTION

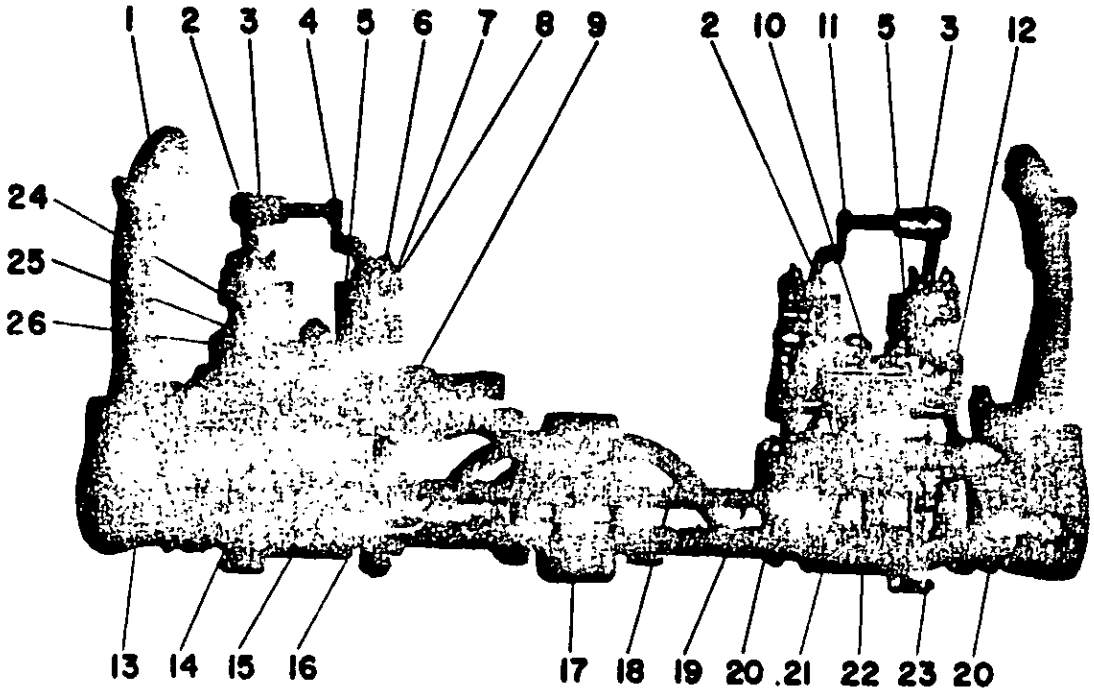
CONTENTS



TYPICAL TRUCK WITH BUDD DISC BRAKE INSTALLATION

Hand Brake Truck Shown

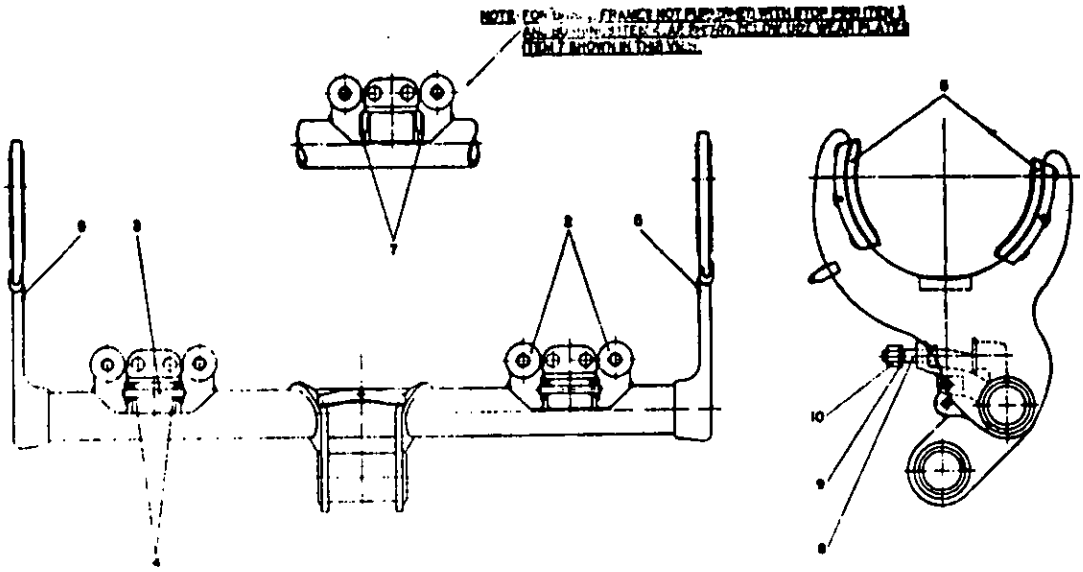
Non-Hand Brake Installation Similar Except Less Hand Brake Parts



BRAKE ASSEMBLY (Typical)

Item No.	Part Name	Item No.	Part Name
1.	Brake Frame Assembly	14.	Hand Brake Lever & Bushing Ass'y.
2.	Brake Shoe & Lining Ass'y., L.H.	15.	Pin (Hand Brake Crank)
3.	Brake Head Ass'y. (Outside)	16.	Hand Brake Crank Ass'y.
4.	Brake Head Ass'y. (Inside, R.H.)	17.	Hanger Box Assembly
5.	Brake Shoe & Lining Ass'y., R.H.	18.	Air Hose Assembly
6.	Key	19.	Tong Assembly, L.H.
7.	Retainer	20.	Tong Pin
8.	Spring	21.	Stop Pin
9.	Pin (Hand Brake Link)	22.	Air Cylinder Assembly
10.	Bridge Assembly	23.	Tong Assembly, R.H.
11.	Brake Head (Inside, L.H.)	24.	Bolt (Bridge to Brake-Frame)
12.	Fulcrum Cover	25.	Nut
13.	Pin (Hand Brake Lever)	26.	Lockwasher

Order MUST Give PART NUMBER and NAME of Part Wanted



BRAKE FRAME ASSEMBLY GROUP NUMBER	PART NUMBERS					
	BUSHING ITEM 2	STOP PIN ITEM 3	BUSHING ITEM 4	WEAR PLATE ITEM 5	RUBBER BACKED BEARING ITEM 6	WEAR PLATE ITEM 7
GROUP NO. 1	E86-05637	———	———	E86-04426	D86-05520	E86-04112
GROUP NO. 2	E86-05637	———	———	E86-01823	D86-05076	E86-04112
GROUP NO. 3	E86-05637	———	———	F86-06539	D86-05076	E86-04112
GROUP NO. 4	E86-05637	F86-06135	F86-06370	E86-01823	D86-05076	———
GROUP NO. 5	E86-05637	F86-06135	F86-06370	F86-06539	D86-05076	———

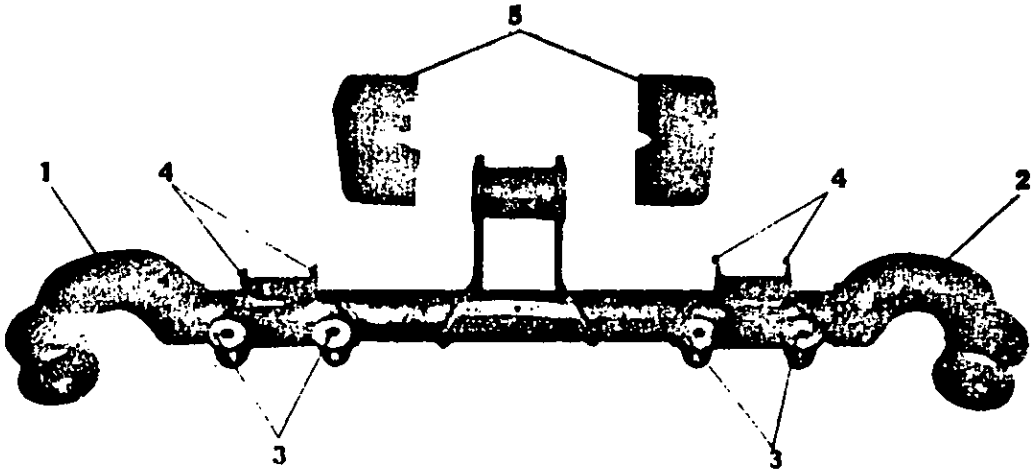
GROUP NUMBER	BRAKE FRAMES IN THE GROUP
GROUP NO. 1	B86-05518 B86-05693
GROUP NO. 2	B86-05037 B86-05732 B86-05797 B86-06150 B86-06199 B86-06285 B86-06471
GROUP NO. 3	B86-06240 B86-06430 B86-06868 B86-09269 B86-09275 B86-09684 B86-09689 B86-09783 B86-10319
GROUP NO. 4	B86-06130
GROUP NO. 5	B86-06387 B86-06440 B86-06809 B86-06835 B86-06965 B86-09930 B86-09195 B86-09231 B86-09244 B86-09330 B86-09387 B86-09388 B86-09389

BRAKE FRAME ASSEMBLIES

Note: The Following Parts Are Not Furnished As Part of the Brake Frame Assembly and Must Be Ordered Separately.

Item No.	Part No.	Part Name
8.	E86-04923	Bolt (Bridge to Brake Frame)
9.	71A40M	Lockwasher (Bridge to Brake Frame)
10.	21J26M	Nut (Bridge to Brake Frame)

Order MUST Give PART NUMBER and NAME of Part Wanted

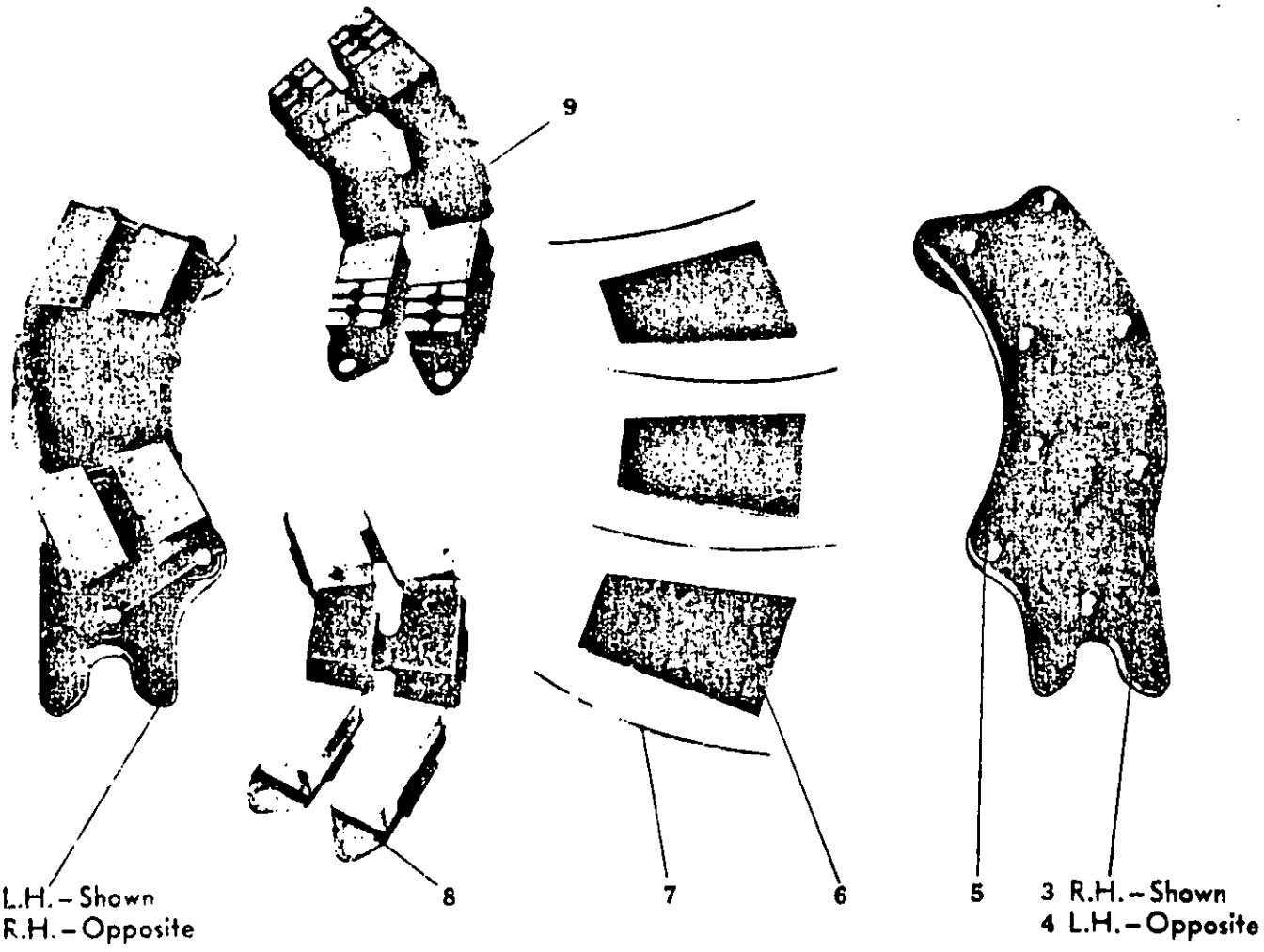


B86-06264 BRAKE FRAME ASSEMBLY

Item No.	Part No.	Part Name
1.	A86-04925	Side Arm, R.H.
2.	A86-04926	Side Arm, L.H.
3.	E86-05637	Bushing (Fulcrum Pin)
4.	E86-04112	Wear Plate
5.	E86-04931	Rubber Segment (Hanger Box)
6.	E86-04923	Bolt (Bridge to Brake Frame)
7.	71A40M	Lock Washer (For Item 6.)
8.	21J26M	Nut (For Item 6.)

Note: Not Illustrated — Items 6, 7, and 8.

Order MUST Give PART NUMBER and NAME of Part Wanted

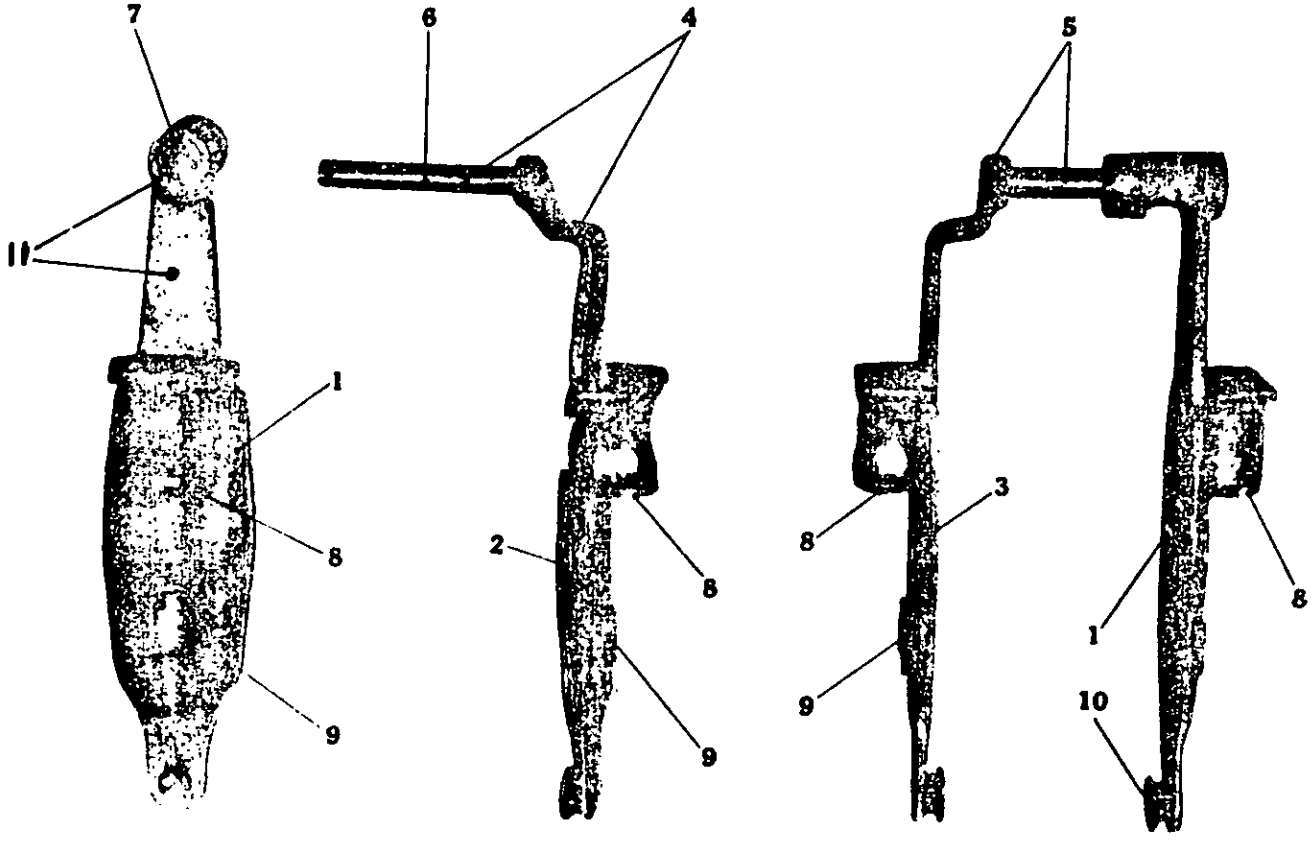


BRAKE SHOE AND LINING ASSEMBLIES

Item No.	Part Name	Part Numbers	
		For 26" Brake Disc	For 28" Brake Disc
1.	Brake Shoe & Lining Ass'y., L.H.	D86-05770	D86-05117
2.	Brake Shoe & Lining Ass'y., R.H.	D86-05771	D86-05116
3.	Brake Shoe & Stud Ass'y., R.H.	D86-05758	D86-05139
4.	Brake Shoe & Stud Ass'y., L.H.	D86-05759	D86-05140
5.	Stud	E86-05177	E86-05177
6.	Rubber Pad	F86-00183	E86-05137
7.	Wire* NO.10 SOFT IRON	* L86-08990	* L86-08990
8.	Brake Lining Ass'y. (Standard)	D86-05772	D86-05134
5.	Brake Lining Ass'y. (Metal Toe)	D86-08800	D86-08869

* Order and cut from L 86-08990 X 10 FT. LONG.

Order MUST Give PART NUMBER and NAME of Part Wanted



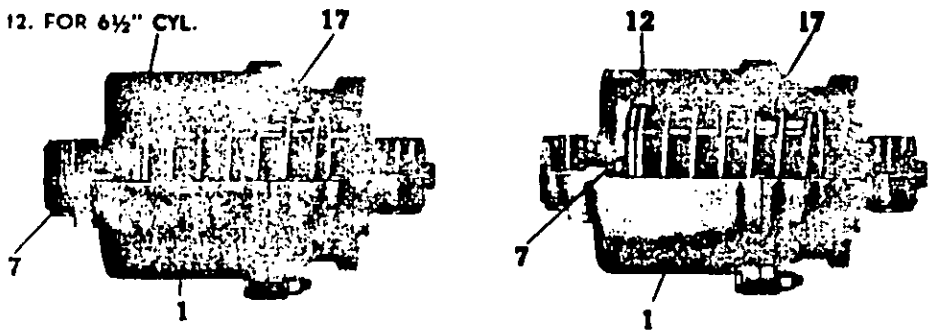
BRAKE HEAD ASSEMBLIES

Item No.	Part No.	Part Name
1.	D86-04912	Brake Head Ass'y. (Outside) Complete
2.	D86-04914	Brake Head Ass'y. (Inside, L.H.) Complete
3.	D86-04913	Brake Head Ass'y. (Inside, R.H.) Complete
4.	E86-06364	Arm & Guide Pin Ass'y., R.H.
5.	E86-06363	Arm & Guide Pin Ass'y., L.H.
6.	E86-04898	Guide Pin
7.	E86-01577	Bushing
8.	E86-06516	Bushing
9.	E86-04578	Wear Plate
10.	E86-05114	Stop Pin
11.	E86-09257	ARM & BUSH. ASSY.

Order MUST Give PART NUMBER and NAME of Part Wanted

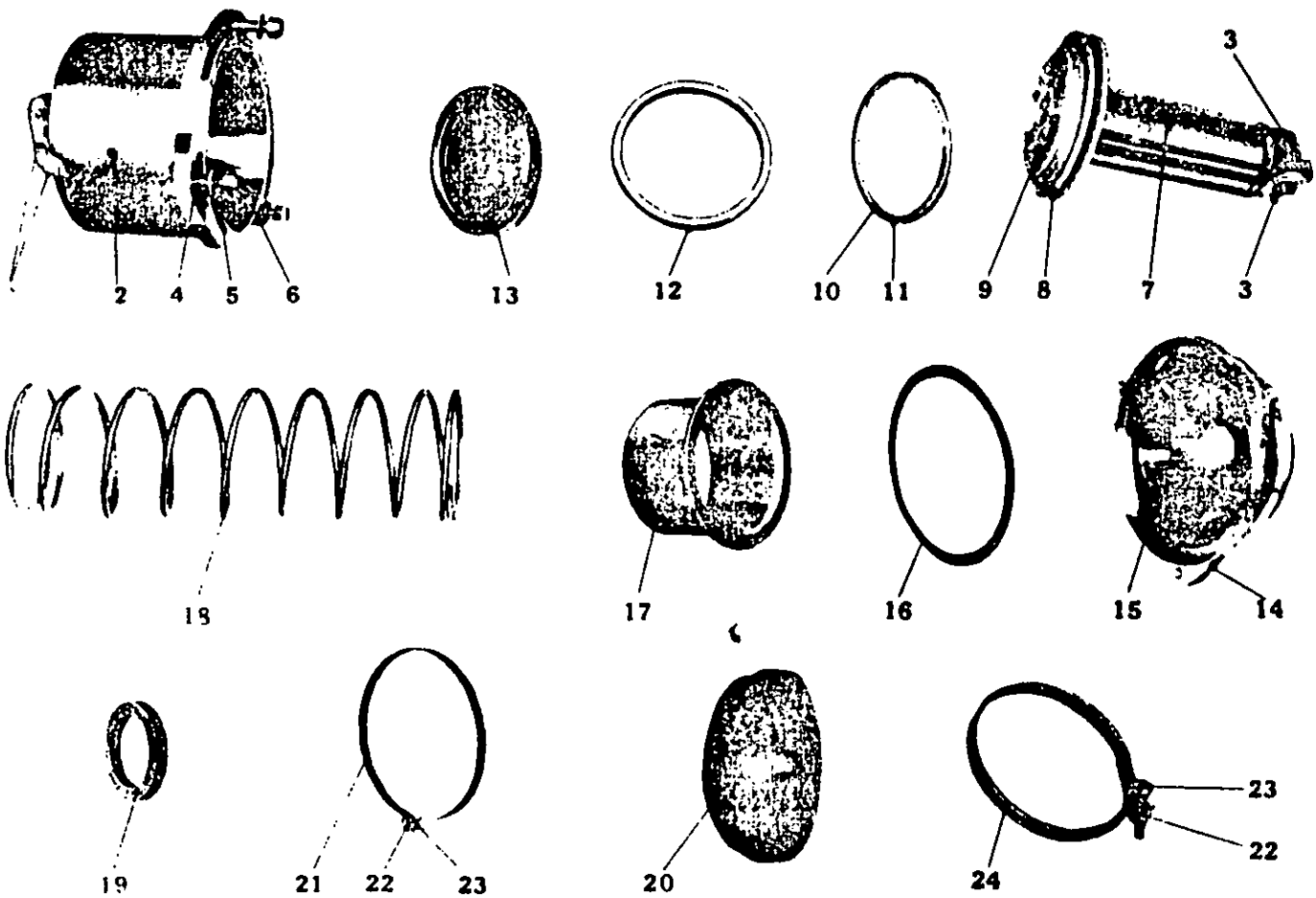
10. FOR 7" & 7½" CYL.

12. FOR 6½" CYL.



Style "A" Style "B"

See Page 6a, Section 2, For Ordering Reference



For Part Numbers See Opposite Page

AIR CYLINDERS AND PARTS

Order MUST Give PART NUMBER and NAME of Part Wanted

AIR CYLINDER ASSEMBLIES

Item No.	Part Numbers 6½" Cylinder	7" Cylinder	7½" Cylinder	8" Cylinder	Part Name
1.	D86-05080	D86-05050	D86-05047	D86-08844	Air Cylinder Assembly
2.	E86-05122	E86-05161	E86-05163	E86-08843	Cylinder Assembly
3.	E86-04172	E86-04172	E86-04172	E86-04172	Bushing (Piston & Cylinder)
4.	7A1243M	7A1243M	7A1243M	7A1243M	Bolt (Cover to Cylinder)
5.	70A24M	70A24M	70A24M	70A24M	Washer (Cover to Cylinder)
6.	21F12M	21F12M	21F12M	21F12M	Nut (Cover to Cylinder)
* 7.	D86-05738	D86-06419	D86-06428	D86-08842	Piston Assembly
* 8.	D86-05733	D86-06377	D86-06376	D86-08841	Piston Head
9.	60A1620	60A1620	60A1620	60A1620	Rivet (Piston Head to Tube)
*10.	.....	E86-00673	E86-01888	.....	Lubricator Swab Assembly
*11.	.....	E86-05133-E4	E86-05133-E5	.....	Felt Swab
*12.	E86-05151	E86-06375	E86-06378	E86-08839	Felt Swab
13.	E86-05156	E86-05158	E86-04188	E86-05095	Packing Cup
14.	E86-05162	E86-05162	E86-05162	E86-05162	Cover Assembly
15.	E86-04181	E86-04181	E86-04181	E86-04181	Bushing (Cover)
16.	E86-05157	E86-05157	E86-05157	E86-05157	Gasket (Cover to Cylinder)
17.	E86-06339	E86-06339	E86-06339	E86-06339	Spring Guide
18.	E86-05088	E86-05088	E86-05088	E86-05088	Piston Return Spring
19.	E86-04182	E86-04182	E86-04182	E86-04182	Felt Ring Lubricator
20.	D86-04186	D86-04186	D86-04186	D86-04186	Boot
21.	F86-05699	F86-05699	F86-05699	F86-05699	Clamp (Boot—Cover End)
22.	20A04M	20A04M	20A04M	20A04M	Nut (Clamps—Boot)
23.	31N9432M	31N9432M	31N9432M	31N9432M	Screw (Clamps—Boot)
24.	E86-08777	E86-08777	E86-08777	E86-08777	Clamp (Boot—Piston End)

*Note: Illustration Style "B" shows an improved Air Cylinder Assembly which incorporates an improved Piston Assembly Item No. 7, Felt Swab Item No. 12 and Spring Guide Item No. 17.

Piston Assembly, for Style "A" Air Cylinder Assembly, is no longer furnished and is replaced by the improved Assembly shown in Style "B".

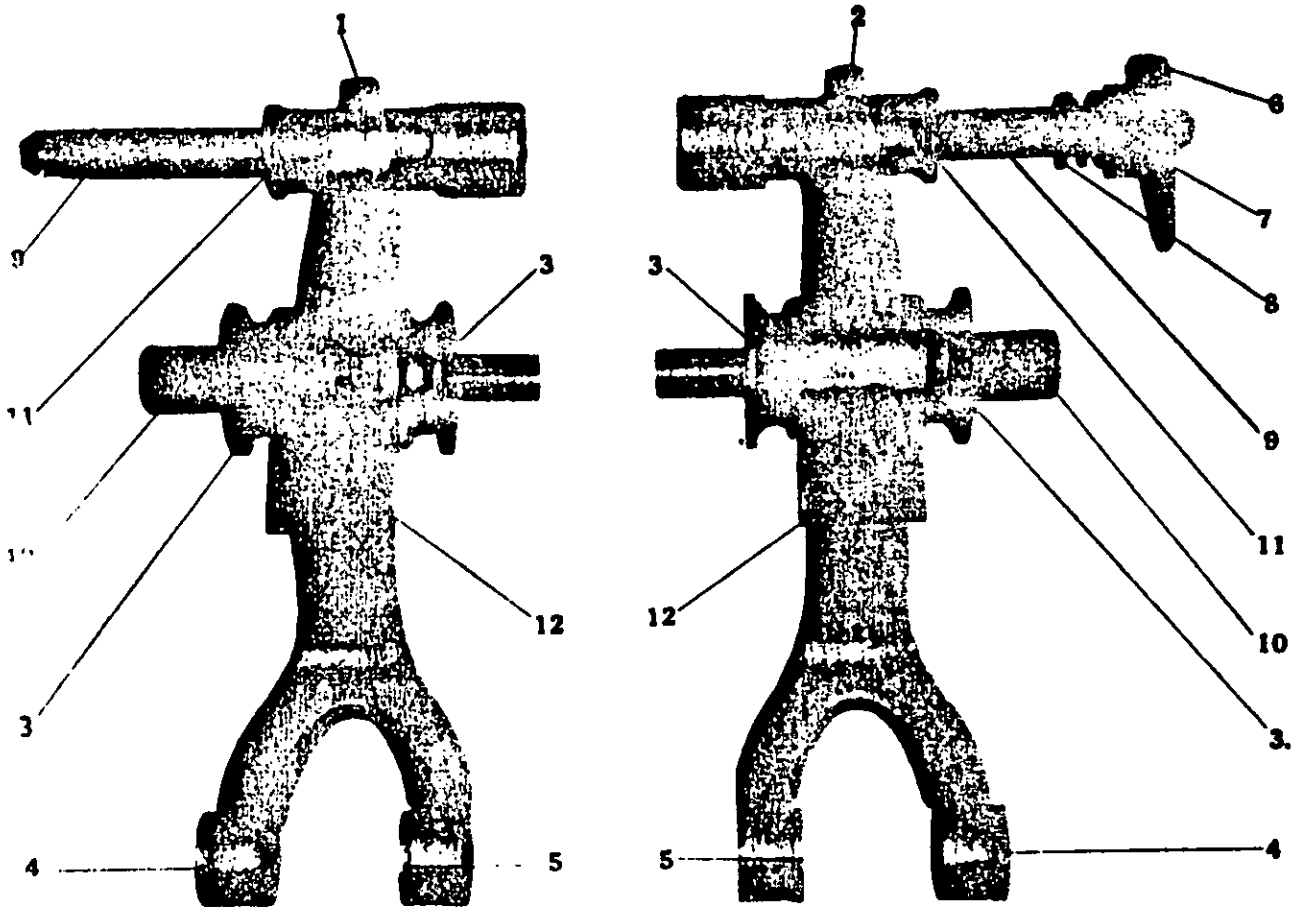
When a replacement Piston Assembly is required for Style "A" Air Cylinder Assemblies, the following parts must be ordered:

For 6½" Air Cylinder Assembly — Piston Assembly Item No. 7 only.
For 7" Air Cylinder Assembly — Piston Assembly Item No. 7 and Felt Swab Item No. 12.
For 7½" Air Cylinder Assembly — Piston Assembly Item No. 7 and Felt Swab Item No. 12.

When a replacement Piston Head is required for Style "A" 7" and 7½" Air Cylinders the following parts must be ordered:

Piston Head Item No. 8 and Felt Swab Item No. 12.

Lubricator Swab Item No. 10 and Felt Swab No. 11, for Style "A" Air Cylinder Assemblies, are available as replacement parts.



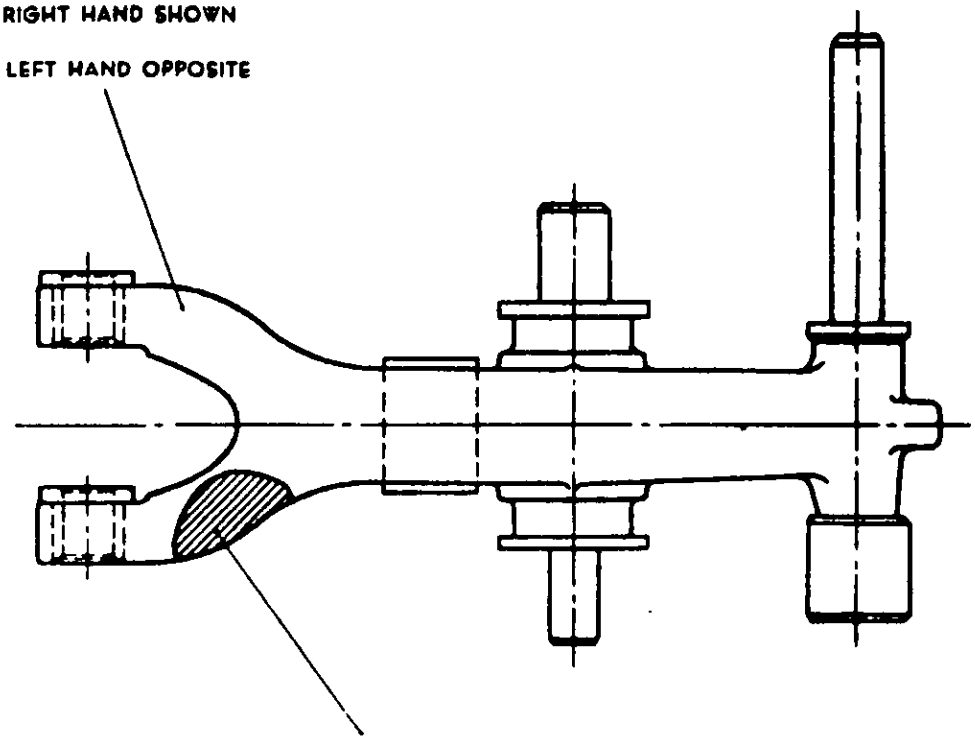
TONG ASSEMBLIES

Note: For Tongs with Special Frame Clearance See Page 7a

Item No.	Part No.	Part Name
1.	D86-05689	Tong Assembly—L.H
2.	D86-05688	Tong Assembly—R.H.
3.	F86-05690	Thrust Washer
4.	E86-04171	Bushing—Tong Upper
5.	E86-04172	Bushing—Tong Lower
6.	E86-04901	Key
7.	E86-04899	Retainer
8.	E86-04586	Spring
9.	E86-05087	Shoe Pin
10.	E86-04163	Fulcrum Pin
11.	E86-05636	Thrust Washer
12.	E86-04112	Wear Plate

Order MUST Give PART NUMBER and NAME of Part Wanted

1. RIGHT HAND SHOWN
2. LEFT HAND OPPOSITE



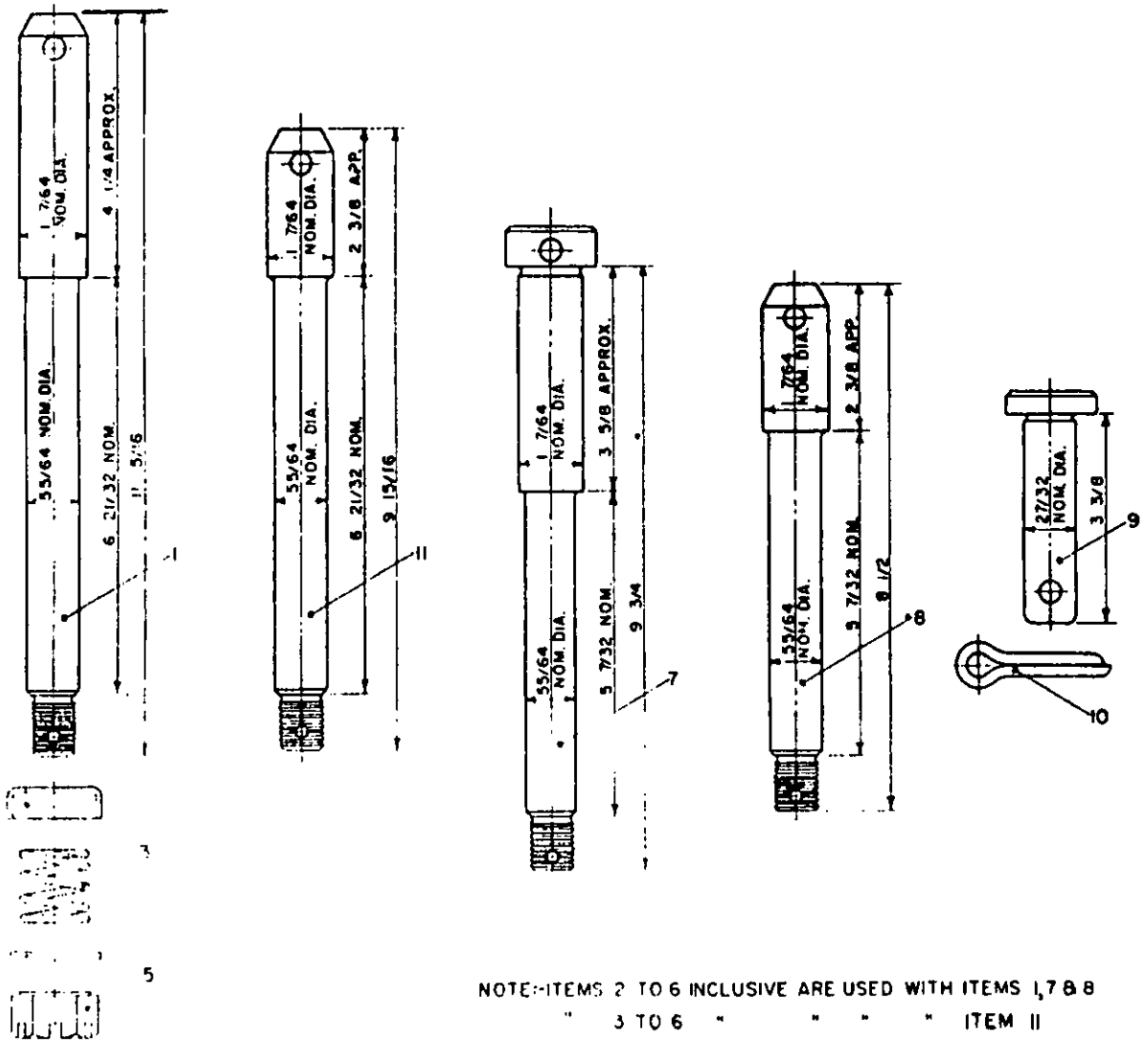
Note: Surface Clearance for Special Frame Only.

TONG ASSEMBLIES

Item No.	Part No.	Part Name
1.	B86-06345	Tong Assembly—R.H.
2.	B86-06346	Tong Assembly—L.H.

All parts, except compiete Assemblies, Items 1 and 2, are the same as shown on Page 7, Section 2.

Order MUST Give PART NUMBER and NAME of Part Wanted



NOTE:-ITEMS 2 TO 6 INCLUSIVE ARE USED WITH ITEMS 1, 7 & 8
" 3 TO 6 " " " " ITEM 11

BRAKE PINS

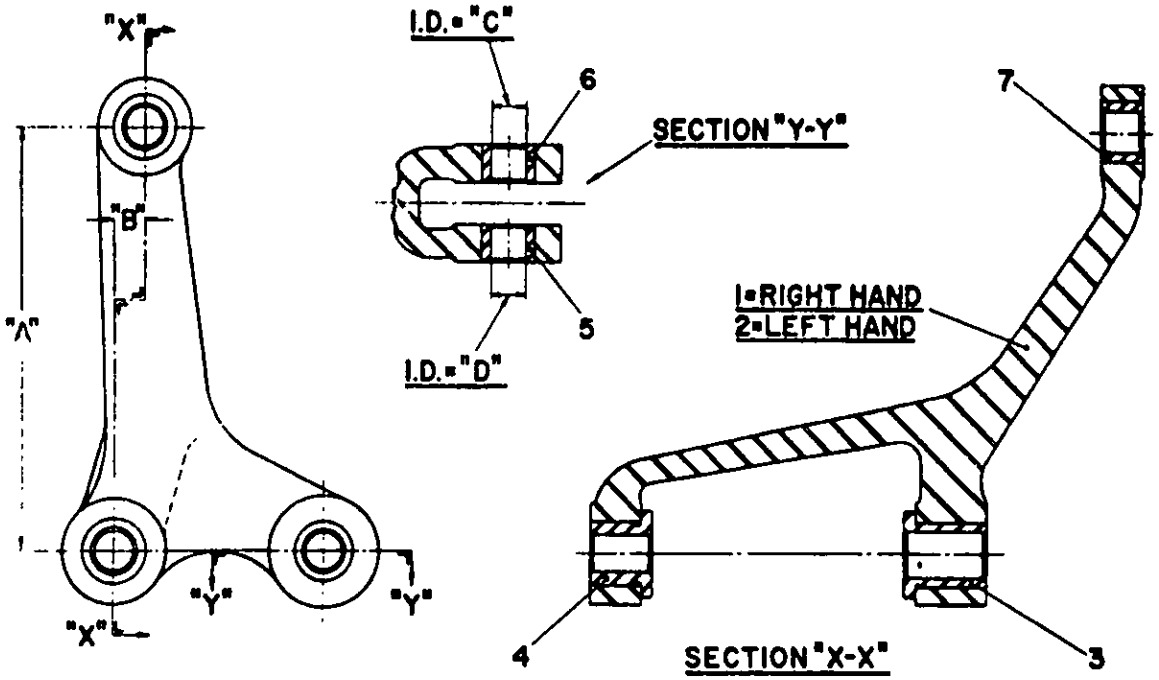
ITEM No.	PART No.	PART NAME
1.	E86-04191	PIN (HAND BRAKE CRANK)
2.	E86-05061	SPRING COVER
3.	E86-05060	SPRING (TONG PIN)
4.	70A32M	FLAT WASHER, 3/4
5.	21L18M	SLOTTED HEX NUT, 3/4-10
6.	F86-09550	ANGLE WIRE
7.	E86-04196	PIN (HAND BRAKE LEVER)
8.	E86-04173	PIN (TONG)
9.	F86-05691	PIN (HAND BRAKE CRANK & LEVER)
10.	95A2039M	COTTER PIN
11.	E86-06654	PIN (HAND BRAKE LEVER)

Order MUST Give PART NUMBER and NAME of Part Wanted

HAND BRAKE LEVER ASSEMBLY

Item No.	Part No.	Part Name
1.	E86-05023	Hand Brake Lever and Bushing Assembly
2.	E86-01746	Bushing

Order MUST Give PART NUMBER and NAME of Part Wanted

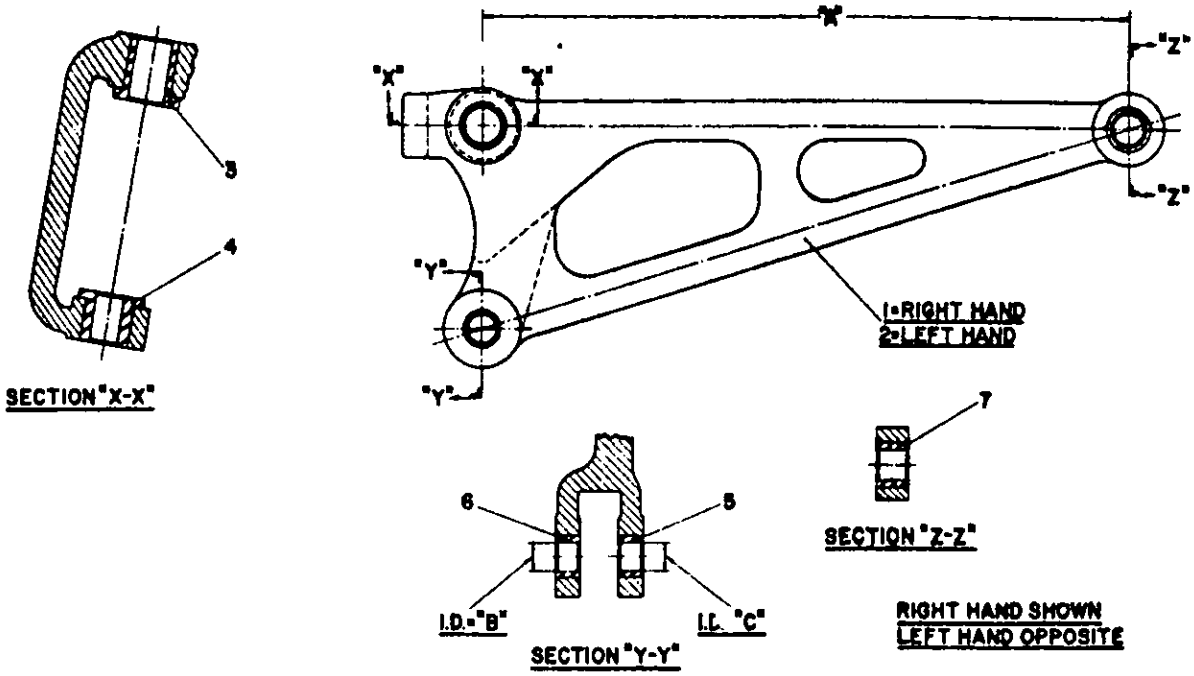


RIGHT HAND SHOWN
LEFT HAND OPPOSITE

HAND BRAKE CRANK ASSEMBLIES

DIMENSIONS				PART NUMBERS						
"A"	"R"	"C" INSIDE DIA.	"D" INSIDE DIA.	ASSY-R.H ITEM 1	ASSY.-L.H. ITEM 2	BUSHING ITEM 3	BUSHING ITEM 4	BUSHING ITEM 5	BUSHING ITEM 6	BUSHING ITEM 7
9 1/4"	0	1 1/8"	7/8"	E86-05045	E86-05046	E86-01746	E86-04172	E86-04192	E86-05081	E86-01577
8 1/8"	0	7/8"	7/8"	E86-05686	E86-05687	E86-01746	E86-04172	E86-04192	E86-04192	E86-01577
10"	3/4"	7/8"	7/8"	E86-05785	E86-05786	E86-01746	E86-04172	E86-04192	E86-04192	E86-01577
6"	0	7/8"	7/8"	E86-06266	E86-06267	E86-01746	E86-04172	E86-04192	E86-04192	E86-05011(TWO)
8 1/2"	33/32"	7/8"	7/8"	E86-06812	E86-06813	E86-01746	E86-04172	E86-04192	E86-04192	E86-01577
10"	3/4"	7/8"	7/8"	E86-06868	E86-06869	E86-04172	E86-04171	E86-04192	E86-04192	E86-04177
10"	1/4	7/8	7/8	E86-09716	E86-09717	E86-C4172	E86-04171	E86-04192	E86-04192	E86-01577

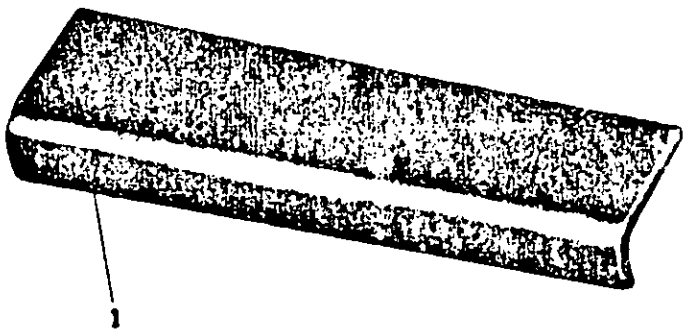
Order MUST Give PART NUMBER and NAME of Part Wanted



HAND BRAKE CRANK ASSEMBLIES

DIMENSIONS			PART NUMBERS						
"A"	"B" INSIDE DIA	"C" INSIDE DIA.	ASSY.-R.H. ITEM 1	ASSY.-L.H. ITEM 2	BUSHING ITEM 3	BUSHING ITEM 4	BUSHING ITEM 5	BUSHING ITEM 6	BUSHING ITEM 7
20 ½"	⅞"	⅛"	D86-05864	D86-05865	E86-01746	E86-04172	E86-04192	E86-04192	E86-01677

Order MUST Give PART NUMBER and NAME of Part Wanted

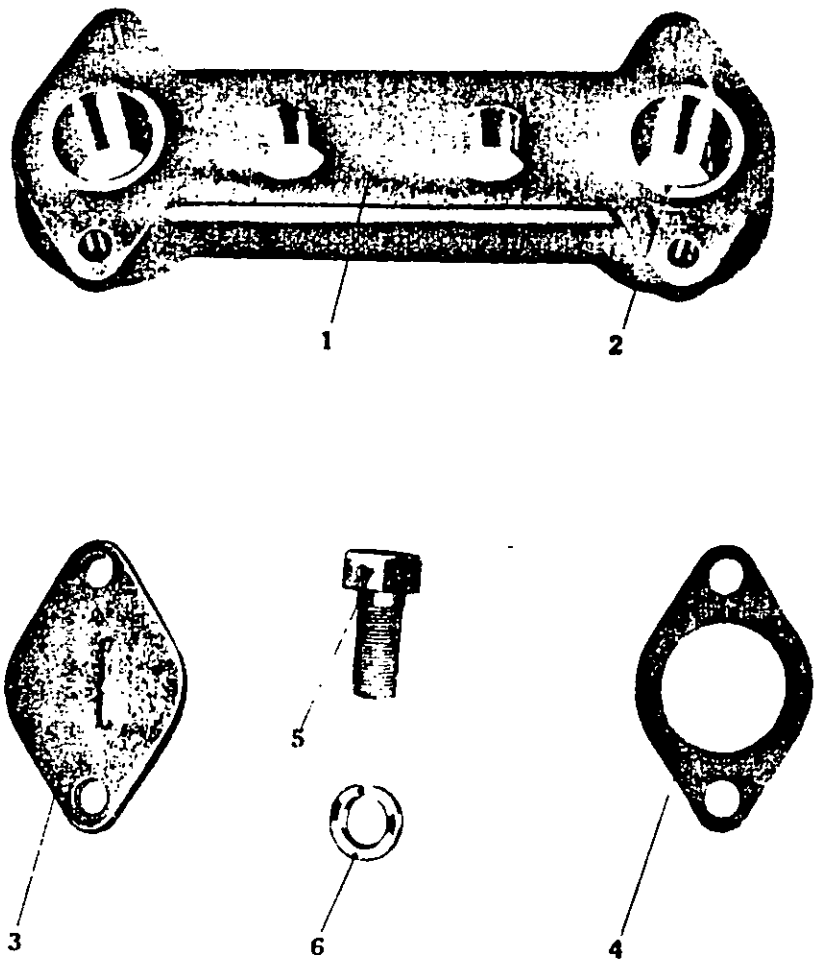


SLIDE — HAND BRAKE LEVER

Item No.	Part No.	Part Name
1.	F86-05872	Slide—Hand Brake Lever

Note: To be welded to Hand Brake Lever and Bushing Assembly E86-05023, when Hand Brake Cranks D86-05864 and D86-05865 are used.

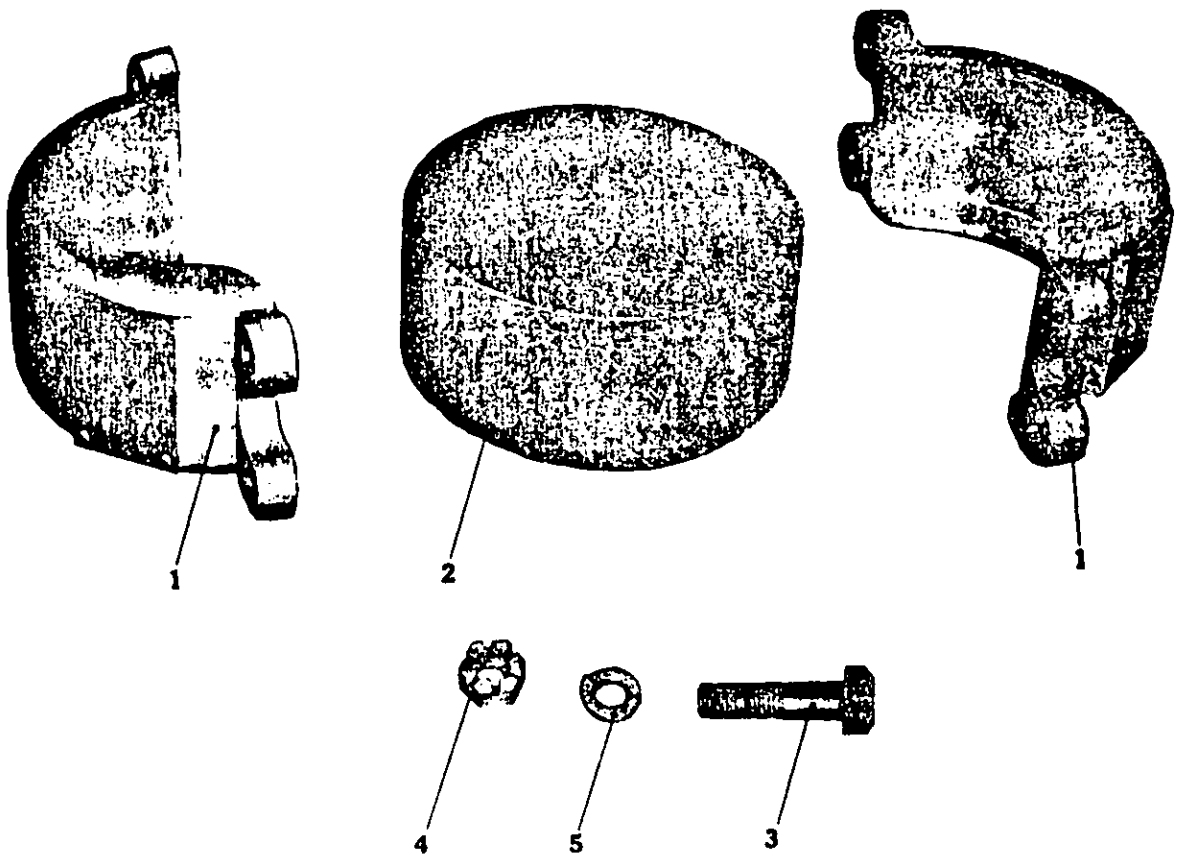
Order MUST Give PART NUMBER and NAME of Part Wanted



BRIDGE ASSEMBLY

Item No.	Part No.	Part Name
1.	E86-05791	Bridge Assembly
2.	E86-05635	Bushing
3.	E86-05079	Fulcrum Cover
4.	E86-01921	Gasket
5.	E86-02190	Cap Screw
6.	71A24M	Lockwasher

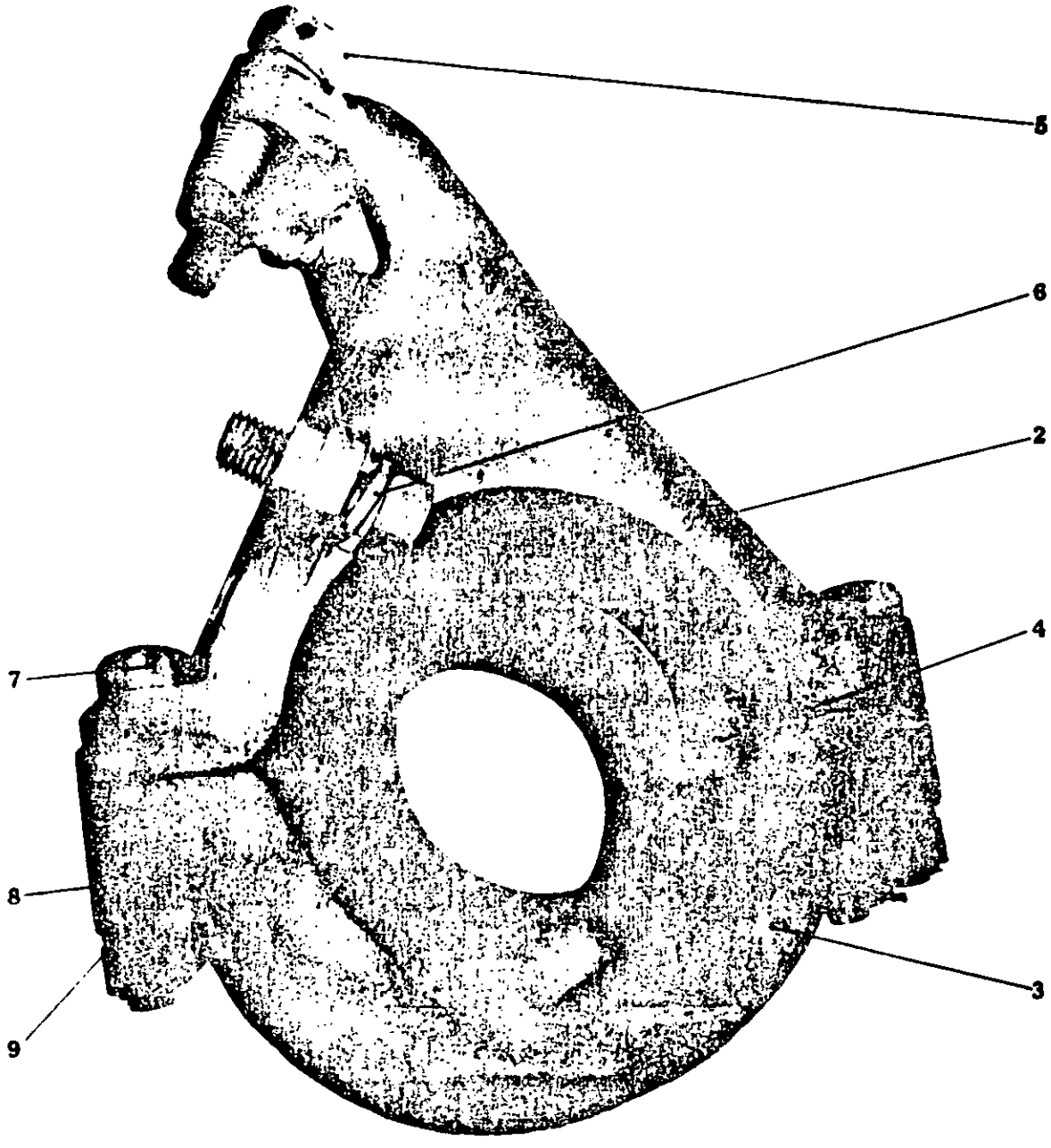
Order MUST Give PART NUMBER and NAME of Part Wanted



HANGER BOX ASSEMBLY

Item No.	Part No.	Part Name
1.	D86-05601	Hanger Box Cap
2.	D86-04469	Rubber Segment
3.	E86-05603	Bolt
4.	21L18M	Nut
5.	71A32M	Lockwasher

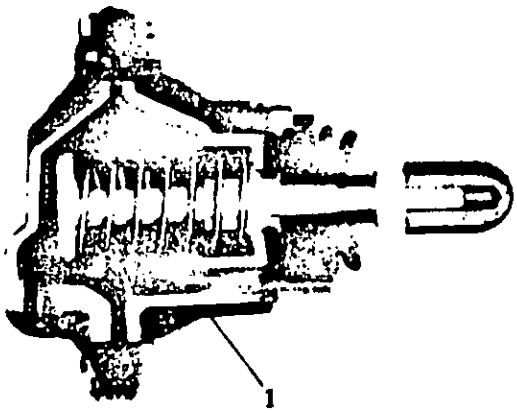
Order MUST Give PART NUMBER and NAME of Part Wanted



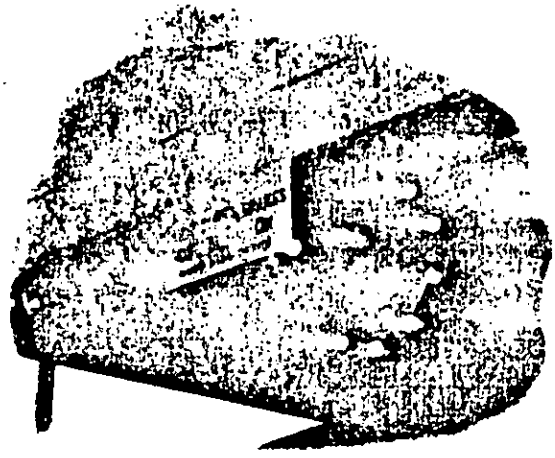
HANGER BOX ASSEMBLY

Item No.	Part No.	Part Name
1.	B86-04471	Hanger Box Assembly
2.	B86-05083	Hanger Box
3.	D86-05085	Hanger Box Cap
4.	D86-04469	Rubber Segment
5.	E86-01883	Bolt
6.	71A34M	Lock Washer
7.	E86-01918	Bolt
8.	71A32M	Lockwasher
9.	21L18M	Nut

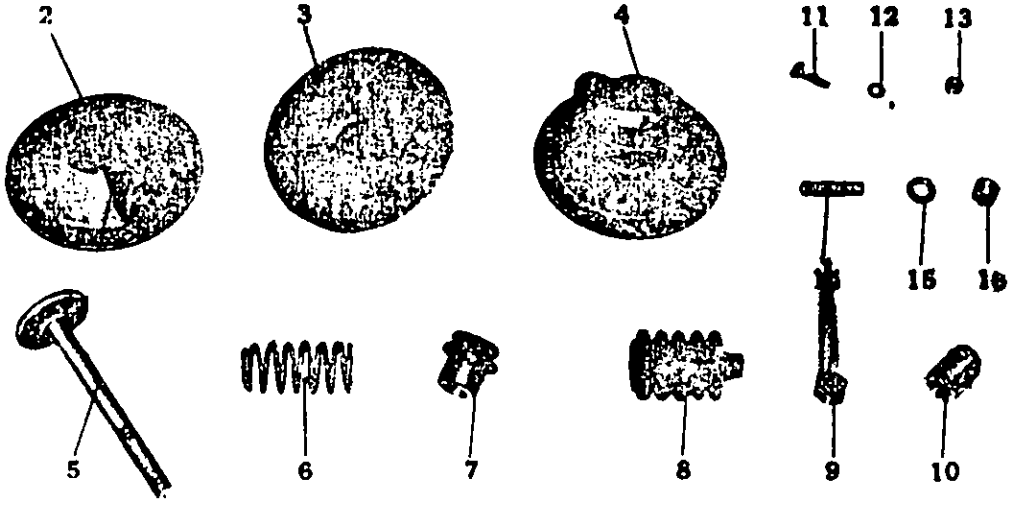
Order MUST Give PART NUMBER and NAME of Part Wanted



INDICATOR ASSEMBLY



INDICATOR APPLIED TO CAR

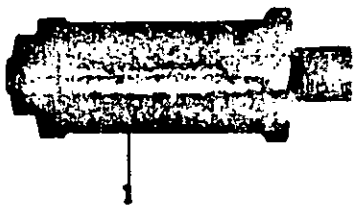


PARTS FOR INDICATOR

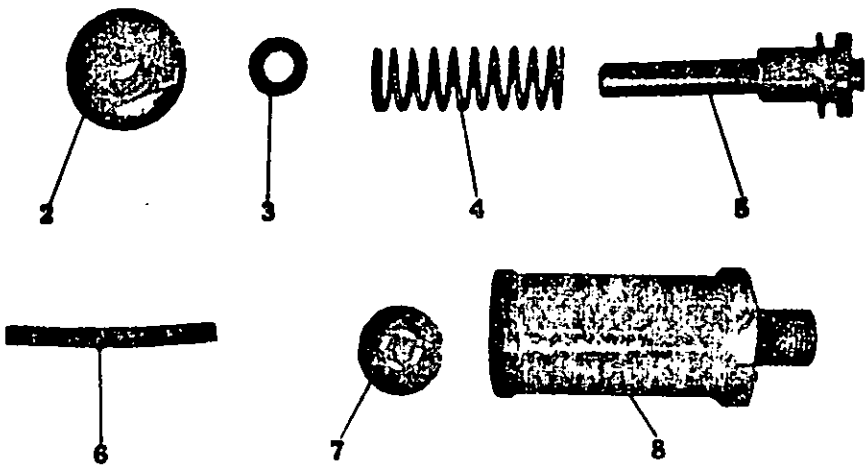
AIR "ON-OFF" INDICATOR ASSEMBLY

Item No.	Part No.	Part Name	Item No.	Part No.	Part Name
1.	D86-00195	Air "On-Off" Indicator Ass'y.	9.	21A13M	Indicator Stop Nut
2.	X86-06187	Pressure Plate	10.	F86-00167	Indicator
3.	X86-06185	Diaphragm	11.	7A0420M	Pressure Plate Bolt
4.	X86-06186	Non-Pressure Head	12.	71B16M	Pressure Plate Washer
5.	X86-06181	Push Rod	13.	21A04M	Pressure Plate Nut
6.	X86-06184	Release Spring	14.	X86-06188	Stud Bolt
7.	X86-06183	Push Rod Guide	15.	71A22M	Lockwasher
8.	X86-06182	Boot	16.	21A11M	Nut

Order MUST Give PART NUMBER and NAME of Part Wanted



INDICATOR ASSEMBLY

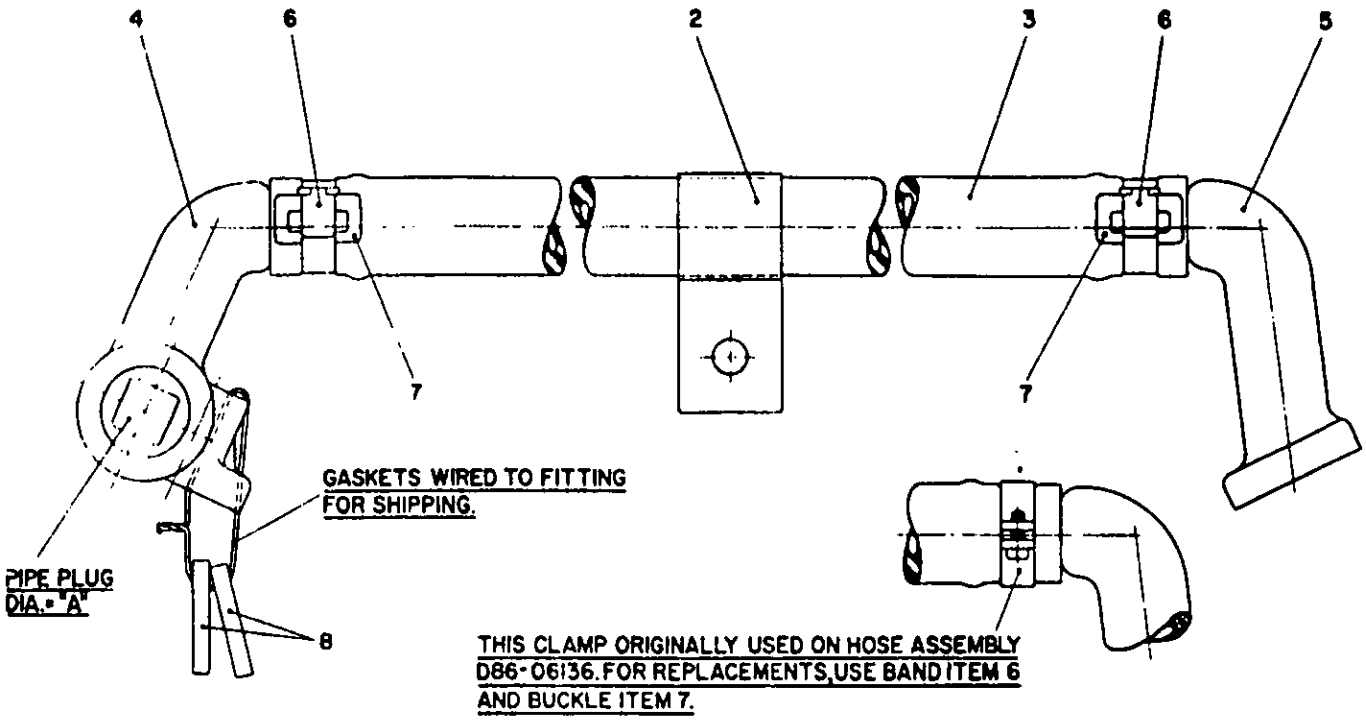


PARTS FOR INDICATOR

AIR "ON-OFF" INDICATOR ASSEMBLY

Item No.	Part No.	Part Name
1.	E86-01707	Air "On-Off" Indicator Ass'y.
2.	E86-01693	End Plug
3.	E86-02009	Felt Swab (Plug)
4.	E86-01695	Spring
5.	E86-01708	Piston
6.	E86-02008	Felt Swab (Piston)
7.	E86-01709	Packing Cup
8.	E86-01692	Cylinder

Order MUST Give PART NUMBER and NAME of Part Wanted



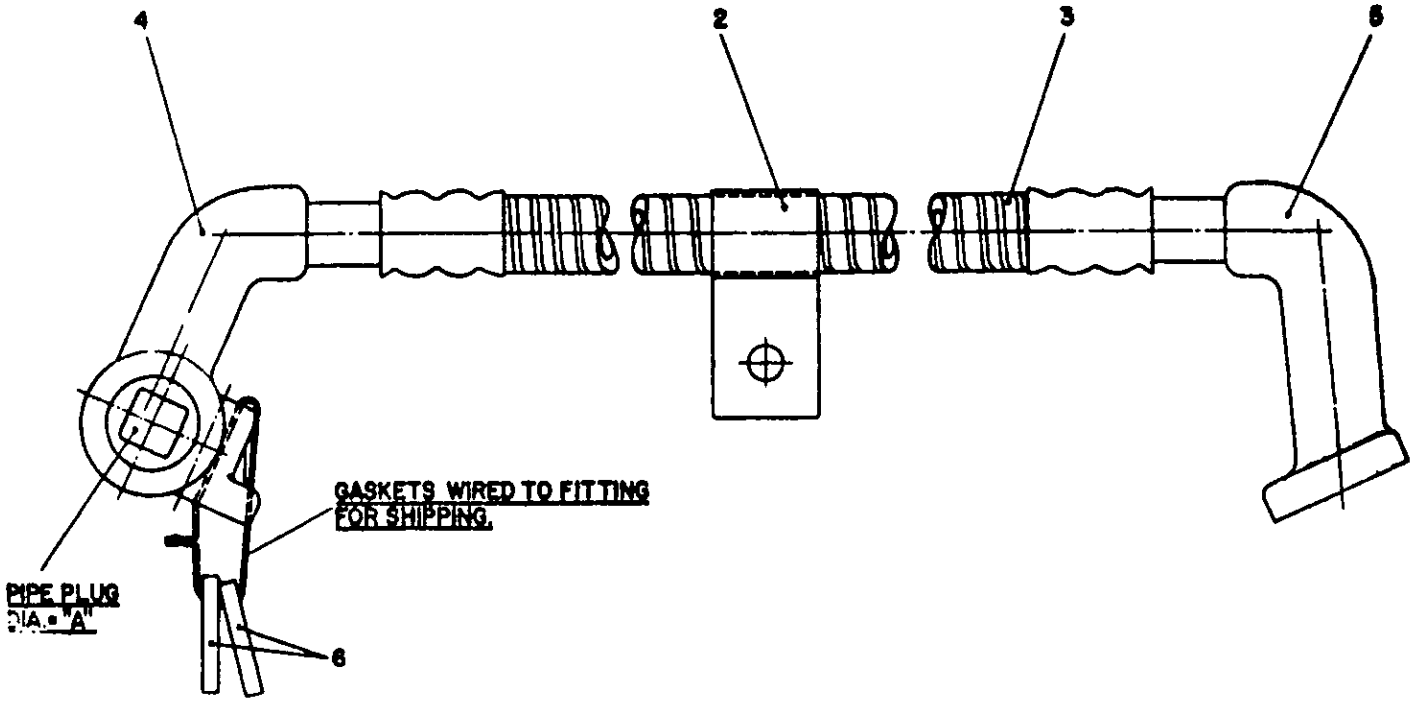
AIR HOSE ASSEMBLIES — CYLINDER

(Single Rubber Hose)

PART NUMBERS								
AIR HOSE ASS'Y (ITEM 1)	CLAMP ITEM 2	HOSE ITEM 3	AIR FITTING ITEM 4	AIR FITTING ITEM 5	BAND ITEM 6	BUCKLE ITEM 7	GASKET ITEM 8	PIPE PLUG DIA. "A"
D86-00182	E86-04949	E86-04973	D86-00180	D86-00179	200-0171	200-0170	E86-00955	3/4"
D86-06136	E86-04949	E86-04973	D86-00180	D86-00179	200-0171	200-0170	E86-00955	3/4"
D86-05388	E86-04949	E86-04973	D86-05583	D86-00179	200-0171	200-0170	E86-00956	1"

CAP SCREWS, BOLTS, NUTS & LOCKWASHERS FOR AIR HOSE ASSEMBLIES					
AIR HOSE ASS'Y. NO	CAP SCREWS FOR FITTING ITEM 4	CAP SCREWS FOR FITTING ITEM 5	BOLTS FOR CLAMP ITEM 2	NUTS FOR CLAMP ITEM 2	LOCKWASHERS FOR ITEMS 2, 4 & 5
D86-00182	F86-05590	E86-02190	E86-02190	21J12M	71A24M
D86-06136	F86-06516	E86-02190	E86-02190	21J12M	71A24M
D86-05388	F86-06516	E86-02190	E86-02190	21J12M	71A24M

Order MUST Give PART NUMBER and NAME of Part Wanted



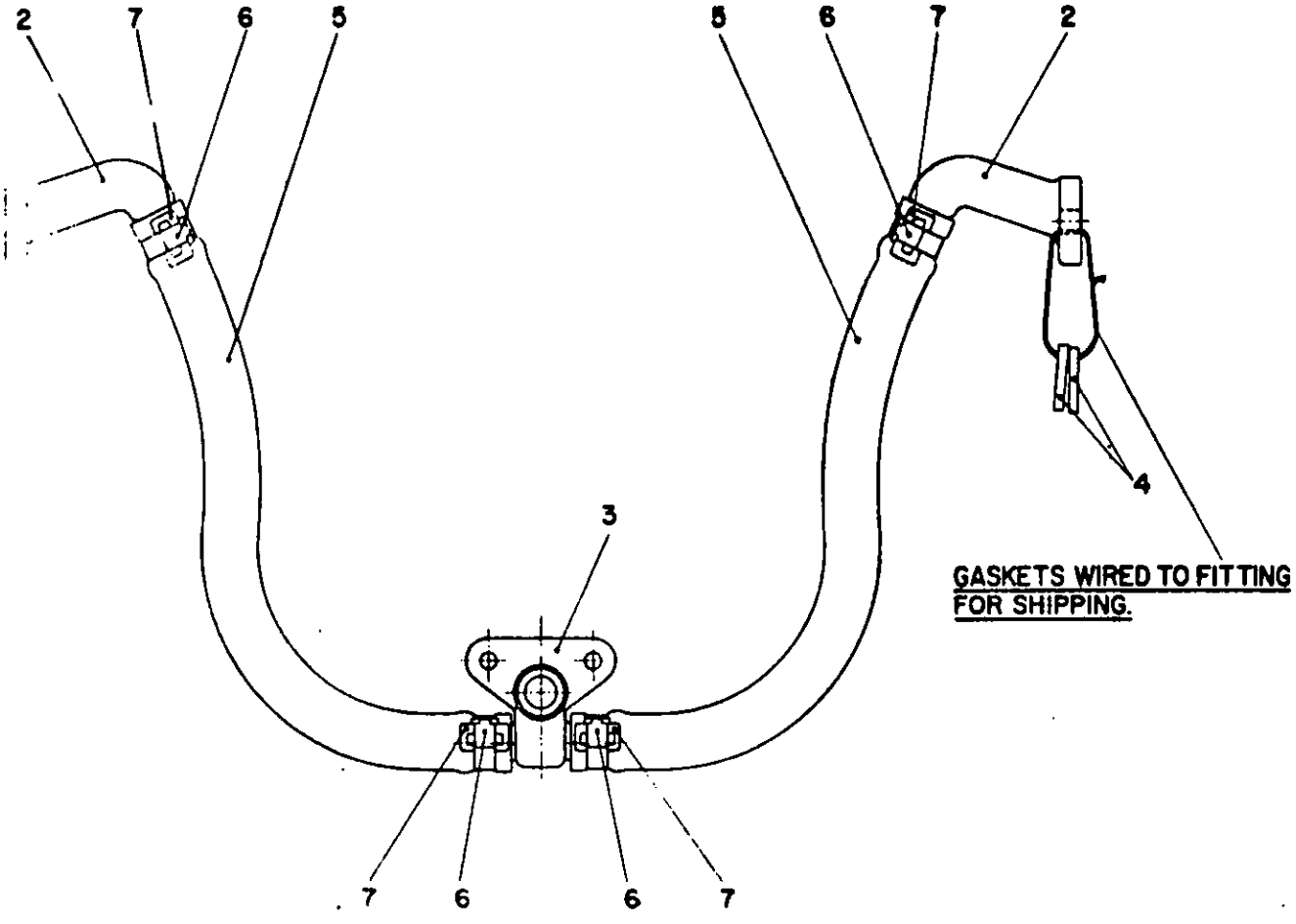
AIR HOSE ASSEMBLIES — CYLINDER

(Single Armored Hose)

PART NUMBERS						
AIR HOSE ASS'Y. ITEM 1	CLAMP ITEM 2	HOSE ITEM 3	AIR FITTING ITEM 4	AIR FITTING ITEM 5	GASKET ITEM 6	PIPE PLUG DIA. "A"
D86-00203	F86-00204	E86-00202	D86-06199	D86-06190	E86-00960	3/4"

CAP SCREWS, BOLTS, NUTS & LOCKWASHERS FOR AIR HOSE ASSEMBLIES					
AIR HOSE ASS'Y. NO.	CAP SCREWS FOR FITTING ITEM 4	CAP SCREWS FOR FITTING ITEM 5	BOLTS FOR CLAMP ITEM 2	NUTS FOR CLAMP ITEM 2	LOCKWASHERS FOR ITEMS 2, 4 & 5
D86-00203	F86-06886	E86-02190	E86-02190	21J12M	71A24M

Order MUST Give PART NUMBER and NAME of Part Wanted



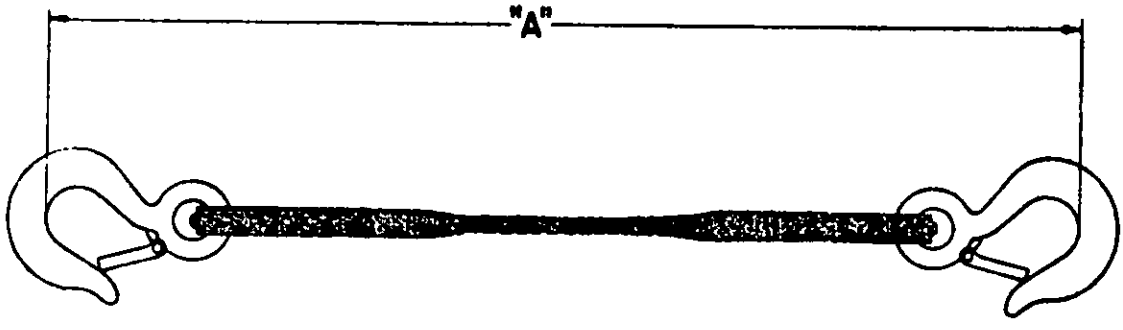
AIR HOSE ASSEMBLIES — CYLINDER

(Two Rubber Hoses in a Unit)

PART NUMBERS						
AIR HOSE ASS'Y. ITEM 1	AIR FITTING ITEM 2	AIR FITTING ITEM 3	GASKET ITEM 4	HOSE ITEM 5	BAND ITEM 6	BUCKLE ITEM 7
D86-08829	D86-00179	D86-06597	E86-00955	E86-08797	200-0171	200-0170
D86-06596	D86-00179	D86-06597	E86-00955	E86-06593	200-0171	200-0170

CAP SCREWS, BOLTS, NUTS & LOCKWASHERS FOR AIR HOSE ASSEMBLIES				
AIR HOSE ASS'Y. NO.	CAP SCREWS FOR FITTING ITEM 2	BOLTS FOR FITTING ITEM 3	LOCK NUTS FOR FITTING ITEM 3	LOCKWASHERS FITTING ITEM 2
D86-08829	E86-02190	7A1236M	21F12M	71A24M
D86-06596	E86-02190	7A1236M	21F12M	71A24M

Order MUST Give PART NUMBER and NAME of Part Wanted

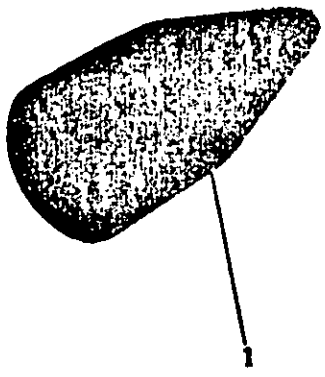


SUPPORT CABLES

Part No.	Dimension "A"
E86-00178	21"
E86-05611	19"
E86-05731	24"
E86-05796	17¾"
E86-08798	22½"

Support Cables are used only when making wheel changes and must be removed after wheels are in assembled position in truck.

Order MUST Give PART NUMBER and NAME of Part Wanted

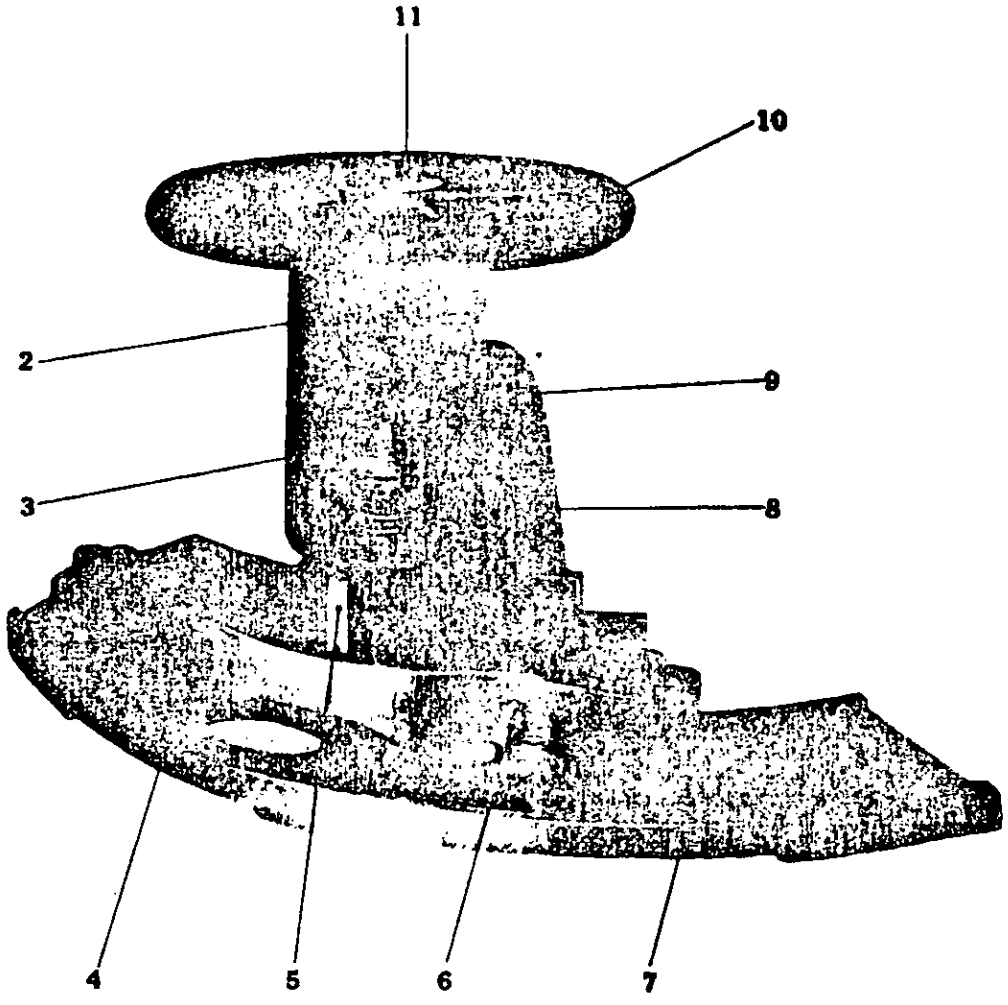


GUIDE POINT

For Inserting Tong Pins at Brake Cylinders

Item No.	Part No.	Part Name
1.	E86-05413	Guide Point

Order MUST Give PART NUMBER and NAME of Part Wanted



BRAKE LINING ASSEMBLY FIXTURE

Item No.	Part No.	Part Name
1.	T86-06224	Lining Assembly Fixture
2.	F86-05627	Coil Spring
3.	E86-05625	Collar
4.	B86-05623	Carriage
5.	F86-05629	Key
6.	F86-05624	Handle
7.	B86-05621	Base
8.	E86-00194	Spindle
9.	B86-06225	Frame
10.	E86-05628	Handwheel
11.	F86-05630	Washer

Order MUST Give PART NUMBER and NAME of Part Wanted

RL 871-007

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 11

DATE 12/27/54

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: MODEL CF DISC BRAKE - Brake Heads
D86-04912, D86-04913 and D86-04914

This Bulletin is to advise method of salvaging Brake Heads with arm forgings damaged or showing abnormal wear.

Replacement arm assemblies may be purchased from The Budd Company to the following part numbers and applied per procedure below:

E86-06363	Arm & Guide Pin Assy.	R.H. Inside
E86-06364	Arm & Guide Pin Assy.	L.H. Inside
E86-09257	Arm Assy. (with bushings)	Outside

PROCEDURE (Refer to Sketch DBB No. 11)

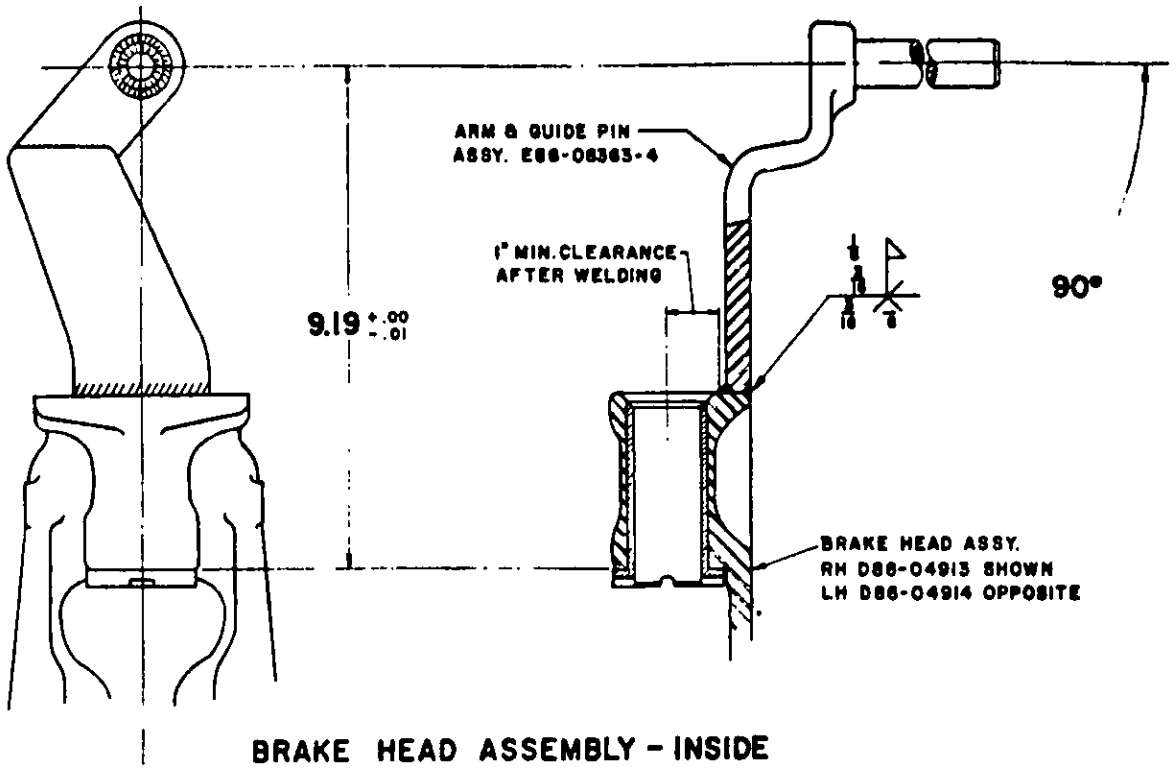
(a) Carefully remove arm forging from brake head and grind head smooth to provide good surface for welding.

(b) Weld new arm assembly to brake head as shown on Sketch DBB No. 11. A holding fixture should be used when welding to maintain proper alignment of parts.

Use mild steel welding rod (AWS E-6015)

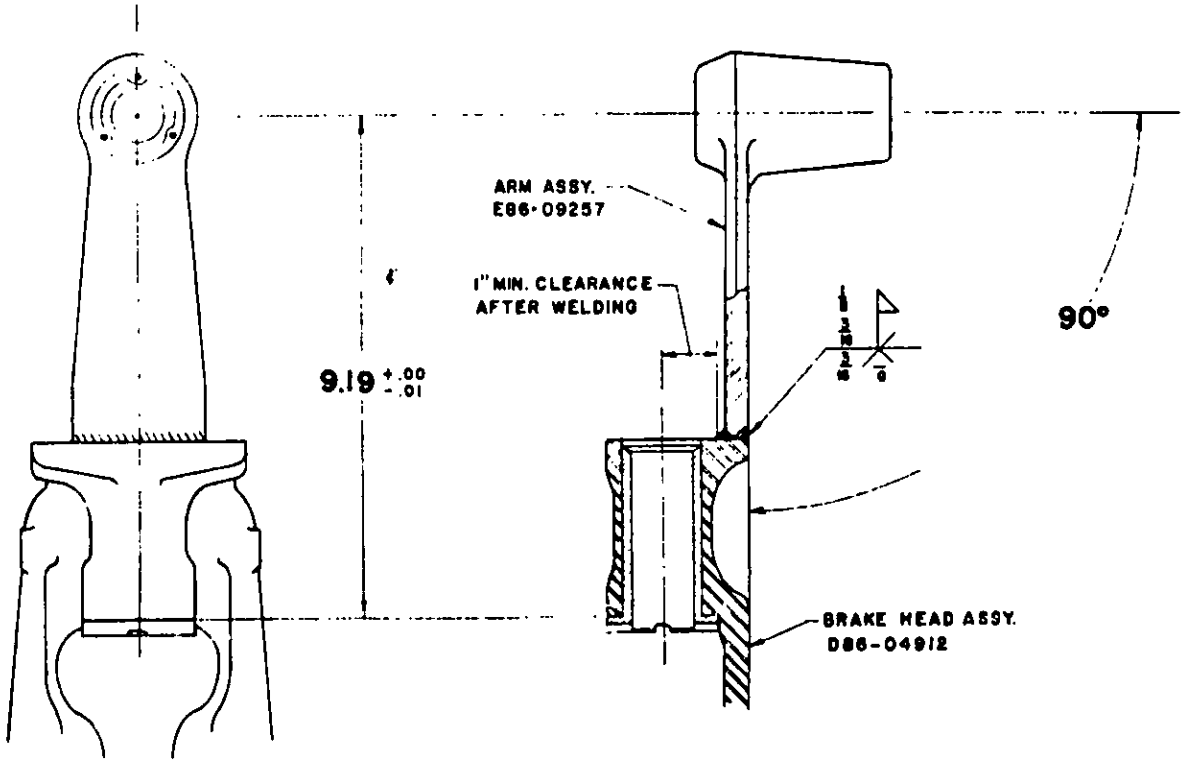
H. F. Blankenbiller, Manager
Customer Service Department

ENCLOSURE: Sketch DBB No. 11



BRAKE HEAD ASSEMBLY - INSIDE

NOTE
USE MILD STEEL WELDING
ROD (AWS E-6015)



BRAKE HEAD ASSEMBLY - OUTSIDE

RL 871-007

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 15

DATE Aug. 12, 1957

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT:

Model CF Disc Brake - Application of
Stainless Steel Liner to Brake Frame Hanger Tube

After many years in service, irregular wear on Hanger Tube of the Brake Frame became evident in some instances. Investigation proves that this wear is not from abrasion alone but starts as earlier corrosion initiated by galling of the rubber segment.

To prevent this wear on the Hanger Tube (Part No. E86-04924), eliminate need for replacing worn tubes, and to increase life of Rubber Segment D86-04469, all future Model CF Brake Frame Assemblies will incorporate replaceable stainless steel Liners E86-09538 on the Hanger Tube. This is illustrated on attached Sketch DB-15.

Several car sets of brake frames having these liners are in regular service for approximately two years. On periodic inspections these hanger tube liners show no wear or corrosion and only few small indications of rubber segment galling but no adherence of rubber to the liners.

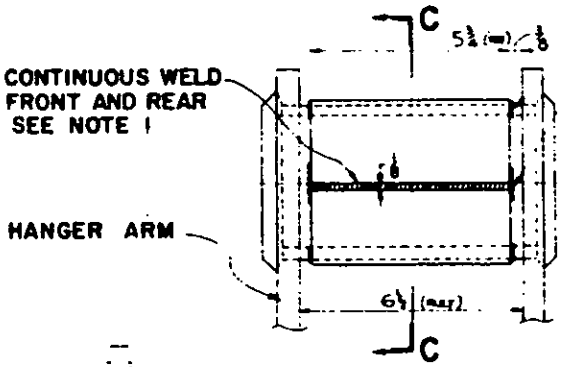
Rubber Segments D86-04469 supplied from now on are 4-5/8" inside diameter (previously was 4-3/8" I.D.). The smaller I.D. rubber segments are no longer available.

We recommend that all Model CF Disc Brake Frames, now in service, have the stainless steel Liners E86-09538 applied to the Hanger Tube per attached sketch DB-15. This to be done at truck overhaul or when rubber segment requires replacement. Liners are obtainable by purchase order placed on The Budd Company specifying "E86-09538 Hanger Tube Liner." When making liner application, present hanger tube should be carefully cleaned of all dirt and corrosion, using a wire wheel. Coarse grained grinding wheel should not be used to clean hanger tube, and any grinding should be done longitudinally (not circumferentially) with the tube. It is not necessary to replace present worn hanger tubes.

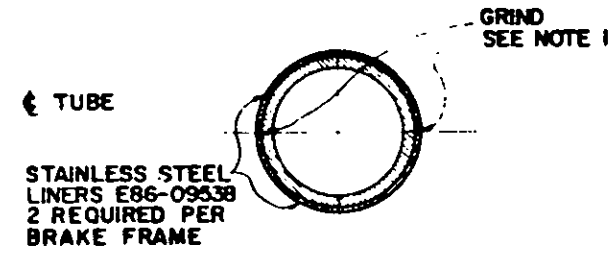
In emergency only, if necessary to apply new 4-5/8" I.D. Rubber Segments D86-04469 to an old frame without stainless liners on its hanger tube, cut off one end of rubber segment (about 1-1/2" wide at outside dia. and 1-1/4" wide at inside dia.). Then add a rubber belting shim 1/4" thick x 3-1/2" wide x 29 1/2" long between O.D. of rubber segment and the Hanger Box Castings.

W. P. Blankenbiller, Manager
Customer Service Department

Attn: Sketch DB-15



VIEW 'B-B'



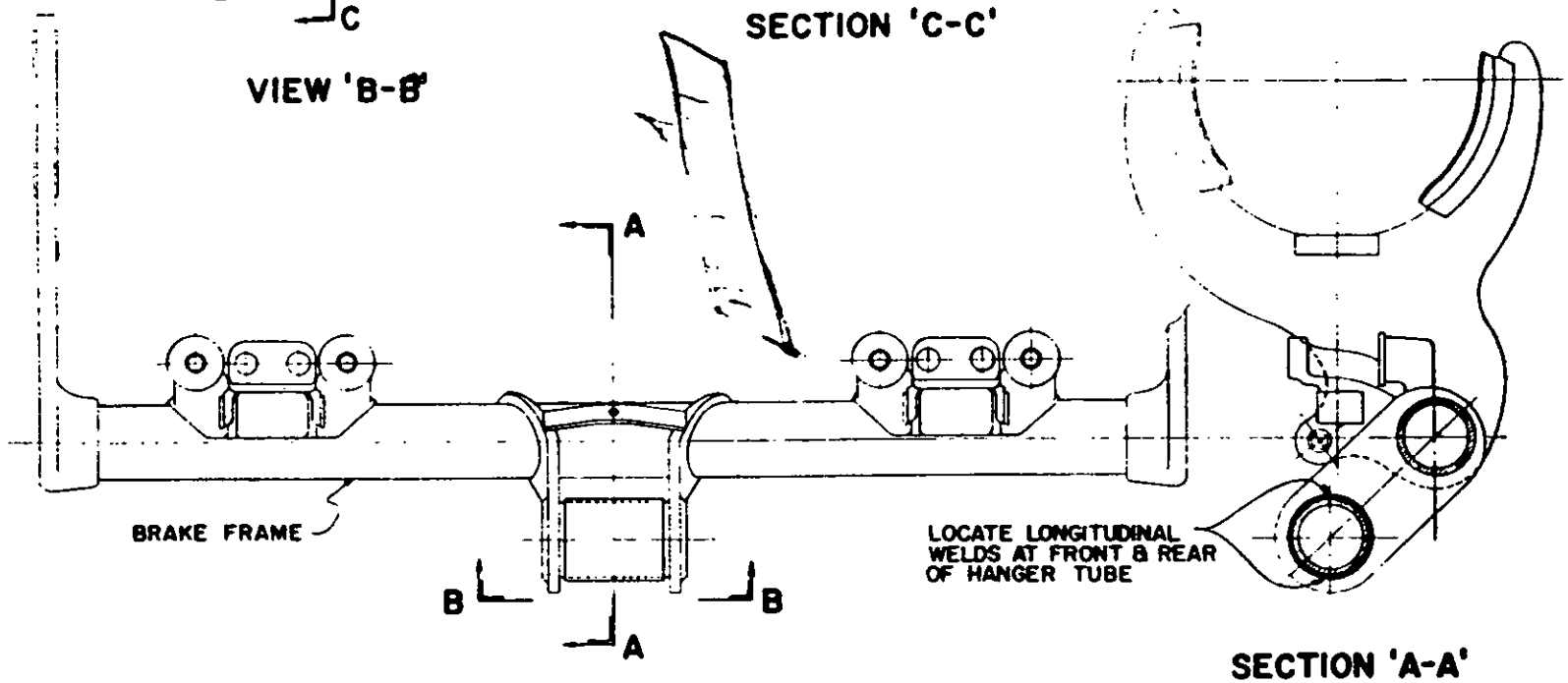
NOTES

1. GRIND LONGITUDINAL WELDS FLUSH TO CONTOUR OF ST. STL. LINER— BOTH SIDES. SURFACE MUST BE FLUSH AND SMOOTH TO PREVENT DAMAGE TO RUBBER SEGMENTS.
2. USE 18-8 STAINLESS STEEL ROD FOR ALL WELDING.

CAUTION

USE ONLY RUBBER SEGMENTS (D86-04469) WITH 4⅝" I.D. ON BRAKE FRAMES WITH ST. STL. LINERS INSTALLED.

SECTION 'C-C'



SECTION 'A-A'

APPLICATION OF STAINLESS STEEL LINERS DISC BRAKE FRAME HANGER TUBE

THE BUDD COMPANY
STOMER SERVICE DEPT.
LADELPHIA 15, PENNA.

SKETCH D 15

BL 871-007

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 16

DATE Feb. 10, 1958

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: Passenger Disc Brakes - Change in application of Wear Plate E86-04578 to Brake Heads.

The application of Wear Plate E86-04578 to Brake Heads used in Budd Disc Brakes on passenger cars has been revised to provide a better and more secure attachment.

For your ready reference, both the old and revised methods of attachment are illustrated on attached Sketch DB-16. In the older method, attachment was by means of a weld bead at each vertical edge of the wear plate. In the revised method, the welds are along the top and bottom curved edges of the wear plate

We recommend that when brake heads are removed from the brake assembly at truck or brake overhaul time, the brake head be wire brushed and cleaned in the wear plate region and the welds carefully examined. If old weld or the wear plate edge along the weld is cracked or broken, reweld existing wear liner to brake head by new welds at top and bottom of liner as shown for new style on Sketch DB-16.

Any heads found on routine inspections with missing wear plate or defective weld should be removed immediately for rework. Where brake heads with missing E86-04578 wear plates are continued in service following undesirable conditions result and cause unnecessary increased maintenance costs:-

(a) Uneven wear and shorter life of brake shoe lining.

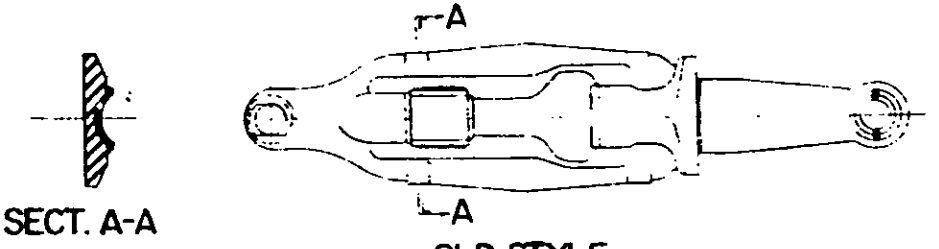
(b) Uneven and excessive wear on Shoe Pin, also Bushing E86-06516 in brake head.

(c) Brake Head wears rapidly and excessively in bearing area for the E86-04578. This may soon make head unsuitable for proper application of wear liner and require scrapping the brake head.

Existing parts in service or stock are not obsoleted by this change.

H. F. Blankenbiller, Manager
Customer Service Department

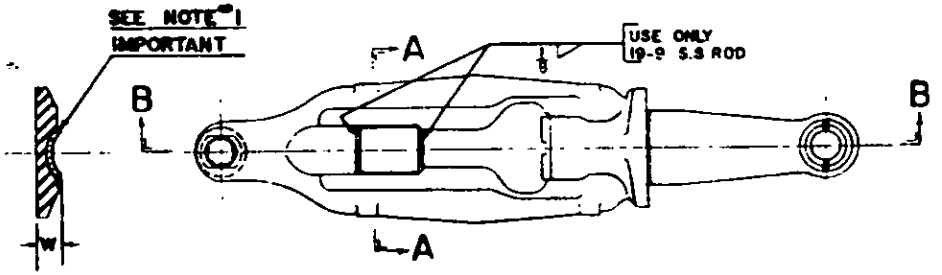
Att: Sketch DB-16



SECT. A-A

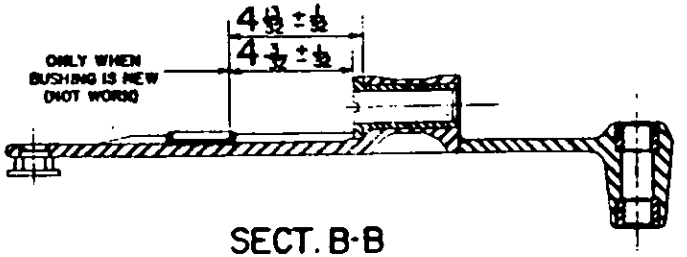
OLD STYLE

WEAR PLATE ATTACHMENT



SECT. A-A

DIM. W	FOR BRAKE HEADS
7/8 MAX	D86-04912-13-14
•	D86-06611-2-3-4
5/8 MAX	B86-09820-1



SECT. B-B

NEW STYLE

WEAR PLATE ATTACHMENT

NOTE* 1

1. CLAMP WEAR PLATE FIRMLY IN PROPER POSITION AND TIGHT AGAINST BRAKE HEAD ALONG CENTER LINE.
2. KEEP CLAMPED TIGHT UNTIL BOTH TOP AND BOTTOM WELDS ARE COMPLETED.
3. USE STAINLESS STEEL ROD & ARC WELD PROCESS, (DO NOT GAS WELD).
4. GRIND OFF EXCESS OF WELD DEPOSIT FLUSH WITH WEAR PLATE SO WELD DEPOSIT DOES NOT PROTRUDE ABOVE WEAR PLATE WEAR SURFACE.

WEAR PLATE E 86-04578

APPLICATION TO BRAKE HEADS

BUDD PASSENGER DISC BRAKES

SKETCH 3-16

RL 871-007

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 17

DATE 3/27/59

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT:

MODEL CF and TFM DISC BRAKES -
USE OF 28" DISCS B86-04636 and B86-09370

It has come to our attention recently that brake discs B86-04636 and B86-09370 are being applied to wheels and used indiscriminately with both CF and TFM disc brakes.

This is to CAUTION against the practice of using brake disc B86-04636 with Model TFM brakes.

Disc B86-04636 was developed for and provides satisfactory service with Model CF brakes. The Model TFM brake however, which was developed for greater economy and lower maintenance cost and which is rigidly mounted to the truck frame, requires greater clearance between the cold rolled steel back plate of the disc and the steel back plate of the brake shoe and lining assembly than that provided by B86-04636 disc.

With the CF brake, the brake shoe and lining assemblies move vertically with the vertical movement of the axle in the pedestal legs of the truck frame. This is not true of the TFM brakes.

Brake disc B86-09370 was deliberately designed to provide the same wheel mounting and the same disc braking face locations. Additional clearance was provided by changing the shape of the cold rolled steel backing plate of the disc assembly as shown on the attached print ESD-1103.

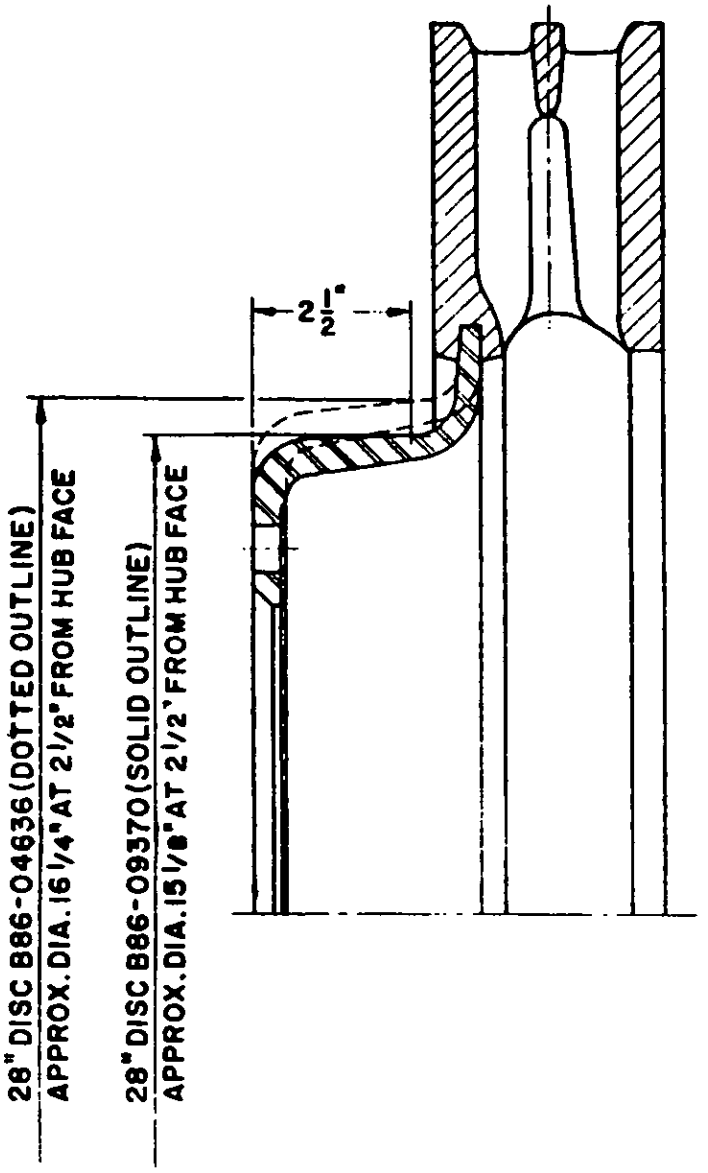
Use of disc B86-04636 with TFM brakes will inevitably result in damage to the back plate of the disc with the possibility of complete failure. The stresses imposed on other brake parts as a result of this interference can cause failure of these parts.

Because it is interchangeable and satisfactory for use with either type brake, disc B86-09370 is currently the only 28" disc supplied for replacement.

DO NOT USE B86-04636 DISCS WITH MODEL TFM DISC BRAKES.

ATT: ESD-1103

H. F. Blankenbiller, Manager
Customer Service Department



NOTE: WHEELS WITH B86-04636 DISCS MUST BE USED ONLY WITH MODEL "CF" DISC BRAKES, BUT DISCS B86-09370 ARE SUITABLE FOR USE WITH BOTH "CF" AND "TFM" MODELS.

DO NOT USE B86-04636 DISCS WITH MODEL "TFM" DISC BRAKES.

SECTION THROUGH 28" DISC

SHOWING DIMENSIONAL DIFFERENCES IN DISC PLATES OF DISCS B86-04636 AND B86-09370

THE BUDD COMPANY
CUSTOMER SERVICE DEPT.
RED LION PLANT
PHILADELPHIA 15, PA.

ESD-1103

RL 871-007

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 20

DATE 9/13/60

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: Locking Plates F86-10855 and F86-10859
For Safetying Brake Disc Attaching Bolts

This bulletin is to advise of the change in method of safetying the Brake Disc attaching cap screws. This revision will result in a better installation at greatly reduced labor and material cost in wheel shops.

Primarily, the cap screw safety wiring is replaced by locking plates (bolt lock straps) which -

(a) eliminate need for 12 lock washers 71A32M per disc
(b) eliminate need for drilled wire holes in head of the F86-06154 cap screws
(c) eliminate need for about 10 feet of 1/8" soft iron wire per disc
(d) eliminate the labor required to apply the safety wiring. This is a difficult and long time consuming operation due to poor accessibility.

Disc application using the new locking plates is illustrated on attached sketch ESD-1243. Locking plates are now available from The Budd Company stock and should be ordered by part numbers as follows:-

F86-10859 Bolt Locking Plate. Used on 28" Discs B86-09370 & B86-04636
F86-10855 Bolt Locking Plate. Used on 26" Discs B86-09360 & B86-05792

The revised F86-06154 cap screws will not change in ordering reference or part number. The only change will be the omission of the two 3/16" dia. drilled holes in the hex head formerly required for the safety wire - this change to become effective when our present stock of F86-06154 drilled head cap screws is exhausted and at that time an appreciable reduction in our selling price shall be made.

Effective with use of Locking Plates, wheel shops should discontinue ordering or using 71A32M Lock Washers and the 212-0044 soft iron wire in mounting Budd brake discs.

J. P. Gaughan, Manager
Customer Service Department

Att: Sketch ESD-1243

BL 871-007

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 20-A

DATE 7/10/63

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: Brake Disc Mounting Bolts - Recommended Torquing Values

This bulletin No. 20-A is issued as a supplement to Disc Brake Bulletin No. 20 dated 9/13/60.

Bulletin No. 20 advised of change in safetying brake disc attaching by means of locking plates instead of the former lock washer and safety wiring method.

Sketch ESD-1243 attached to Bulletin No. 20 specified bolts F86-06154 (cap screws) be tightened to 180-200 ft.-lbs. torque. This torque value had been changed to 130-150 ft.-lbs. when used with clean smooth surface locking plates. If the lock plate surface is rusted, a light coat of oil should be applied in area under bolt head.

Some Railroads prefer to continue older standard, using lockwasher 71A24M instead of locking plate and safety wiring the cap screws in pairs. For this type application cap screw has head drilled for wire insertion. Cap screw part number is now F86-11257. Cap screw torque tightening values of 180-200 ft.-lbs. are recommended for this type application.

J. P. Gaughan, Manager
Customer Service Department

Att: Sketch ESD-1243, Rev. 7/10/63

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 20-B

DATE 11/11/64

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: Brake Disc Mounting Bolts
Recommended SAE Grade 5 Bolts & Torquing Values

This bulletin is issued to supplement Disc Brake Bulletins No. 20 and No. 20-A.

Because of change in material of disc mounting bolts to SAE Grade 5, change in torque value to 200 ft. lbs. is recommended. This torque value applies when used with clean, smooth surface locking plates. If the lock plate surface is rusted, a light coat of oil should be applied on area under bolt head.

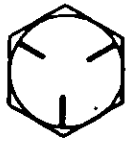
Grade 5 bolts F86-06154, used with locking plates, and F86-11257, drilled for safety wire, have been furnished on all orders following June, 1964.

Grade 5 bolts may be identified by the 3 raised lines in the form of a 'Y' on the head; see illustration on sketch ESD-1243 Rev. B, attached.

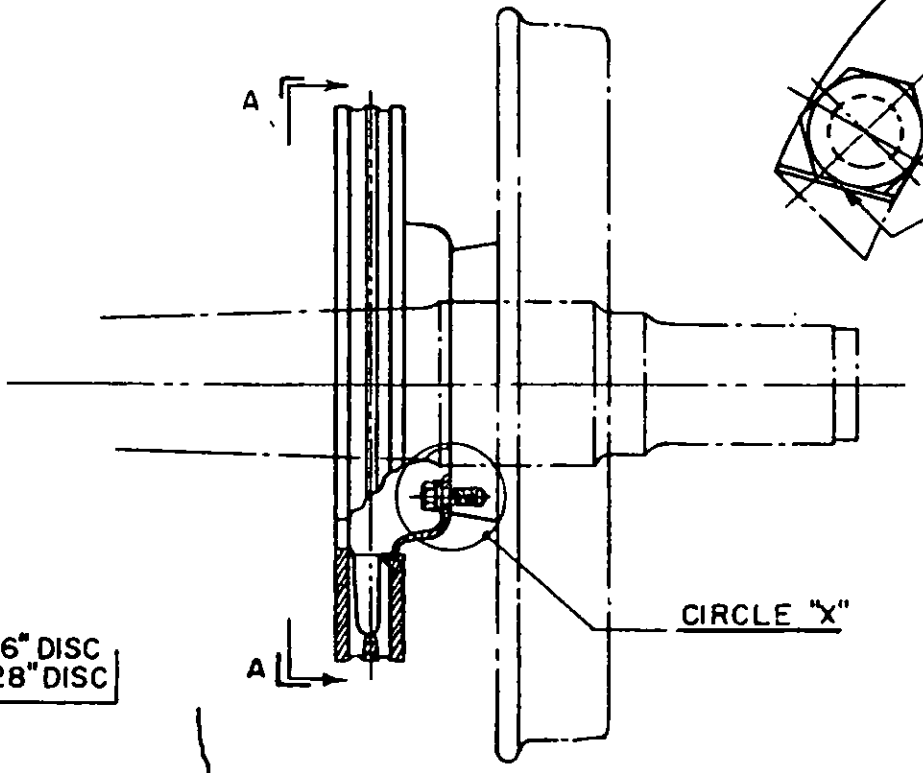
Only grade 5 bolts should be used when mounting new discs.

J. P. Gaughan, Manager
Customer Service Department

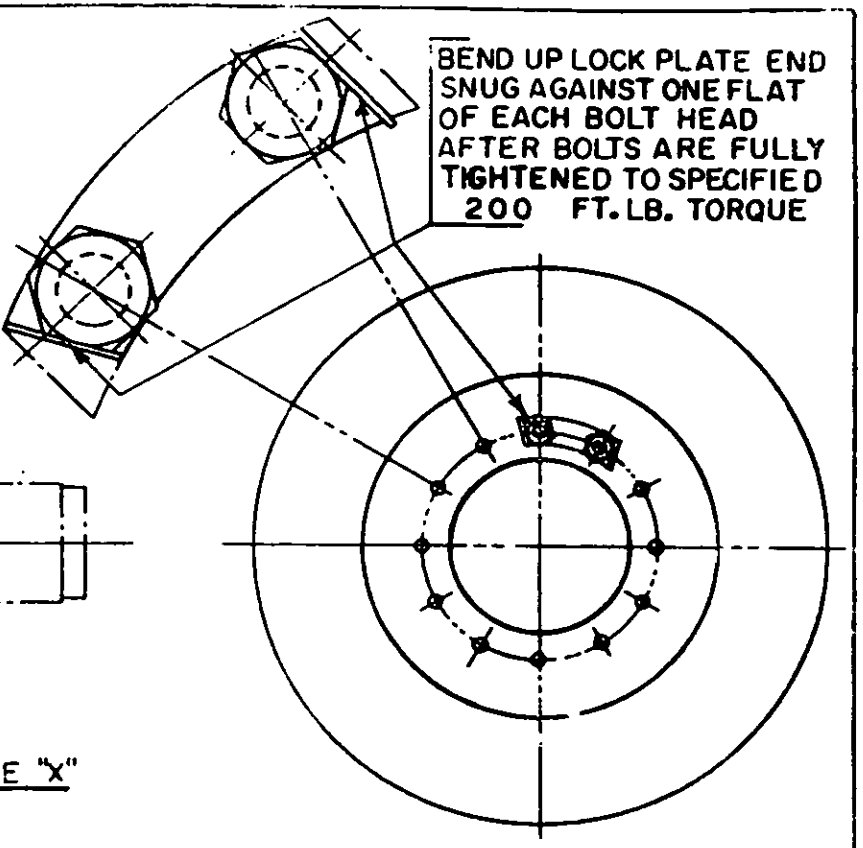
Att: Sketch ESD-1243, Rev. 11/11/64



IDENTIFICATION SYMBOL OF SAE GRADE 5 BOLT



BEND UP LOCK PLATE END SNUG AGAINST ONE FLAT OF EACH BOLT HEAD AFTER BOLTS ARE FULLY TIGHTENED TO SPECIFIED 200 FT. LB. TORQUE



VIEW A-A

LOCKING PLATE
F86-10855 FOR 26" DISC
F86-10859 FOR 28" DISC

12 HOLES EQUALLY SPACED IN WHEEL
43/64 DIA. TAP DRILL, 3/4-16 N.F. THREAD
PITCH DIA. .7094-.7126 #2 LIMIT TAP
1/16 x 45° CHAMFER

BOLT
F86-06154

1 1/2" MIN. FULL THREAD IN WHEEL

ENLARGED VIEW—CIRCLE "X"

APPLICATION OF LOCKING PLATES FOR DISC MOUNTING BOLTS

ESD-1243
REV. B 11-10-64
HRUBANT 9-9-60

RL 871-007

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 21

DATE Aug. 8, 1960

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: Metal Toe Brake Shoe Lining D86-08800
RDC Disc Brakes with 26" Diameter Disc

This bulletin is to advise of change in design of Metal Toe Brake Shoe Lining D86-08800 for use with 26" diameter discs on RDCs. The original D86-08800 linings were developed to meet stringent braking requirements encountered by some railroads during seasonal adverse weather conditions.

Attached Sketch DB-21 illustrates the primary changes.

The major advantages resulting from the new design which were proven in dynamometer runs and in regular road service performance on a number of cars over several months' operations are:

1. Reduced original cost.
2. Longer service life of shoe lining
3. Pronounced improvement in wear life of disc, particularly on the diametrically inner wear path of outboard (wheel side) braking face of disc.
4. Eliminate seasonal change of brake pipe pressure adjustments.

The redesigned Metal Toe Lining carries the same D86-08800 part number as the 1959 version. This is to avoid need for revising Railroads' purchasing and stores departments ordering and stock references. All orders for D86-08800 Brake Lining Assembly will be filled by the new design type linings.

RDCs, when equipped with the new D86-08800 Metal Toe Brake Linings, should be operated with the same 90 psi brake pipe pressure that is used when equipped with standard linings (D86-05572).

This eliminates need for seasonal changes in air brake system settings.

RDC Bulletin No. 43 dated 7/20/56 - "Winter Braking - Use of Metal Toe Brake Lining Assemblies" applies only to older style D86-08800 Brake Linings shipped from The Budd Company prior to August 1960. This RDC Bulletin No. 43 must be disregarded and voided for RDCs equipped with new design Brake Linings D86-08800 shipped from The Budd Company after August 8, 1960.

Limit of Wear - Brake Linings D86-08800

Brake Shoes with Brake Lining D86-08800 should be removed from service when worn to bottom of grooves in the metal toe block. This is at about 13/32 lining thickness.

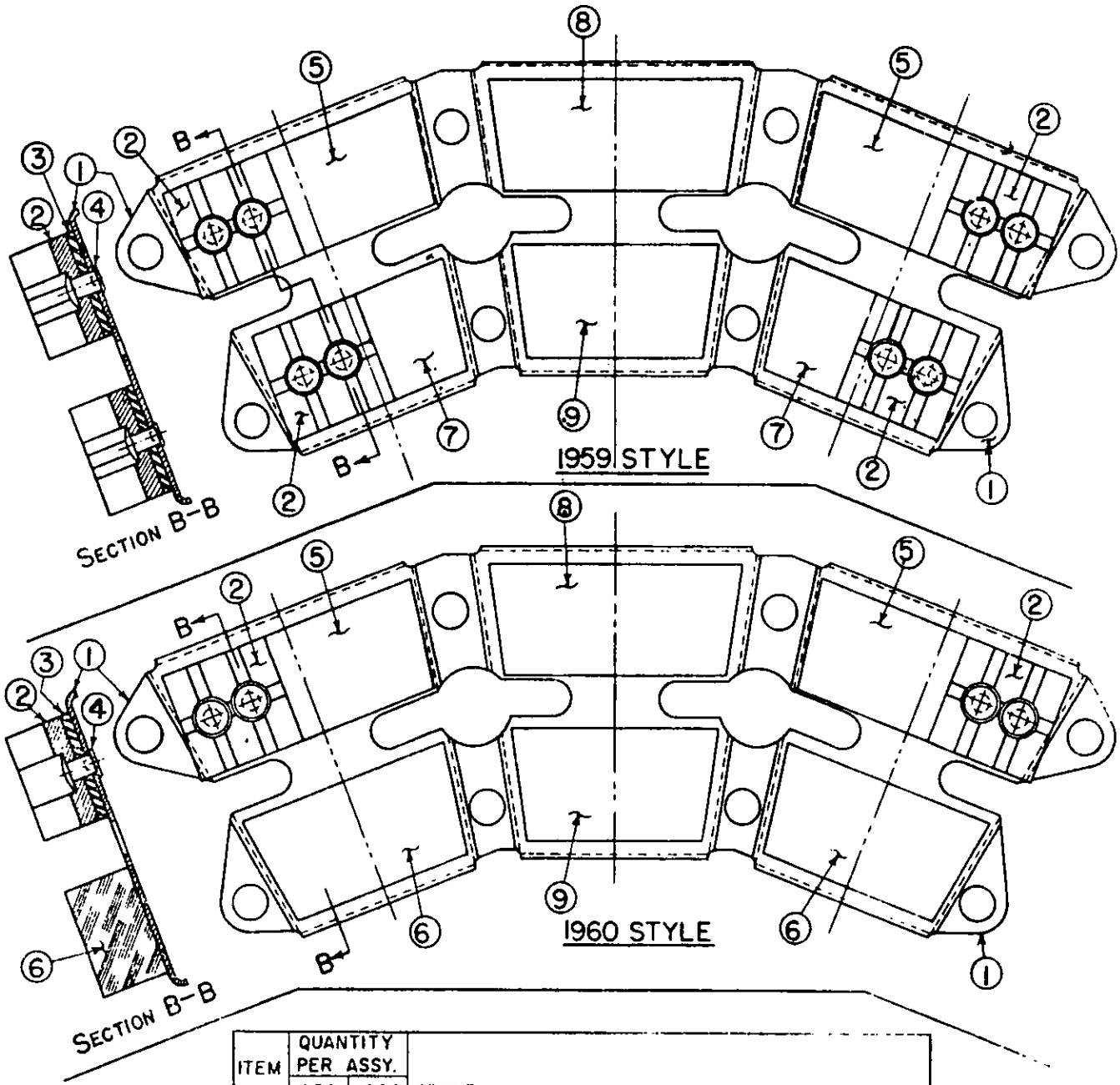
If linings are used with less than this condemning thickness, the steel rivets which fasten the bronze metal toes will be in contact with and damage the disc.

The 1/4" limit of wear on brake linings shown in Disc Brake Manual applies to standard linings (D86-05772), not Metal Toe Linings D86-08800

J. P. Gaughan, Manager
Customer Service Department

cms

ATT: SKETCH DB-21



ITEM	QUANTITY PER ASSY.		STYLE
	1959	1960	
1	1	1	LINING BACK-UP PLATE
2	4	2	BRONZE TOE PLATE
3	4	2	INSULATION BACK-UP FOR BRONZE TOE PLATE
4	8	4	TUBULAR RIVET—STEEL
5	2	2	BRAKE LINING—WOVEN, PARTIAL O.D. END SEGMENT
6	0	2	BRAKE LINING—WOVEN, I.D. END SEGMENT
7	2	0	BRAKE LINING—WOVEN, PARTIAL I.D. END SEGMENT
8	1	1	BRAKE LINING—MOLDED, O.D. MIDDLE SEGMENT
9	1	1	BRAKE LINING—MOLDED, I.D. MIDDLE SEGMENT

CHANGES IN
D86-08800 BRAKE LINING ASSEMBLY
(METAL TOED FOR 26" DIA. DISC)
SKETCH DB-21

BL 871-007

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 22

DATE 9/15/60

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: E86-04921 Gasket and E86-05079 Fulcrum Cover
Omission from future Model TFM & Model CF Disc Brakes

To reduce labor and material costs, especially at overhaul, of both standard Model CF and Model TFM Budd Disc Brakes, the design is changed to eliminate Fulcrum Covers E86-05079 plus associated items. On a car having regular 4 wheel trucks this will save labor and material expended on maintenance or application of -

16 E86-04921 Fulcrum Cover Gasket
16 E86-05079 Fulcrum Cover
32 E86-02190 Cap Screw
32 71A24M Lock Washer
and safety wiring the cap screw.

Decision to omit Fulcrum Covers was based on results of trial installation in regular service for several years. This on 31 full car sets on 4 Railroads starting in 1955 with 10 cars on one Railroad. There was no "freezing" of fulcrum pin and no difference in rate of wear on fulcrum pin or bushings compared with fulcrum cover equipped brakes in same service.

Starting with late October 1960 delivery, all new Model TFM and Model CF Disc Brakes will be without fulcrum covers.

On future D86-05791 Bridge Assemblies used with standard Model CF Brakes, the bridge forging will be without machined seats for the fulcrum cover or its gasket and without the tapped holes for the cover attaching cap screws. Equivalent provisions for application of fulcrum covers are omitted from the casting used in making Fulcrum Pivot Assembly D86-09719 (free lateral type) and D86-06616 (non free lateral type) used with standard Model TFM Brakes.

E86-04921 Gasket and E86-05079 Fulcrum Cover will not be available after our present stock is exhausted.

We recommend omitting the fulcrum covers from existing brakes at general overhaul or whenever work about the cover is required.

J. P. Gaughan, Manager
Customer Service Department

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 26

DATE 11/29/62

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: Budd Brake Cylinder Modifications
Cylinder Assemblies D86-05080 ($6\frac{1}{2}$"), D86-05050 (7"), D86-05047 ($7\frac{1}{2}$") and D86-08844 (8").

This bulletin is to advise of changes made by The Budd Company in make-up of Budd common standard disc brake cylinders to improve their operation at extreme low temperatures.

The changes in brief consist of:-

1. Lubrication

   Brake cylinder lubricant adopted is Molylube 80-18 Grease made by Bel-Ray Co., Inc., Farmingdale, N.J. This replaces former standard AAR M914-42 Brake Cylinder Lubricant and also replaces light machine oil formerly used for the felt swabs.

2. Cylinder Piston Packing Cups.

   Composition of piston packing cup was changed to a special grade WRT type Neoprene. This assures sufficient flexibility to provide seal at extremely low temperatures in combination with the specified lubricant.

3. Eliminated piston head lubricator swab felt.

4. Reduced piston outside diameter.
   This to increase nominal clearance between piston head and cylinder wall.

We suggest above 4 changes be incorporated in these brake cylinders at air-data cleaning or other periodic maintenance overhaul. For this purpose we give below and in the attached sketches LW-21 and LW-22 more detailed information.

1. LUBRICATION

Many greases were tested. Molylube 80-18 Grease was the only one which successfully passed all of the tests considered applicable to all operating requirements and packing cup compatibility. This grease sells within reasonable price limits.

Following lubrication instructions are presently used in assemblying new cylinders at Red Lion plant and it is suggested these also be followed when brake cylinders are given periodic maintenance or repairs.

Brake Cylinder Lubrication Instructions:-

Cylinder Wall
Apply a light coat of cylinder lubricant to entire wall. Do not coat inside surface of cylinder head.

Felt Ring E86-04182
Piston tube felt ring to be smeared with same cylinder lubricant, undiluted. Hand rub inside diameter surface of felt ring which contacts piston tube so as to work in a generous quantity of lubricant into the felt.

Piston Tube
Apply a light coat of cylinder lubricant over entire working surface.

Spring Guide E86-06339
Apply a light coat of cylinder lubricant over entire surface which may come in contact with the return spring.

Piston Return Spring E86-05088
Apply a light coat of cylinder lubricant to end surface of spring where it seats in piston head.

Packing Cup
Apply a light coat of cylinder lubricant on outside lip surface where cup contacts cylinder wall.

2. PISTON PACKING CUPS

There is no change in Part number ordering reference for the new composition packing cup. For ready identification these cups now have 1/4" high letters "LT" in raised molded characters located directly under the cup part number.

3. LUBRICATOR FELT SWAB IN PISTON HEAD

The piston lubricator swab (felt) is omitted from all new brake cylinder assemblies. Tests brought out that the piston swab felt contributes to cylinder leakage and blow-by at sub-zero temperatures and especially at low brake cylinder pressures as felt fibers tear out in the stiffened grease. These loose fibers and felt segments then collect under packing cup lip and destroy cup-to-wall seal.

Felt swabs E86-05151, E86-06375, E86-06378 and E86-08839 will no longer be supplied by The Budd Company. This item should be canceled in all stock lists.

Piston lubricator swab felt should be omitted when brake cylinders are given periodic overhaul.

SPECIAL NOTICE:-
This special notice applies to old style piston assemblies equipped with separate metal swab retainers like in lubricator swab assemblies E86-00673 and E86-01888. These are 7" and 7½" piston assemblies manufactured prior to 1952, assembly part numbers T-5159-E (7" with steel head), D86-05739 (7" with aluminum head), T4428-F (7½" with steel head) and D86-05740 (7½" with aluminum head).

On future service orders lubricator swab assemblies E86-00673 and E86-01888 will be supplied without the felt swabs. Felt swabs E86-05133-E4 and E86-05133-E5 will no longer be supplied.

When overhauling brake cylinders having any of above 4 piston head assemblies, remove and omit the felt swab only of the lubricator swab assembly.

The swab metal retainer, less the felt swab, must be reapplied to the piston for support of the packing cup.

Caution - Check O.D. of metal retainers before application to piston head. The metal retainer O.D. should not be over 6-27/32" for 7" cylinder or not over 7-11/32" for 7½" cylinder. This diametral size reduction is required so metal retainer does not project beyond newly reduced O.D. of piston head - this to avoid possible scoring of aluminum cylinder wall by the steel retainer.

4. REDUCED PISTON DIAMETER

Nominal clearance between piston and cylinder wall was increased to 1/8" on the diameter. This clearance increase is obtained by reducing O.D. of piston heads. This was made effective with all new piston assemblies manufactured after March 1, 1962.

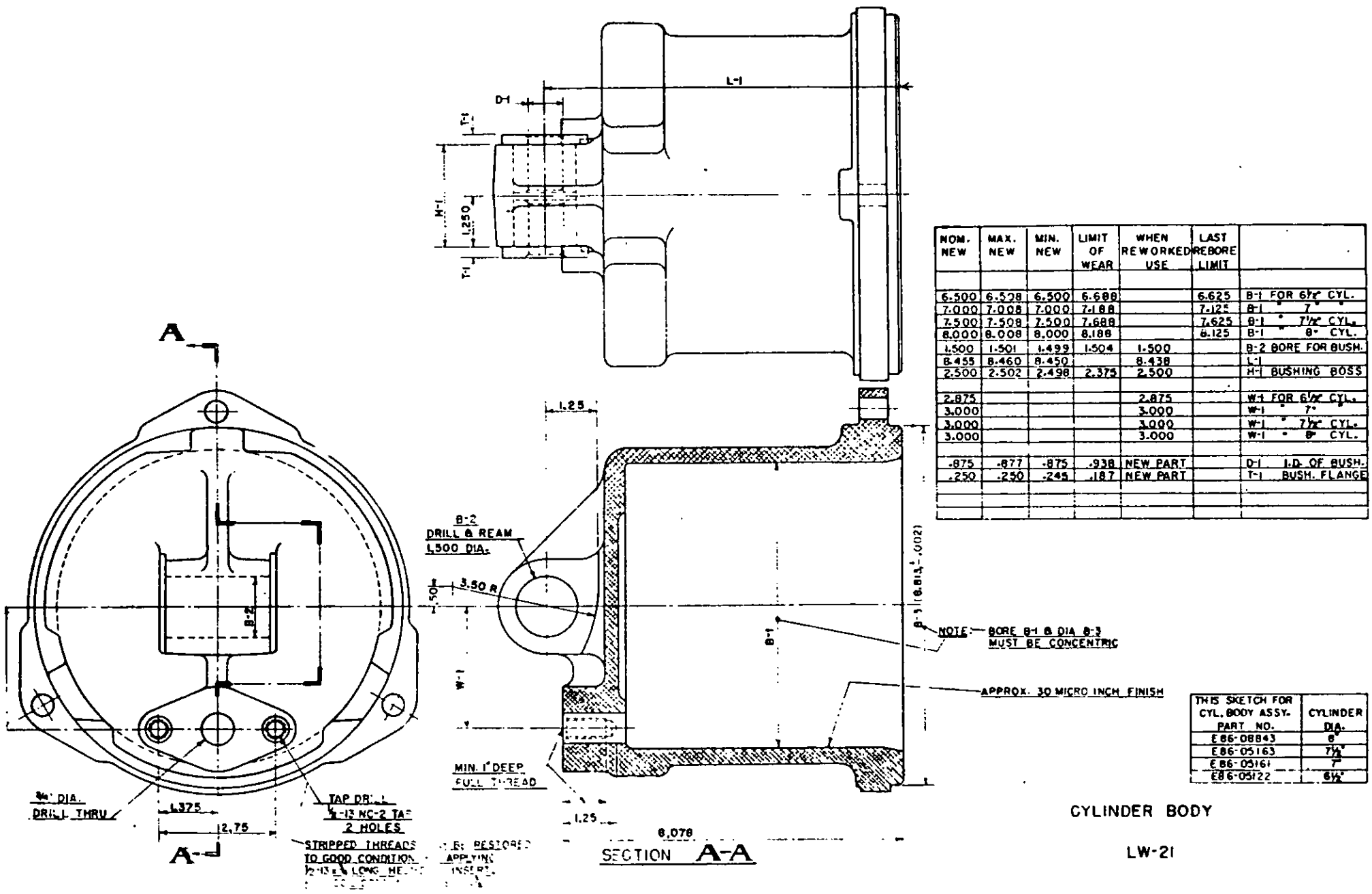
Attached sketch LW-22 under heading "when reworked use" for dimension D-3 shows maximum O.D. to which existing piston heads should be turned at brake cylinder overhaul. Old style piston assemblies T-4428-E, T-5159-E, D86-05739 and D86-05740 should be turned on O.D. corresponding to sketch LW-22.

Attached sketch LW-21 illustrates cylinder body, giving certain suggested limits of wear, etc., for use in cylinder reconditioning. Deep score marks or grooves in packing cup working area of cylinder wall may be removed by honing or machining without lightest cut needed to just remove the sharp grooves or score marks.

Where cylinder wall has only a few light scratches or small ridges, removal by machining may not be needed so long as cylinder passes leakage test. If desired these imperfections may be smoothed out by hand, using emery cloth over a rounded wood block.

J. P. Caughan, Manager
Customer Service Department

Att: Sketch LW-21
Sketch LW-22

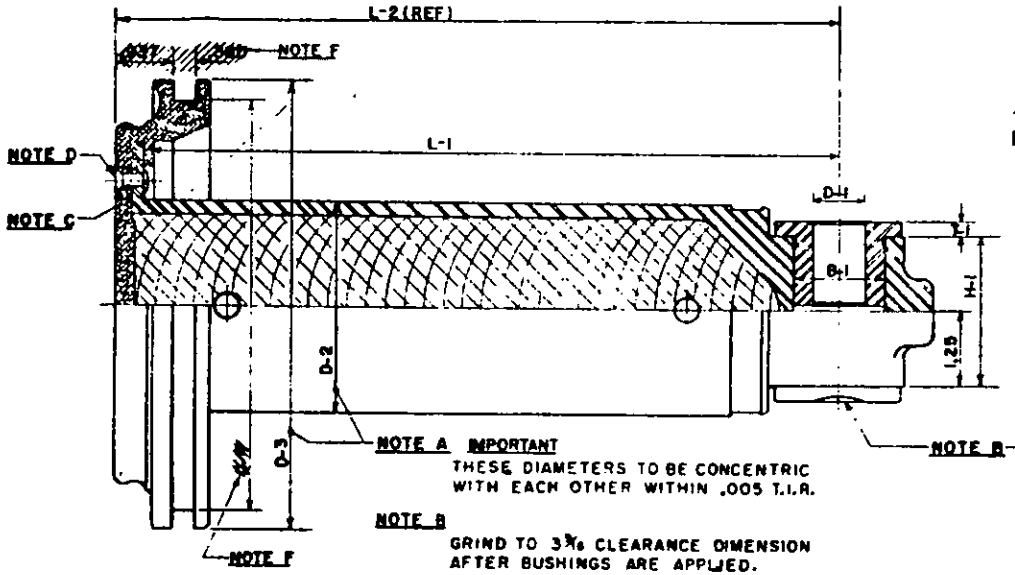


NOM. NEW	MAX. NEW	MIN. NEW	LIMIT OF WEAR	WHEN REWORKED USE	LAST REBORE LIMIT	
6.500	6.508	6.500	6.688		6.625	B-1 FOR 6½" CYL.
7.000	7.008	7.000	7.188		7.125	B-1 " 7" "
7.500	7.508	7.500	7.688		7.625	B-1 " 7½" CYL.
8.000	8.008	8.000	8.188		8.125	B-1 " 8" CYL.
1.500	1.501	1.499	1.504	1.500		B-2 BORE FOR BUSH.
8.455	8.460	8.450		8.438		L-1
2.500	2.502	2.498	2.375	2.500		H-1 BUSHING BOSS
2.875				2.875		W-1 FOR 6½" CYL.
3.000				3.000		W-1 " 7" "
3.000				3.000		W-1 " 7½" CYL.
3.000				3.000		W-1 " 8" CYL.
.875	.877	.875	.938	NEW PART		D-1 I.D. OF BUSH.
.250	.250	.245	.187	NEW PART		T-1 BUSH. FLANGE

THIS SKETCH FOR CYL. BODY ASSY. PART NO.	CYLINDER DIA.
E86-08843	8"
E86-05163	7½"
E86-05161	7"
E86-05122	6½"

CYLINDER BODY

LW-21



NOTE A IMPORTANT
THESE DIAMETERS TO BE CONCENTRIC WITH EACH OTHER WITHIN .005 T.I.R.

NOTE B
GRIND TO 3⅜ CLEARANCE DIMENSION AFTER BUSHINGS ARE APPLIED.

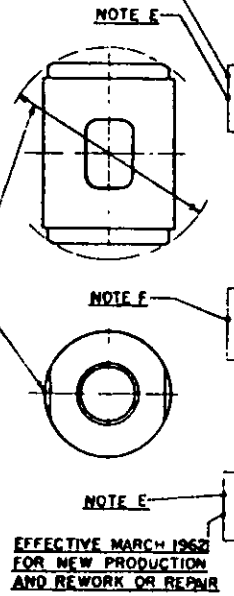
NOTE C
INSERT HAIR SO THAT NO HAIRS ARE PINCHED BETWEEN THESE SURFACES.

NOTE D
RIVETS MUST PROTRUDE BEYOND PISTON HEAD, BUT NOT OVER .020

NOTE E
DIMENSION D-3 SHOWN IS FOR FULLY FINISHED PISTON ASSEMBLY READY FOR INSTALLATION. NEW REPLACEMENT PISTON HEADS ARE SUPPLIED ROUGH TURNED OVERSIZE ON DIA. D-3 AND MUST BE FINISHED PER NOTE "A" AND DIMENSION D-3 AFTER PISTON HEAD IS ASSEMBLED TO THE PISTON TUBE.

NOTE F
MACHINING OF LUBRICATING SWAB GROOVE DISCONTINUED NOVEMBER 1962.

THESE DIMENSIONS WERE EFFECTIVE THRU FEB. 1962



EFFECTIVE MARCH 1962 FOR NEW PRODUCTION AND REWORK OR REPAIR

NOM. NEW	MAX. NEW	MIN. NEW	LIMIT OF WEAR	WHEN REWORKED USE	
1.500	1.501	1.499	1.504	1.500	B-1 BORE FOR BUSHING
.875	.877	.875	.938	NEW PART	D-1 LARGEST I.D. OF BUSH.
3.599	3.600	3.598	3.562	NEW PART	D-2 PISTON TUBE O.D.
6.438	6.438	6.433	6.343	6.438	D-3 PISTON HEAD, 6½ CYL.
6.938	6.938	6.933	6.843	6.938	D-3 " " 7" "
7.438	7.438	7.433	7.343	7.438	D-3 " " 7½ "
7.938	7.938	7.933	7.843	7.938	D-3 " " 8" CYL.
2.500	2.502	2.498	2.375	2.500	H-1 PISTON TUBE HEIGHT
11 7/32				11 7/32	L-1 LENGTH TO BUSH ℄
11 29/32				11 29/32	L-2 " OVER PISTON HEAD
.250	.250	.245	.187	NEW PART	T-1 BUSH FLANGE THICKNESS
5.781	5.791	5.771		5.790	D-4 PISTON HEAD 6½
6.281	6.291	6.271		6.290	D-4 " " 7 "
6.781	6.791	6.771		6.790	D-4 " " 7½ "
7.281	7.291	7.271		7.290	D-4 " " 8 "
6.375	6.375	6.370	6.250	6.375	D-3 PISTON HEAD, 6½" CYL.
6.875	6.875	6.870	6.750	6.875	D-3 " " 7" "
7.375	7.375	7.370	7.250	7.375	D-3 " " 7½" "
7.875	7.875	7.870	7.750	7.875	D-3 " " 8" CYL.

THIS SKETCH FOR PISTON ASSY. PART NO.	USED IN CYLINDER I DIA.
D86-08842	8"
D86-06426	7½"
D86-06419	7"
D86-05738	6½"

PISTON ASSEMBLY

LW-22

REV. B 11-29-62

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 26A

DATE 7/26/65

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: Budd Brake Cylinder Lubricant used in Cylinder Assemblies:-

B86-12048 (6½")	B86-12051 (7")
B86-05047 (7½")	B86-11912 (7") (Cast Iron)
D86-12054 (7½")	D86-08844 (8")
	D86-12057 (8")

This bulletin is to advise of change in lubricant to be used in standard Disc Brake Cylinders to improve their operation at extreme low temperatures and to provide better corrosion protection to interior of the cylinders.

Brake cylinder lubricant now recommended is "Molylube #850 Grease" furnished by Bel-Ray Co. Inc., Farmingdale, N.J. This replaces former standard Molylube 80-18 brake cylinder lubricant.

The thickener used in this lubricant is an aluminum soap or complex. This substance will not absorb water which tends to harden other thickeners and cause them to be wiped off the surfaces to be lubricated (such as the hollow forged piston tube assembly).

This same property will provide corrosion protection in cast iron cylinders by maintaining the surface coating and eliminating the absorption of water.

Molylube #850 Grease will be supplied on all future orders for Molylube 80-18.

J. P. Gaughan, Manager
Customer Service Department

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 27

DATE 2/26/64

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: Change in Brake Cylinder Boots and Boot Clamps
Budd Standard Type Brake Cylinders

Starting March 1964, new Budd standard type Brake Cylinders manufactured at Budd Red Lion Plant will be fitted with a slightly changed Boot attached with new style Boot Clamps.

Purpose of this change is to reduce maintenance costs while getting more trouble-free service by obtaining more positive clamping application of boot at piston end and eliminating chances of puncturing boot by "pinching" action of clamp at the cylinder cover end. This with lower cost clamps which may be obtained direct from Punch-Lok Company or their distributors.

CYLINDER BOOT D86-04186 & CLAMPS

(a) Boot ordering part number remains the same D86-04186.

(b) Boot clamp at large end on cylinder cover (non-pressure head):

Old style clamp is Budd part number E86-05699.
New style clamp is Budd part number L86-11984 (Punch-Lok #0-358).

These two clamps E86-05699 and L86-11984 are interchangeable and may be used with either new or old style boot. Manufacture of clamp E86-05699 is discontinued.

(c) Boot clamp at small end or piston end:

Old style clamp is Budd part number E86-08777. This clamp must be used with old style boot. This clamp is not suitable and should not be used with new style boot.

New style clamp is Budd part number L86-11983 (Punch-Lok #0-332). This clamp must be used with new style boot only; it must not be used with old style boot.

To permit re-application of old style boots which are in good condition, old style clamp assemblies E86-08777 will be available from Budd stock and will be supplied on purchase orders specifying E86-08777.

Old style boots D86-04186 will no longer be stocked. On orders calling for boot D86-04186 the new style boot will be supplied. New style clamps L86-11983 (Punch-Lok #0-332) should be ordered for use with the new style boot.

Boot D86-04186 is used on the following cylinders:

D86-05047 - 7½" standard cylinder (aluminum body)
D86-05050 - 7" " " " "
D86-05080 - 6½" " " " "
D86-08840 - 8" " " " "
B86-11912 - 7" standard cylinder (with iron body)
B86-09992 - 7½" cylinder used with hydraulic hand brake.

SKETCH DBD-27

Attached sketch DBD-27 illustrates position of boot and clamps on a completely assembled brake cylinder assembly. Sketch also shows difference in shape of old style and new style boot D86-04186 by means of enlarged views of region designated as "circle A".

APPLYING NEW STYLE CLAMPS

The new style clamps are 3/8 inch wide Open-End Punch-Lok.

Because of close clearances with boot walls, Punch-Lok Model P-38 Clamp-Master Locking Tool is recommended to use in making application of clamp at piston (small) end of boot.

Attached sketch DB-27-B illustrates the P-38 tool and how it is to be used.

Attached sketch DB-27-A is an illustrated instruction notice showing recommended "lacing-up" of the open-end type clamps preparatory to use of P-38 tool for final tightening of clamp.

Sketch DB-27-B illustrates and instructs the use of tool P-38 in a normal manner for locking the clamp by means of hammer blow punch indentation lock. Where punching is difficult because of restricted clearance for a good, clean hammer blow (like possible obstruction by the boot wall) many users prefer an alternate method of locking the clamp and obtain better results. This alternate method omits steps 6 and 7 illustrated in sketch DB-27 and substitutes the following:

After desired tension is obtained by step 5:

(a) raise Clamp-Master tool P-38 to bend clamp tail pieces at right angle
(b) remove winder and withdraw tool part way out
(c) clip off tail piece about 1/4" above the bend
(d) fold the 1/4" projection down over the Lok.

The Model P-38 Clamp Master Locking Tool, also 3/8" wide open-end clamps Punch-Lok #0-332 and Punch-Lok #0-358, may be purchased from:

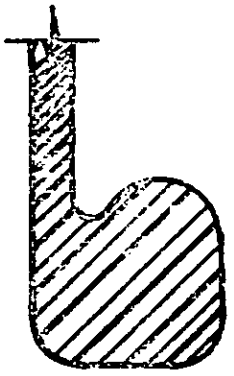
PUNCH-LOK COMPANY
321 North Justine Street
Chicago, Illinois 60607

or

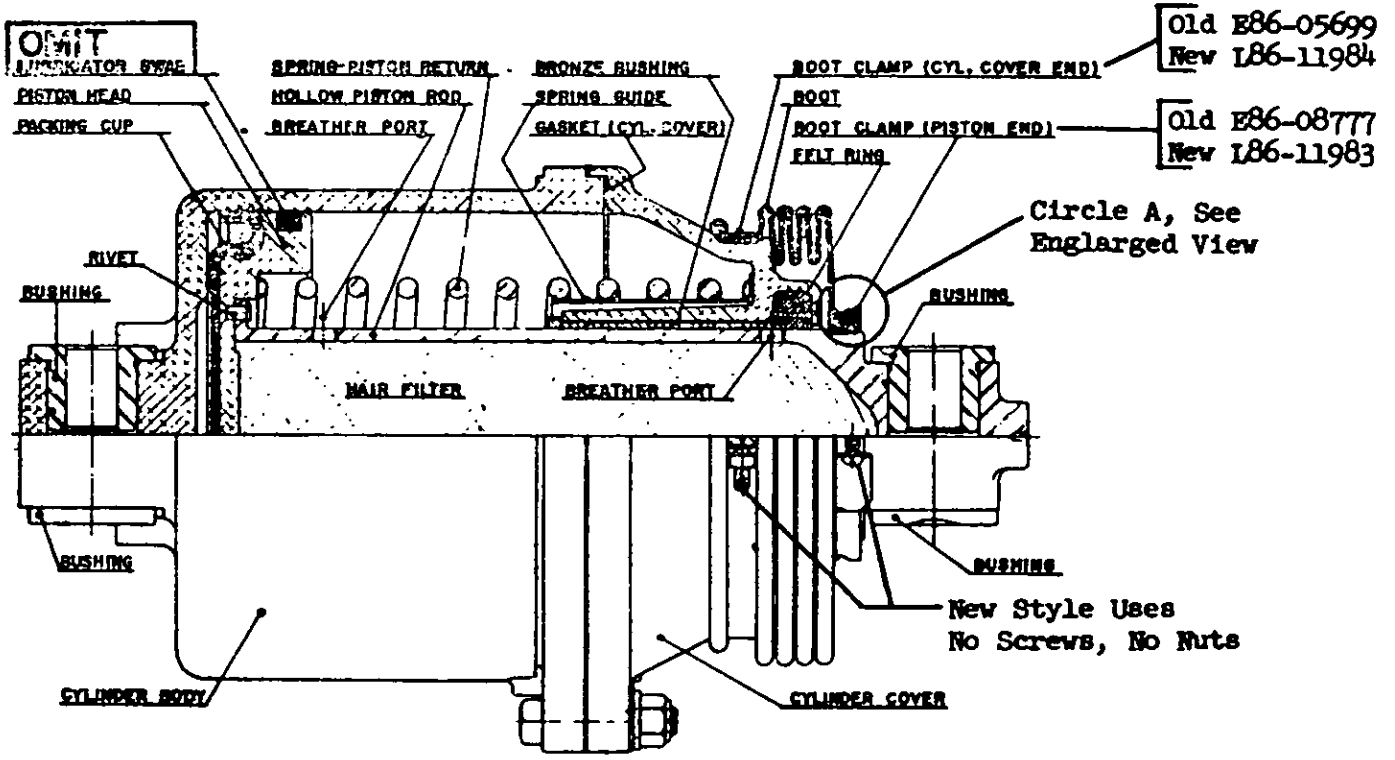
through PUNCH-LOK distributors

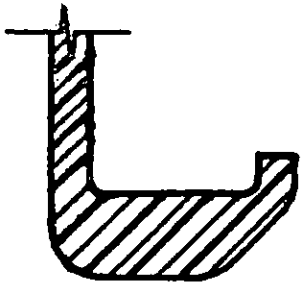
J. P. Gaughan, Manager
Customer Service Dept.

att: Sketch DHD-27
" DB-27-A
" DB-27-B



Enlarged View
Circle A
Old Style Boot



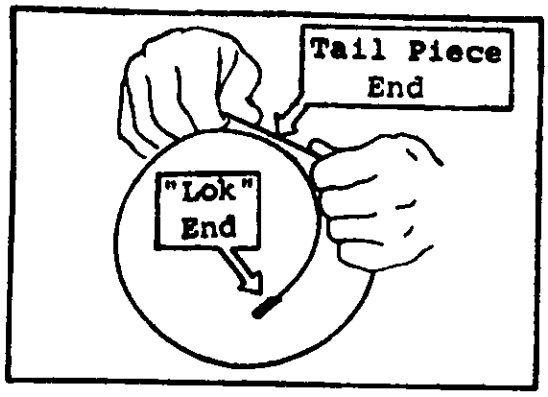


Enlarged View
Circle A
New Style Boot

Change in
Boot & Boot Clamps

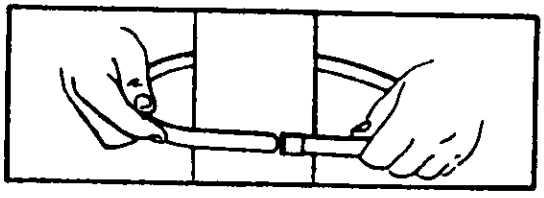
DBD-27

LACING PUNCH-LOK OPEN END, HEAVY DUTY CLAMPS

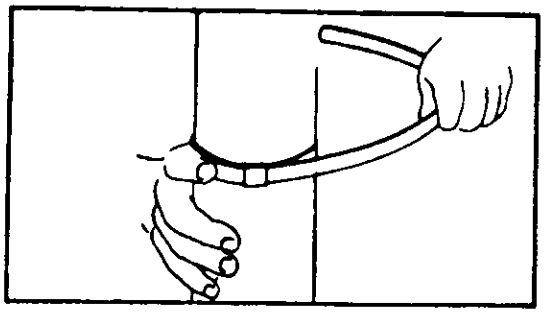


TO DO THIS "LACING UP", THE EASIEST WAY

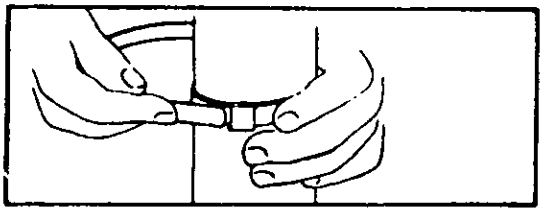
1. STRAIGHTEN OUT THE CURVED TAIL PIECE FOR AT LEAST 3-1/2"



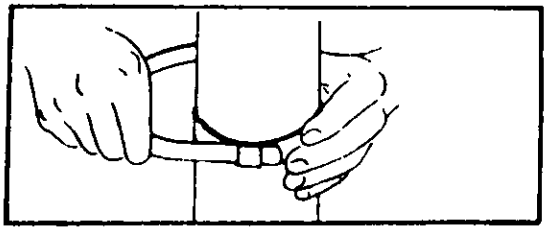
2. PUT CLAMP AROUND AND "LACE" FIRST WRAP THROUGH THE "LOK".



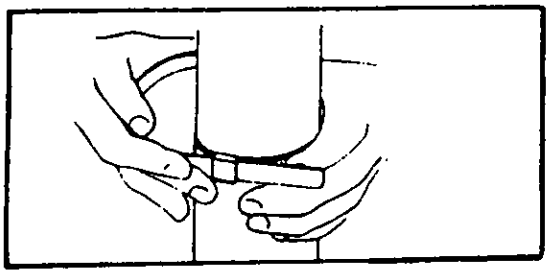
3. PULL UP TIGHT AND DON'T LET IT SLIP WHILE "LACING UP" TO COMPLETE 2nd WRAP.



4. USING THE EXTRA LENGTH OF STEEL TO GET A HAND HOLD ON THE TAIL PIECE -



5. PUSH SECOND WRAP THROUGH LOK WITH ONE HAND WHILE HOLDING BOTH WRAPS WITH THE OTHER HAND.



6. WORK THE TAIL PIECE THROUGH LOK. READY FOR THE TOOL.

DO NOT TRY TO SAVE ANY STEEL IN THE TAIL PIECE BY ORDERING A SMALLER SIZE CLAMP. THE EXTRA LENGTH MAKES AN EASIER AND FASTER APPLICATION.

SK DB-27-A
2-27-64

How to Use the CLAMP-MASTER

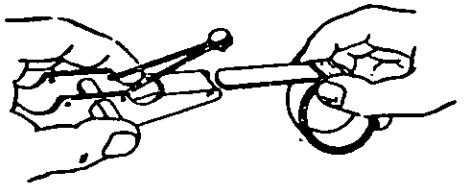
1 The CLAMP-MASTER is an assembly unit consisting of four parts that will apply any size clamp:

Frame

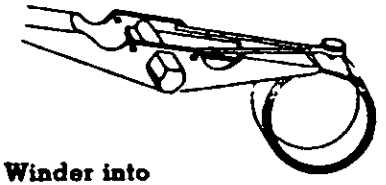
Punch and Holder

Winder

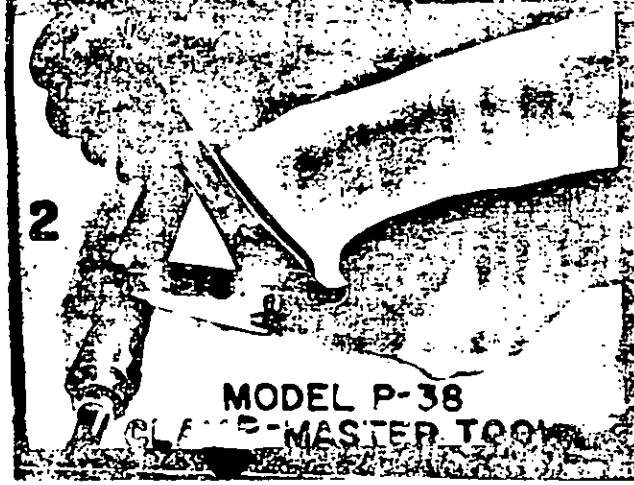
Ratchet Wrench



3 Push end of Clamp completely into slotted end of CLAMP-MASTER. For ⅜" width Clamp use narrow slotted end.

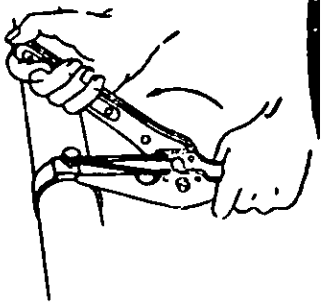


4 Push Winder into Frame with slot engaging Clamp end.

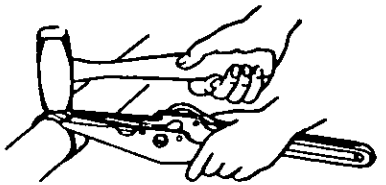


MODEL P-38
CLAMP-MASTER TOOL

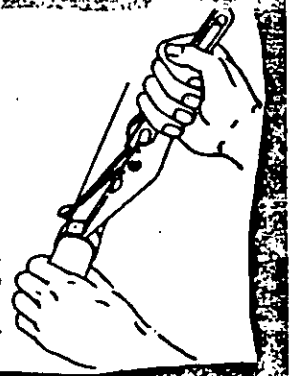
5 Apply Ratchet Wrench to Winder. Push forward with sufficient strokes until desired tension is obtained.



6 Push punch down on LOK and while holding tension with Wrench, strike firm blow with hammer, thus locking Clamp.



7 Raise punch and while holding tension with Wrench, swing Frame forward and up against edge of LOK, breaking off tail piece. Peen corners of LOK smooth. Twist up tail and when it is free, pull out the Winder. To move punch from one end to other end, squeeze legs of punch holder and re-engage in holes at opposite end.



8

To use Open End Clamp, wrap and lace the clamp twice around, threading each wrap through LOK, then apply and use P-38 tool.

See Sketch DB-27-A for clamp lacing instructions.

SK DB-
2-27

871

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 27-A

DATE 2/26/64

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: Change in Brake Cylinder Boot Clamps
Budd Type Special Brake Cylinders

This bulletin is to advise of change in clamps for brake cylinder Boot D86-09874.

Boot D86-09874 and boot clamps covered by this Bulletin No. 27-A are for use on following Budd brake cylinders:-

D86-09893 - 6½" dia. (P.R.R. Cars #150, 152, 154)
D86-11801 - 7" dia. (M.U. Cars:- Reading Cars 9001-9017 &
P.R.R. Cars 201-219 & 251-269)

(a) Boot D86-09874 remains the same contour or cross section as those now in service; no change in boot.

(b) Boot clamp at small end or piston end:-
Old style clamp is Budd part number F86-09869
New style clamp is Budd number L86-11981 (Punch-Lok #0-320)
These two clamps may be used interchangeably.

(c) Boot clamp at large end or cylinder cover end:-
Old style clamp is Budd part number F86-09868
New style clamp is Budd number L86-11982 (Punch-Lok #0-342).
These two clamps may be used interchangeably.

The new style clamps have two advantages over the old:-

1. New style is considerably less expense.

2. New style clamp, properly applied, makes a better seal and more secure fastening due to eliminating possibility of gathering a "buckle" of boot at clamp ends or "puncturing" of boot due to pinching by old style clamp.

Old style clamps F86-09868 and F86-09869 will no longer be stocked.

The same P-38 tool and the same method of application with these new style clamps Punch-Lok #0-320 and #0-342 are recommended as that described in Bulletin #27 for the larger diameter clamps.

J. F. Gaughen, Manager
Customer Service Department

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 28

DATE MARCH 11, 1960

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: REVISED AIR "ON-OFF" INDICATOR ASSEMBLY

THIS BULLETIN IS TO ADVISE THAT AIR "ON-OFF" INDICATOR ASSEMBLY D86-00195 WILL BE OBSOLETE AND REPLACED BY AN IMPROVED ASSEMBLY D86-12151 AS SHOWN ON ATTACHED DSD-1296.

ALL REPLACEMENT PARTS FOR THE OBSOLETE D86-00195 ASSEMBLY WILL BE STOCKED BY THE BUDD COMPANY IN MODEST QUANTITIES FOR A PERIOD OF TIME. HOWEVER, COMPLETE ASSEMBLIES WILL NOT BE STOCKED.

COMPLETE D86-12151 ASSEMBLIES AS WELL AS ALL REPLACEMENT PARTS WILL BE STOCKED BY THE BUDD COMPANY.

EXTERNAL MOUNTING DIMENSIONS OF THE NEW D86-12151 ASSEMBLIES ARE THE SAME AS THE OLD D86-00195 UNITS MAKING THEM DIRECTLY INTERCHANGEABLE.

MAINTENANCE

AS WITH THE D86-00195 INDICATOR THIS UNIT SHOULD BE REMOVED FROM CAR AND DISASSEMBLED AT AIR DATING.

CLEAN ALL METAL PARTS THOROUGHLY USING CLEANING SOLVENT AND INSPECT THEM FOR DAMAGE. REPLACE ALL DAMAGED PARTS. INSPECT DIAPHRAGM FOR SIGNS OF CHECKING OR WEAR AND REPLACE IF FOUND.

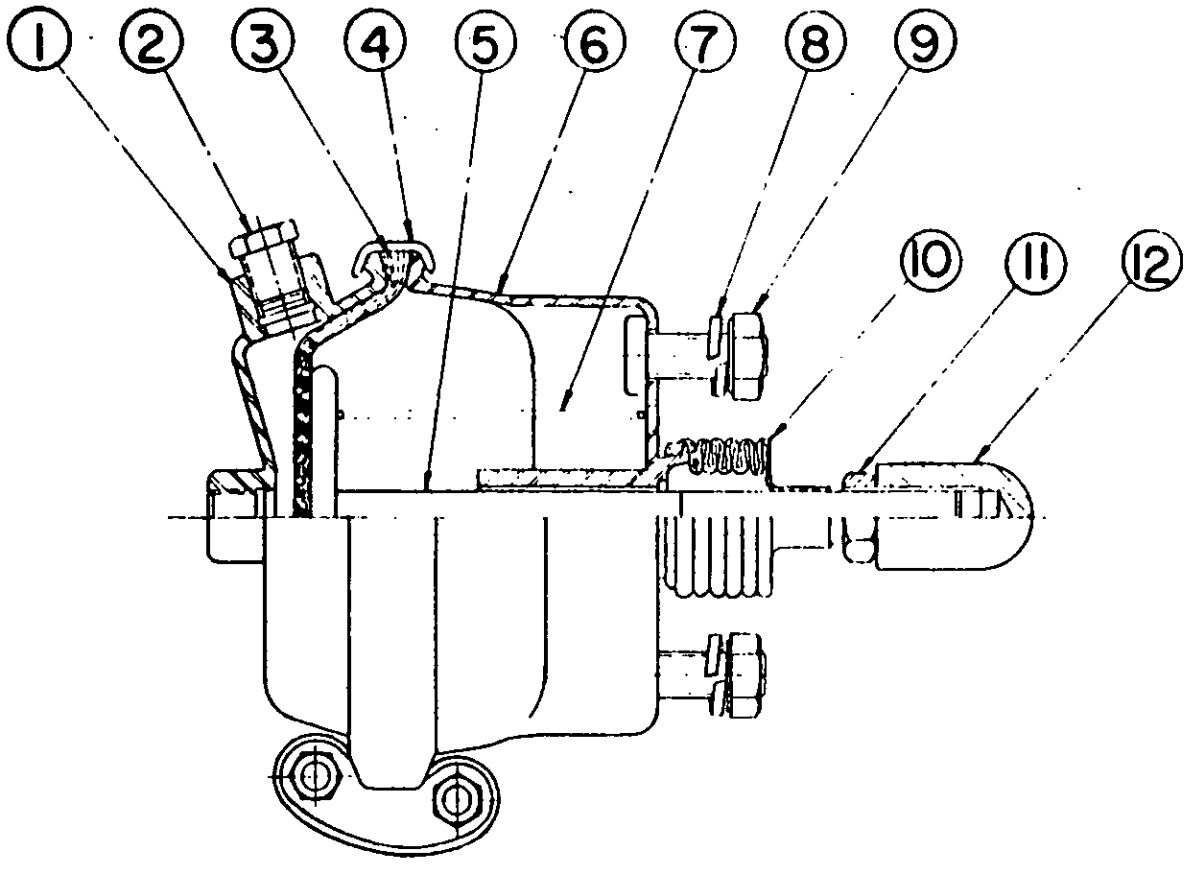
INSPECT BOOT FOR WEAR OR DAMAGE AND REPLACE IF REQUIRED

LEAKAGE TEST

WITH AIR APPLIED TO THE INDICATOR, CHECK FOR LEAKAGE THRU THE DIAPHRAGM. REMOVE THE RUBBER BOOT AND APPLY SOAP SUDS AROUND THE PUSH ROD CLEARANCE HOLE. IF LEAKAGE IS FOUND, THE DIAPHRAGM MUST BE REPLACED.

J. P. GAUGHAN, MANAGER
CUSTOMER SERVICE DEPARTMENT

ATT: DSD-1296



D86-12151 AIR "ON-OFF" INDICATOR ASSEMBLY

ITEM	PC.NO.	DESCRIPTION
1	L86-12156	PLATE, PRESSURE
2	L86-12155	PIPE PLUG
3	L86-12157	DIAPHRAGM
4	L86-12158	CLAMP
5	L86-12159	PUSH ROD
6	L86-12160	PLATE, NON-PRESSURE
7	L86-12161	SPRING-RELEASE
8	71A22M	LOCKWASHER-SPRING
9	21A11M	NUT
10	L86-12162	BOOT
11	21A13M	NUT
12	F86-00167	INDICATOR

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 29

DATE 1/24/66

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: Model CF & TFM Disc Brake - Brake Head Repair & Guide Pin Bushing Replacement

This bulletin is issued to advise:-

(a) Change to single full length guide pin bushing in brake head.

(b) Method of salvaging all 3 types of Brake Heads with arm forgings damaged or with abnormal wear.

All brake heads, both CF & TFM type, manufactured since approximately May, 1963 have been furnished with a single full length guide pin bushing rather than 2 short bushings.

This change is made to eliminate bending of brake head arms under certain conditions. We recommend that the single bushing be installed at time of brake head repair or overhaul.

PROCEDURE

Refer to sketches:-

DBB-29A	CF type	D86-04912
DBB-29B	TFM type (long)	D86-06611 & D86-06612
DBB-29C	TFM type (short)	D86-10578 & D86-10579

1. Press out existing bushings (E86-01577).

2. Bore and ream arm forging to 1.374 plus .002, minus .000.

3. Remove 1/4" from bushing boss to provide additional clearance at brake operation; brake heads D86-04912, D86-06611 and D86-06612 only.

4. Press new bushing (F86-11793 or F86-11726) in place.

5. Arc tack 2 places as shown. Use stainless steel rod.

Bushings F86-11793 and F86-11726 should be purchased from The Budd Company.

Superseding information covered in Bulletin No. 11 and current Service Manuals, method of salvaging Brake Heads with arm forgings damaged or worn is as follows:

PROCEDURE

Refer to sketches DBB-29A, DBB-29B or DBB-29C for respective brake head involved.

(a) Carefully remove arm forging from brake head and grind head smooth to provide good surface for welding.

(b) Weld new arm assembly to brake head as shown. A holding fixture should be used when welding to maintain proper alignment of parts.

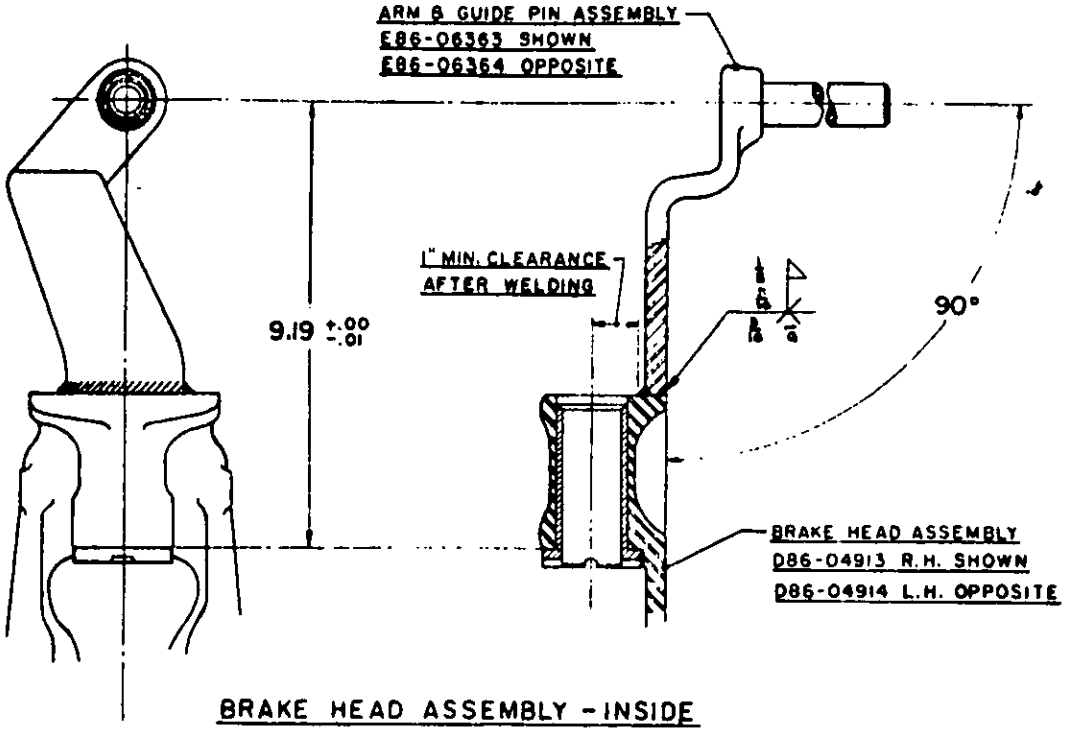
Use mild steel welding rod AWS E-6015.

Replacement arm assemblies (with single bushing) should be purchased from The Budd Company to following part numbers:

Brake Head Assy.	Replacement Arm Assy.	Replacement Arm & Guide Pin Assy.
D86-04912	E86-09257	
D86-04913		E86-06363
D86-04914		E86-06364
D86-06611	E86-09637	
D86-06612	E86-09638	
D86-06613		E86-09635
D86-06614		E86-09636
D86-10578	E86-11733	
D86-10579	E86-11734	
D86-10525		E86-11736
D86-10526		E86-11737

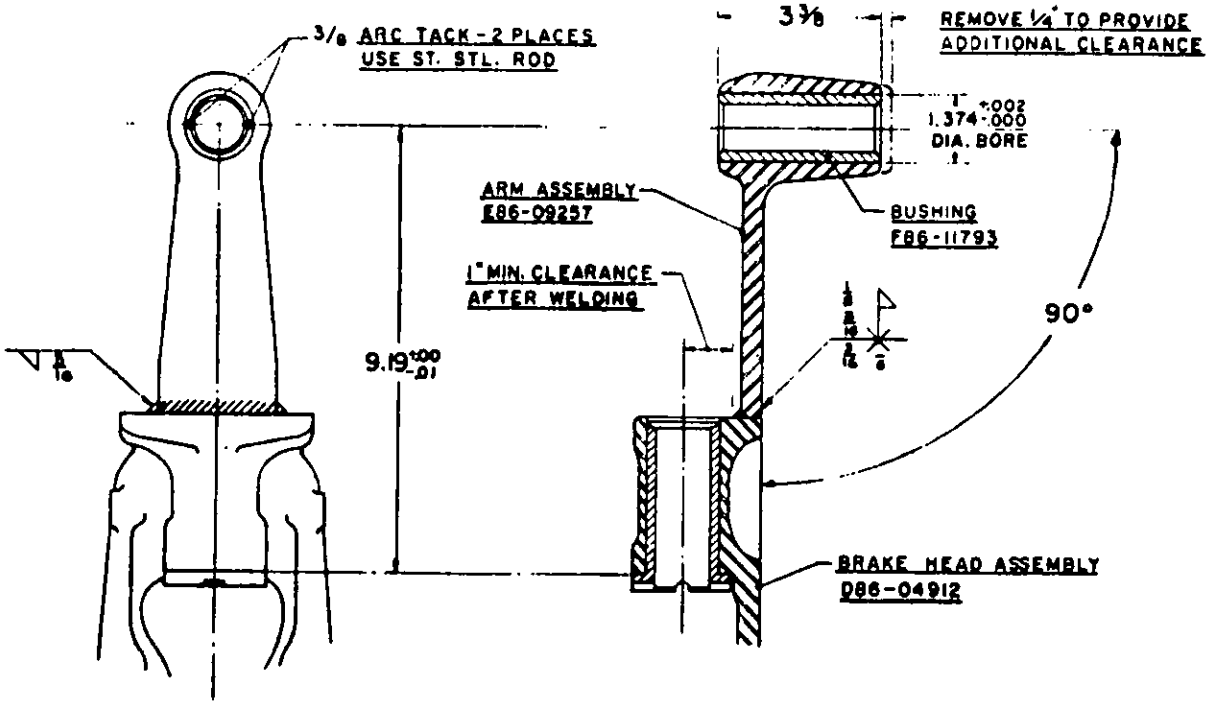
J. P. Gaughan, Manager
Customer Service Department

Enclosures: Sketches DBB-29A
DBB-29B
DBB-29C

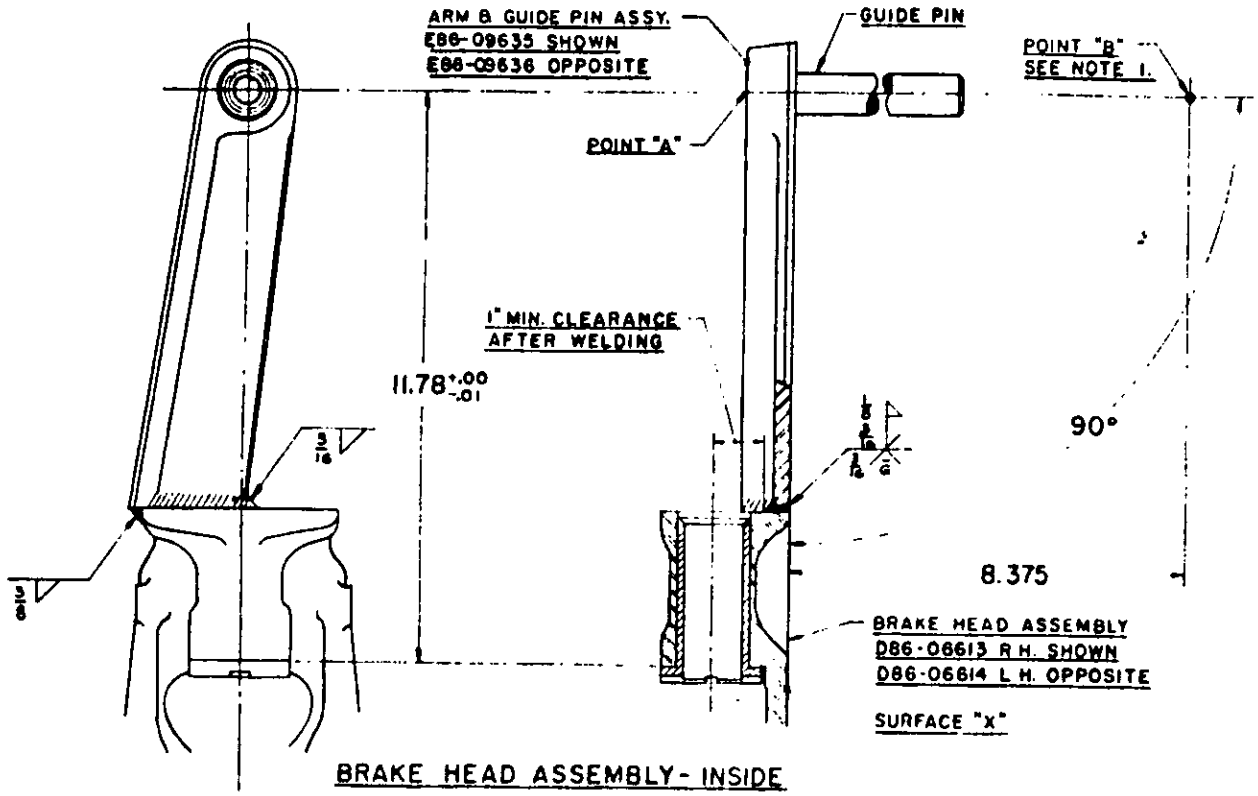


BRAKE HEAD ASSEMBLY - INSIDE
CF TYPE

NOTE
USE MILD STEEL WELDING ROD (AWS E-6015) EXCEPT AS NOTED

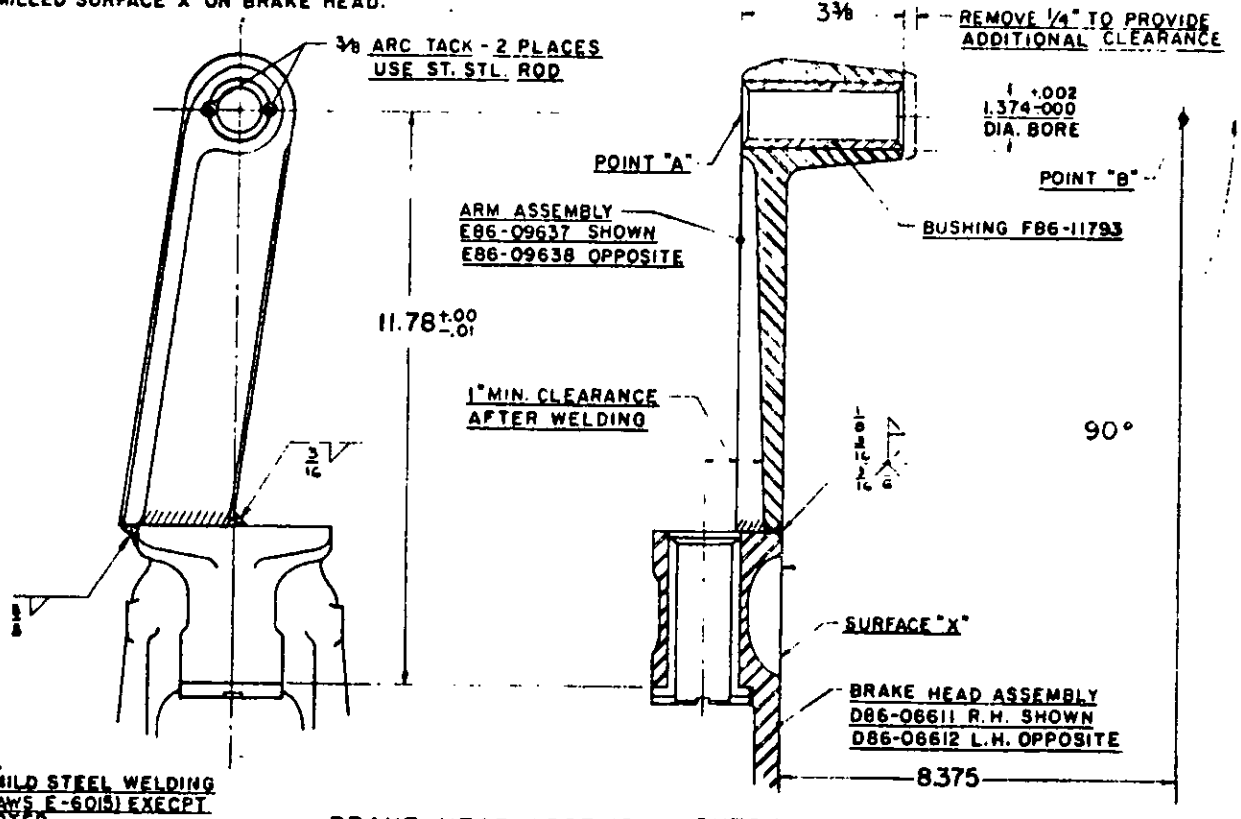


BRAKE HEAD ASSEMBLY - OUTSIDE
CF TYPE



BRAKE HEAD ASSEMBLY - INSIDE
TFM TYPE (LONG)

NOTE 1.
POINT "B" OF GUIDE PIN ℄ AND POINT "B" OF BUSHING F86-11793 ℄ MUST BE WITHIN .030 OF TRUE LOCATION OF POINT "A" WITH RESPECT TO PERPENDICULARITY TO MILLED SURFACE "X" ON BRAKE HEAD.

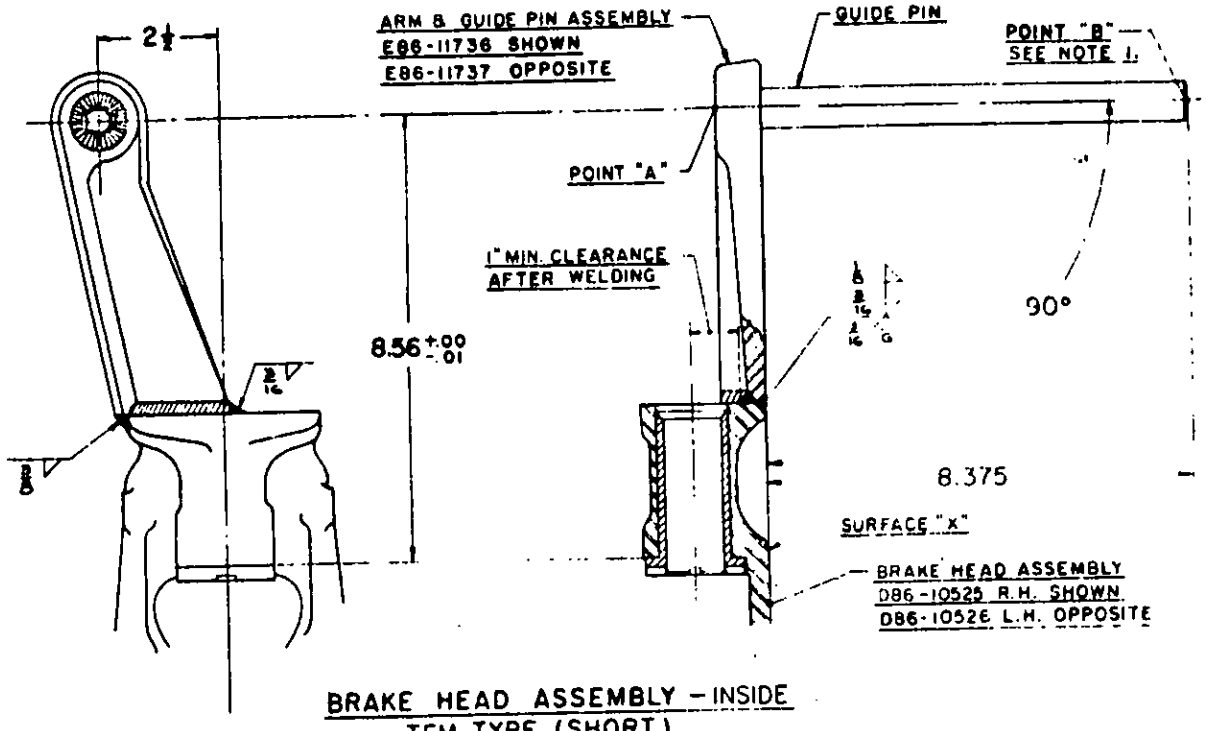


NOTE.
USE MILD STEEL WELDING ROD (AWS E-6015) EXCEPT AS NOTED

BRAKE HEAD ASSEMBLY - OUTSIDE
TFM TYPE (LONG)

1-17-66

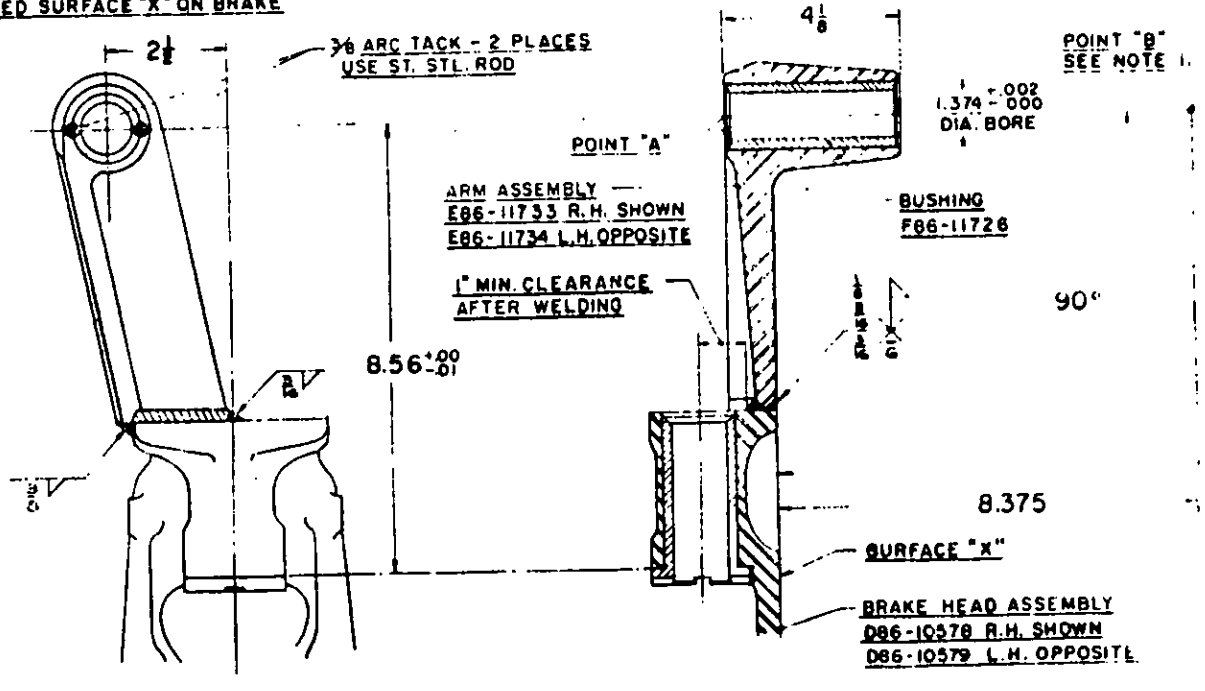
DBB-29 B



BRAKE HEAD ASSEMBLY – INSIDE
TFM TYPE (SHORT)

NOTE 1.
POINT "B" OF GUIDE PIN ℄ AND POINT "B" OF BUSHING F86-11726 ℄ MUST BE WITHIN .030 OF TRUE LOCATION OF POINT "A" WITH RESPECT TO PERPENDICULARITY TO MILLED SURFACE "X" ON BRAKE

NOTE
USE MILD STEEL WELDING ROD (E-6015) EXCEPT AS NOTED



BRAKE HEAD ASSEMBLY - OUTSIDE
TFM TYPE (SHORT)

DBB-29C

1-17-66

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 30

DATE 9/12/66

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: Type CF and TFM Disc Brake
Improved Tong to Cylinder Pin Arrangement

This bulletin is issued to advise of improved tong to cylinder pin arrangement on the types CF and TFM disc brake.

Briefly this modification involves the use of a straight pin rather than the shoulder type pin and increase in inside diameter of the various bushings to accommodate the new pin.

We recommend that these modifications be made at brake overhaul for the following reasons:-

1. Eliminates frozen tong pins caused by ring of corrosion at space between the 2 bushings in the cylinder cover and the piston tube assembly.

2. Eliminates anti-rattle spring, cover, washer and nut.

3. Simplified pin, thus less costly.

4. Point on new pins eliminates need for Guide Point E86-05413, required to assemble cylinder to tongs.

5. Larger diameter of pin permits increased hand brake shoe loading when required.

6. Eliminates need for lubrication.

All TFM brake assemblies manufactured since March, 1964 are of this improved design.

MODIFICATION PROCEDURES - Refer to Figures 1 and 2.

1. Remove cylinder tongs, hand brake levers and cranks. Discard shoulder pins (part numbers vary with location), F86-12344 Nut, 70A32M Washer, E86-05060 Spring and E86-05061 Spring Cover.

2. Remove E86-04172 Bushings from Cylinder Body and Piston Tube Assembly. Replace with new Bushings F86-12030.

   Outside diameter of new bushing flange has been reduced to eliminate need for grinding the piston rod bushings to provide clearance when installing cylinder cover over the piston rod.

3. Remove lower bushing E86-04172 from tongs. Press in new bushing E86-12030.

4. Remove smaller I.D. bushing E86-04172 from hand brake lever (TFM brake only) and replace with new bushing F86-12031. Insert bushing from opposite side of lever.

5. Remove bushings E86-01746, E86-04171 and E86-04172, as used, from shoe pin locations in hand brake cranks and replace with new bushings F86-12030.

   NOTE:- All bushings should be pressed in with an arbor press. Driving these bushings with a hammer may damage the bushing or distort bushing fit in part.

6. Reinstall cylinder, tongs, hand brake levers and cranks, using new pins and fasteners. Note that pins vary in length depending on whether hand brake lever or crank is used.

   TFM arrangement with hand brake requires Pin E86-12035 and Retainer F86-12032. Refer to sketch, Figure 2.

PARTS INFORMATION

New parts and assemblies should be ordered from The Budd Company as shown on the following sketches. Note that parts are shown as type 1 and type 2. After modifications have been completed per this bulletin, replacement parts shown as type 2 must be ordered

Fig. 3 - Brake Cylinder Assemblies

Fig. 4 - Tong Assemblies.

Fig. 5 - Hand Brake Levers.

Fig. 6 - Pins and Retainer.

Figs. 7, 8, 9, 10 & 11 - Hand Brake Crank Assemblies.

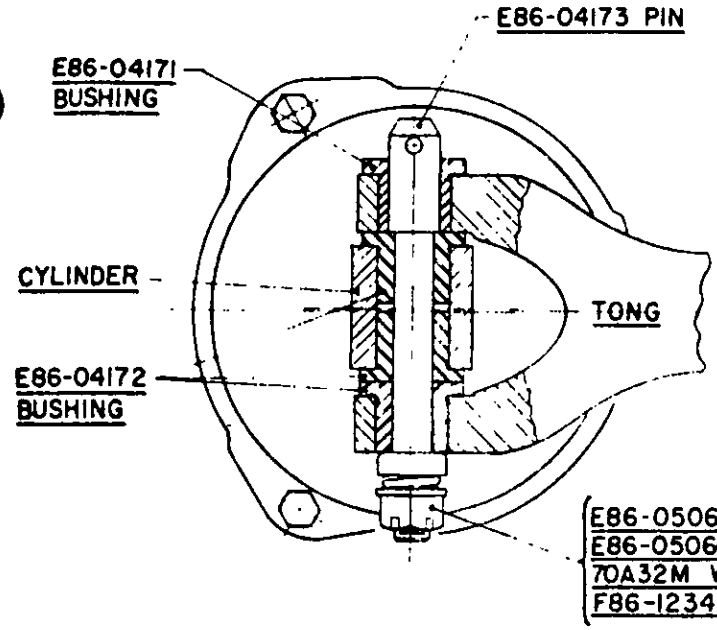
Fig. 12 - Hand Brake Crank Assembly - RDC

LUBRICATION'

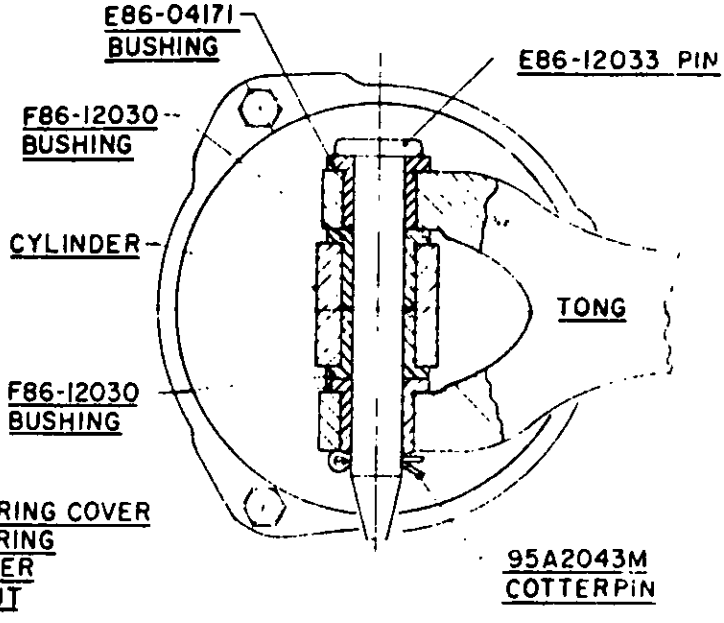
Following modification, lubrication of pins and bushings is not recommended.

J. P. Gaughan, Manager
Customer Service Department

Encls. Figures 1 thru 12.



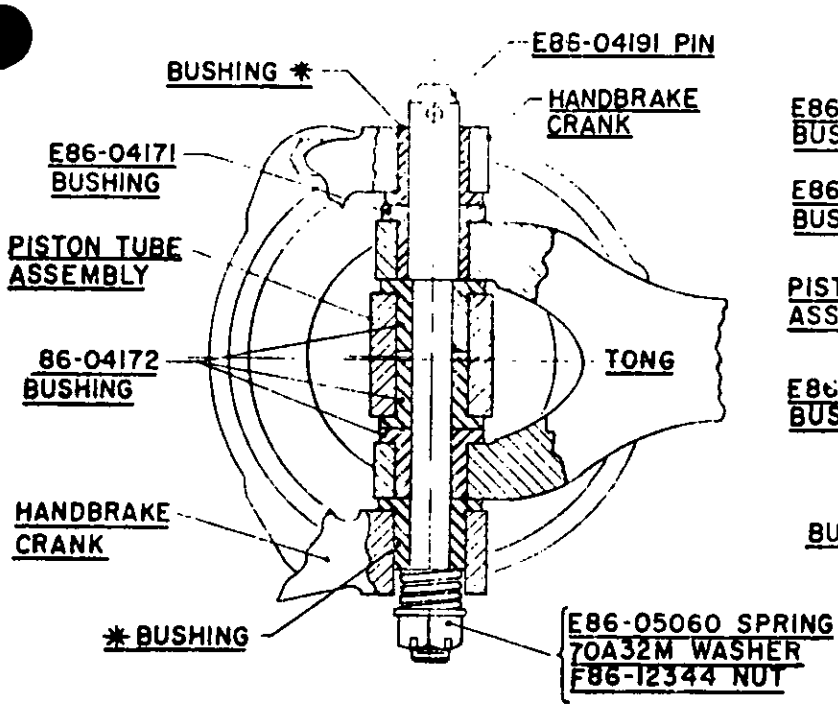
SHOULDER TYPE PIN



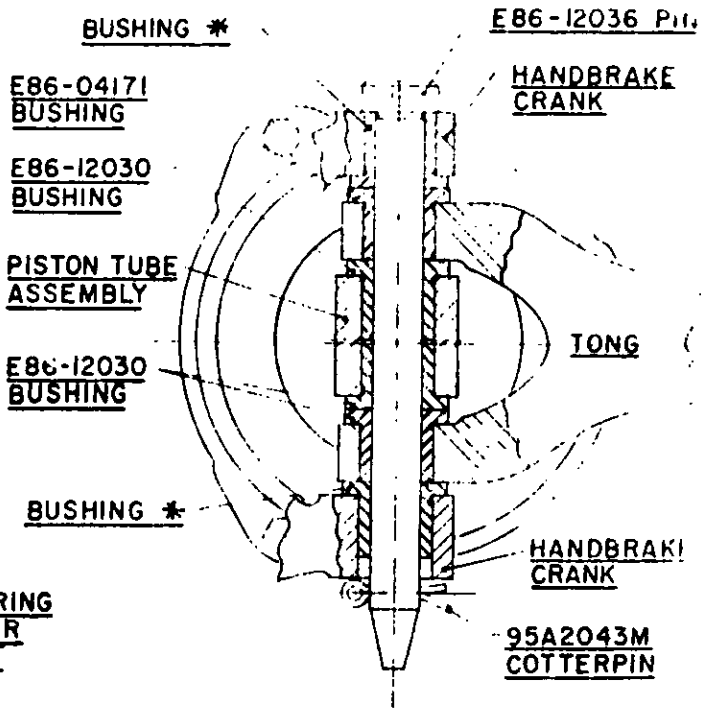
STRAIGHT PIN

NON-HANDBRAKE ARRANGEMENT - TYPE CF & TFM

* PART NUMBERS VARY -- REFER TO PARTS INFORMATION - FIGURES 7 TO 10 INCLUSIVE



SHOULDER TYPE PIN

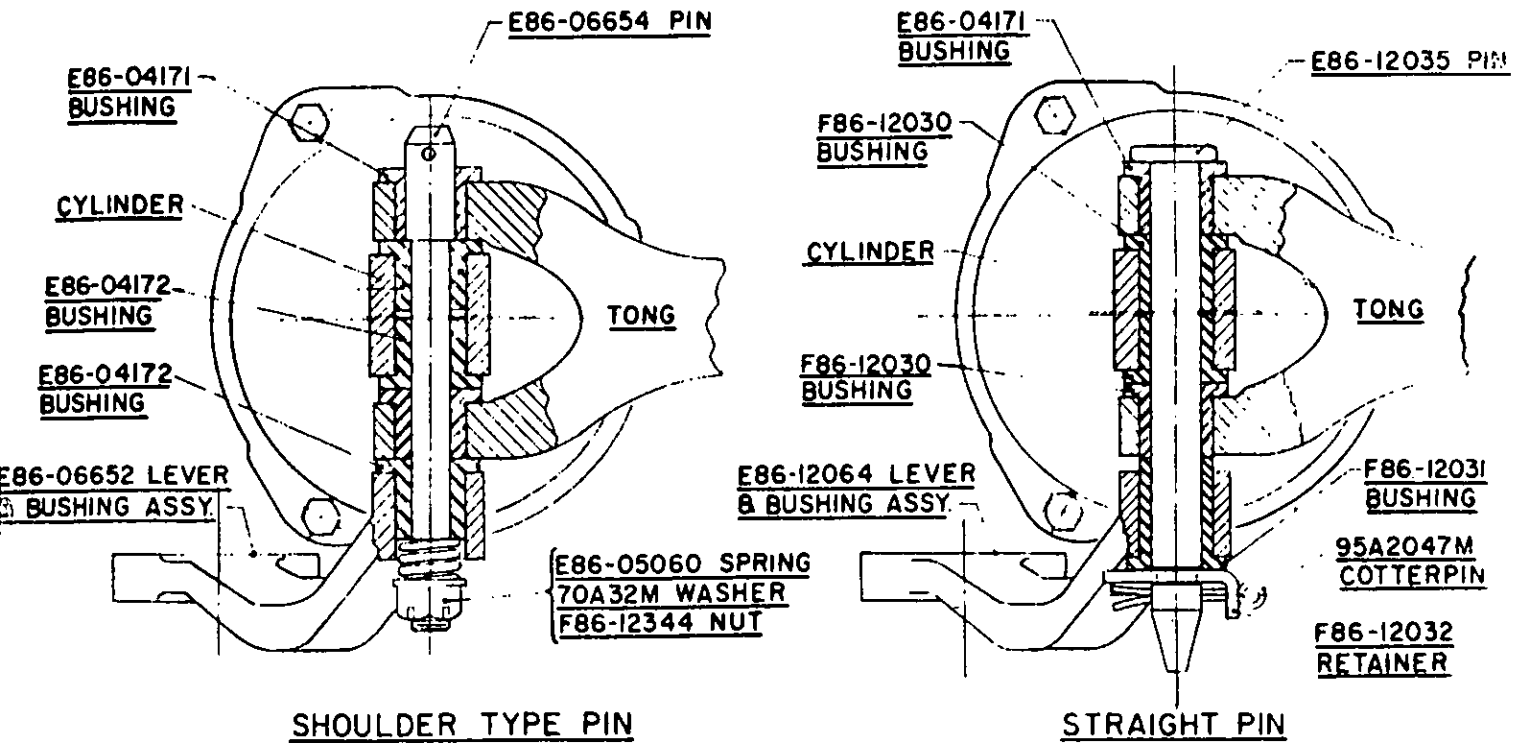


STRAIGHT PIN

HANDBRAKE CRANK ARRANGEMENT - TYPE CF & TFM

TONG PIN AND BUSHING MODIFICATION

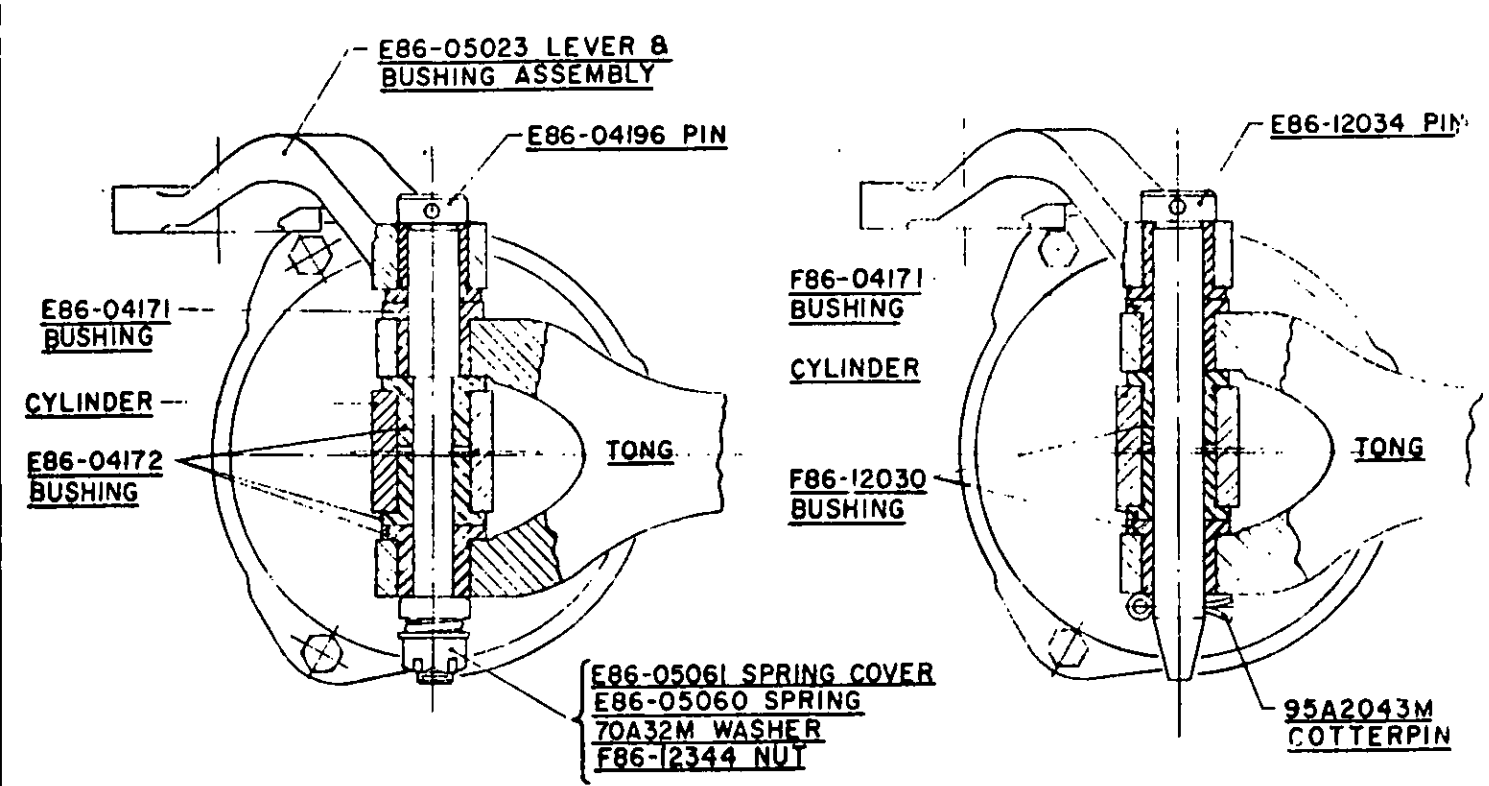
FIGURE 1



SHOULDER TYPE PIN

STRAIGHT PIN

HANDBRAKE LEVER ARRANGEMENT - TYPE TFM



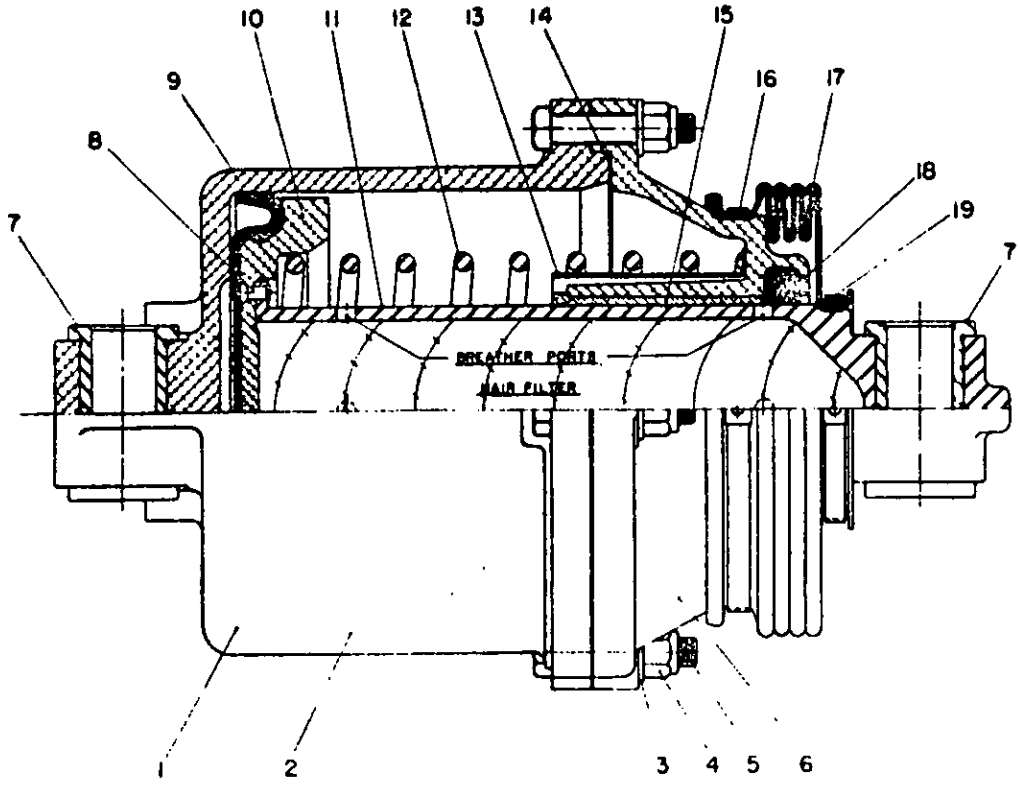
SHOULDER TYPE PIN

STRAIGHT PIN

HANDBRAKE LEVER ARRANGEMENT - TYPE CF

TONG PIN AND BUSHING MODIFICATION

FIGURE 2



AIR CYLINDERS AND PARTS

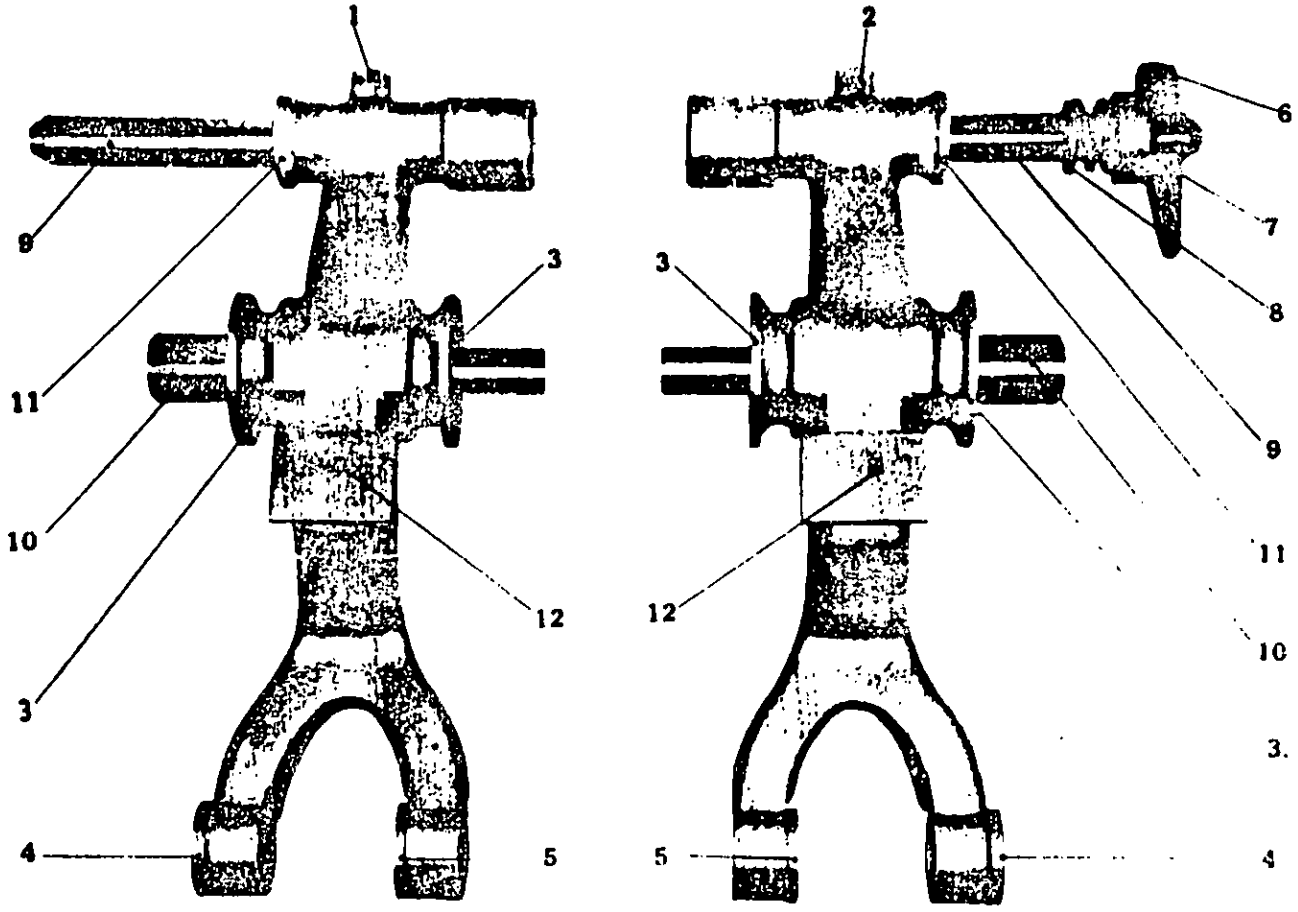
TYPE 1 - USE WITH SHOULDER TYPE PINS
TYPE 2 - USE WITH STRAIGHT PINS

* CAST IRON BODY

ITEM	PART NAME	6½" CYLINDER		7" CYLINDER		7" CYLINDER *		7½" CYLINDER		8" CYLINDER	
		TYPE 1	TYPE 2	TYPE 1	TYPE 2	TYPE 1	TYPE 2	TYPE 1	TYPE 2	TYPE 1	TYPE 2
1	AIR CYLINDER ASSY COMPLETE	D86-05080	B86-12048	D86-05050	B86-12051	B86-11912	B86-12060	D86-05047	B86-12054	D86-08844	B86-12057
2	CYLINDER BODY - WITH BUSHING, ITEM 7	E86-05122	E86-12049	E86-05161	E86-12052	E86 11850	E86-12061	E86 05163	E86-12055	E86-08843	E86-12058
3	WASHER	70A24M	70A24M	70A24M	70A24M	70A24M	70A24M	70A24M	70A24M	70A24M	70A24M
4	NUT	21F12M	21F12M	21F12M	21F12M	21F12M	21F12M	21F12M	21F12M	21F12M	21F12M
5	BOLT	7A1243M	7A1243M	7A1243M	7A1243M	7A1243M	7A1243M	7A1243M	7A1243M	7A1243M	7A1243M
6	COVER ASSY - WITH BUSHING, ITEM 15	E86-05162	E86-05162	E86-05162	E86-05162	E86-05162	E86-05162	E86 05162	E86 05162	E86 05162	E86 05162
7	BUSHING - CYLINDER AND PISTON	E86-04172	F86-12030	E86-04172	F86-12030	E86-04172	F86-12030	E86-04172	F86 12030	E86-04172	F86 12030
8	RIVET - PISTON HEAD TO PISTON TUBE	60A1620	60A1620	60A1620	60A1620	60A1620	60A1620	60A1620	60A1620	60A1620	60A1620
9	PACKING CUP	E86 05156	E86-05156	E86-05158	E86-05158	E86-05158	E86-05158	E86-04188	E86-04188	E86-05095	E86-05095
10	PISTON HEAD	D86 05733	D86-05733	D86-06377	D86-06377	D86-06377	D86-06377	D86-06376	D86-06376	D86-08841	D86-08841
11	PISTON ASSY. - INCLUDES ITEMS 7,8 AND 9	D86-05738	D86-12050	D86-06419	D86-12053	D86-06419	D86-12053	D86-06428	D86-12056	D86-08842	D86-12059
12	PISTON RETURN SPRING	E86-05088	E86-05088	E86-05088	E86-05088	E86-05068	E86-05088	E86-05088	E86-05088	E86-05088	E86-05088
13	SPRING GUIDE	E86-06339	E86-06339	E86-06339	E86-06339	E86-06339	E86-06339	E86-06339	E86-06339	E86-06339	E86-06339
14	GASKET - COVER TO BODY	E86-05157	E86-05157	E86-05157	E86-05157	E86-05157	E86-05157	E86-05157	E86-05157	E86-05157	E86-05157
15	BRONZE BUSHING - CYLINDER COVER	E86-04181	E86-04181	E86-04181	E86-04181	E86-04181	E86-04181	E86-04181	E86-04181	E86-04181	E86-04181
⊖ 16	CLAMP - BOOT (PUNCH LOK NO 0-358)	L86-11984	L86-11984	L86-11984	L86-11984	L86-11984	L86-11984	L86-11984	L86-11984	L86-11984	L86-11984
17	BOOT	D86-04186	D86-04186	D86-04186	D86-04186	D86-04186	D86-04186	D86-04186	D86-04186	D86-04186	D86-04186
18	FELT RING LUBRICATOR	E86-04182	E86-04182	D86-04182	D86-04182	D86-04182	D86-04182	D86-04182	D86-04182	D86-04182	D86-04182
⊖ 19	CLAMP - BOOT (PUNCH LOK NO. 0-332)	L86-11983	L86-11983	L86-11983	L86-11983	L86-11983	L86-11983	L86-11983	L86-11983	L86-11986	L86-11986

⊖ OBTAIN FROM:- PUNCH LOK COMPANY
321 NORTH JUSTINE STREET
CHICAGO, ILL. 60607

FIGURE 3



TONG ASSEMBLIES

ITEM NO.	PART NO. TYPE 1	PART NO. TYPE 2	
1.	D86-05689	B86-12063	TONG ASSEMBLY L.H.
2.	D86-05688	B86-12062	TONG ASSEMBLY R.H.
3.	F86-05690	F86-05690	THRUST WASHER
4.	E86-04171	E86-04171	BUSHING - UPPER
5.	E86-04172	F86-12030	BUSHING - LOWER
6.	E86-04901	E86-04901	KEY
7.	E86-04899	E86-04899	RETAINER
8.	E86-04586	E86-04586	SPRING
9.	E86-05087	E86-05087	SHOE PIN
10.	E86-04163	E86-04163	FULCRUM PIN
11.	E86-05636	E86-05636	THRUST WASHER
12.	E86-04112	E86-04112	WEAR PLATE

TYPE 1 - USE WITH SHOULDER TYPE PIN

TYPE 2 - USE WITH STRAIGHT PIN

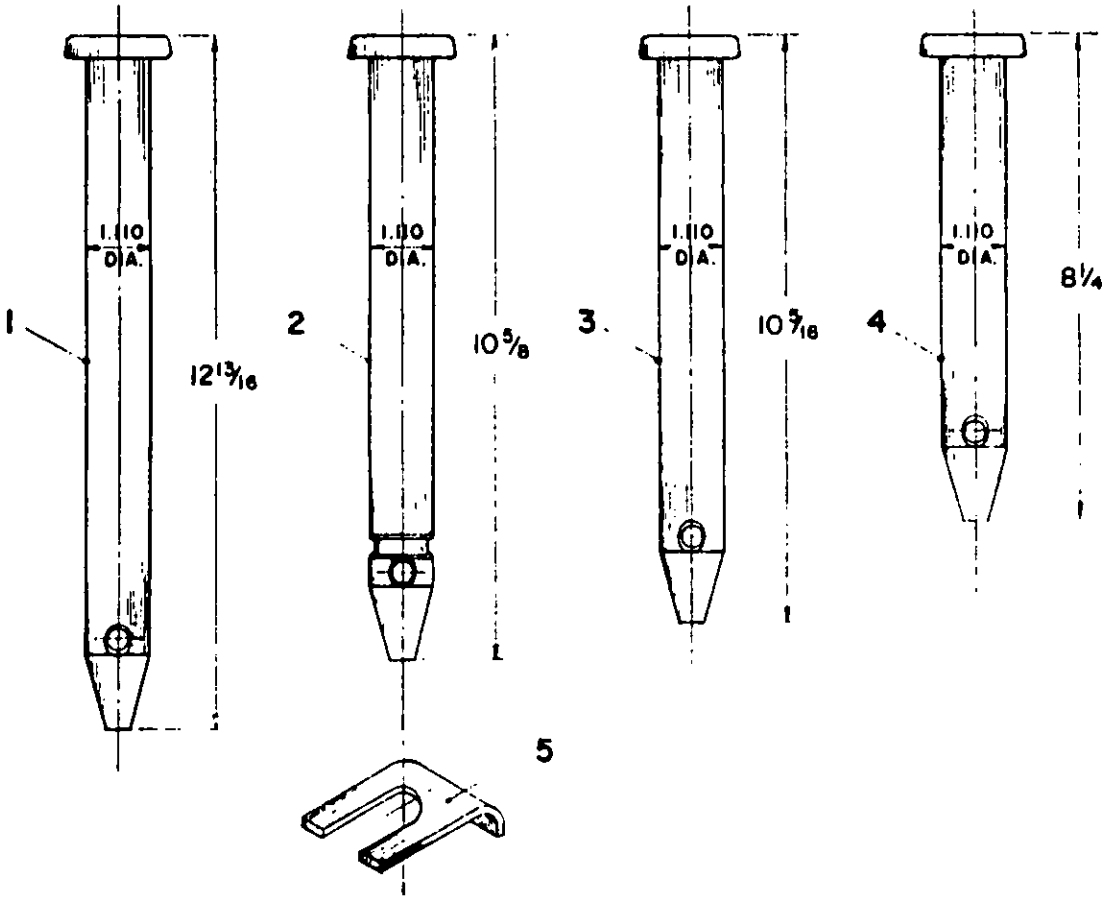
FIGURE 4

HAND BRAKE LEVER ASSEMBLIES

ITEM NO.	PART NO. TYPE 1	PART NO. TYPE 2	
1.	E86-06652	E86-12064	LEVER & BUSHING ASSY.
2.	E86-04172	F86-12031	BUSHING

TYPE 1 - USE WITH SHOULDER TYPE PIN
TYPE 2 - USE WITH STRAIGHT PIN

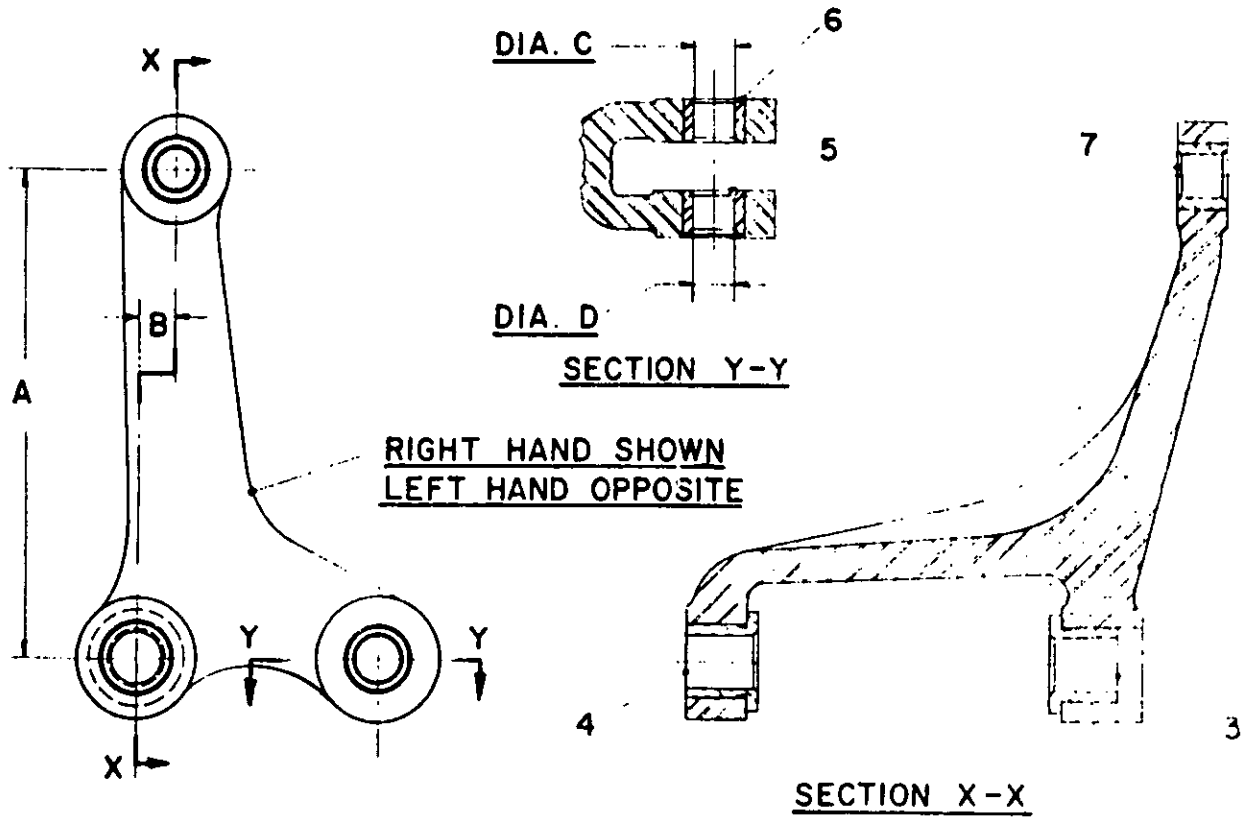
FIGURE 5



1. E86-12036 PIN (CF & TFM HANDBRAKE CRANK)
2. E86-12035 PIN (TFM HANDBRAKE LEVER)
3. E86-12034 PIN (CF HANDBRAKE LEVER)
4. E86-12033 PIN (CF & TFM TONG)
5. F86-12032 RETAINER

PINS AND RETAINER

FIGURE 6

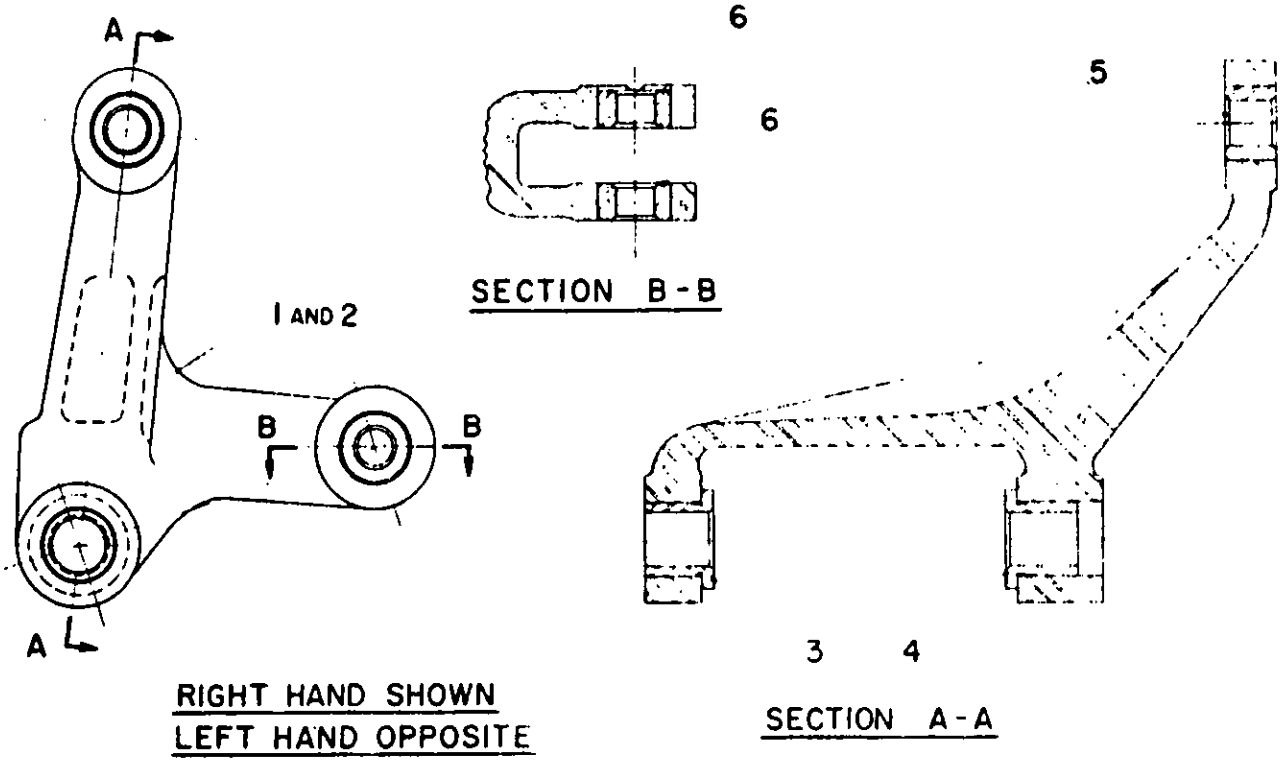


TYPE	ASSEMBLY NUMBERS R.H. SHOWN	ASSEMBLY NUMBERS L.H. OPPOSITE	DIMENSIONS A	B	C	D	PART NUMBERS ITEM 3	ITEM 4	ITEM 5	ITEM 6	ITEM 7
1	E86-05045	E86-05046	8¼	0	1⅛	⅞	E86-01746	E86-04172	E86-04192	E86-05081	E86-01577
2	E86-12079	E86-12080	8¼	0	1⅛	⅞	F86-12030	F86-12030	E86-04192	E86-04192	E86-01577
1	E86-05686	E86-05687	8¼	0	⅞	⅞	E86-01746	E86-04172	E86-04192	E86-04192	E86-01577
2	E86-12077	E86-12078	8¼	0	⅞	⅞	F86-12030	F86-12030	E86-04192	E86-04192	E86-01577
1	E86-05785	E86-05786	10	¾	⅞	⅞	E86-01746	E86-04172	E86-04192	E86-04192	E86-01577
2	E86-12073	E86-12074	10	¾	⅞	⅞	F86-12030	F86-12030	E86-04192	E86-04192	E86-01577
1	E86-06658	E86-06659	10	¾	⅞	⅞	E86-04172	E86-04171	E86-04192	E86-04192	E86-01577
2	E86-12075	E86-12076	10	¾	⅞	⅞	F86-12030	F86-12030	E86-04192	E86-04192	E86-01577

TYPE 1. - USE WITH SHOULDER TYPE PIN
TYPE 2. - USE WITH STRAIGHT PIN

HANDBRAKE CRANK ASSEMBLIES

FIGURE 7

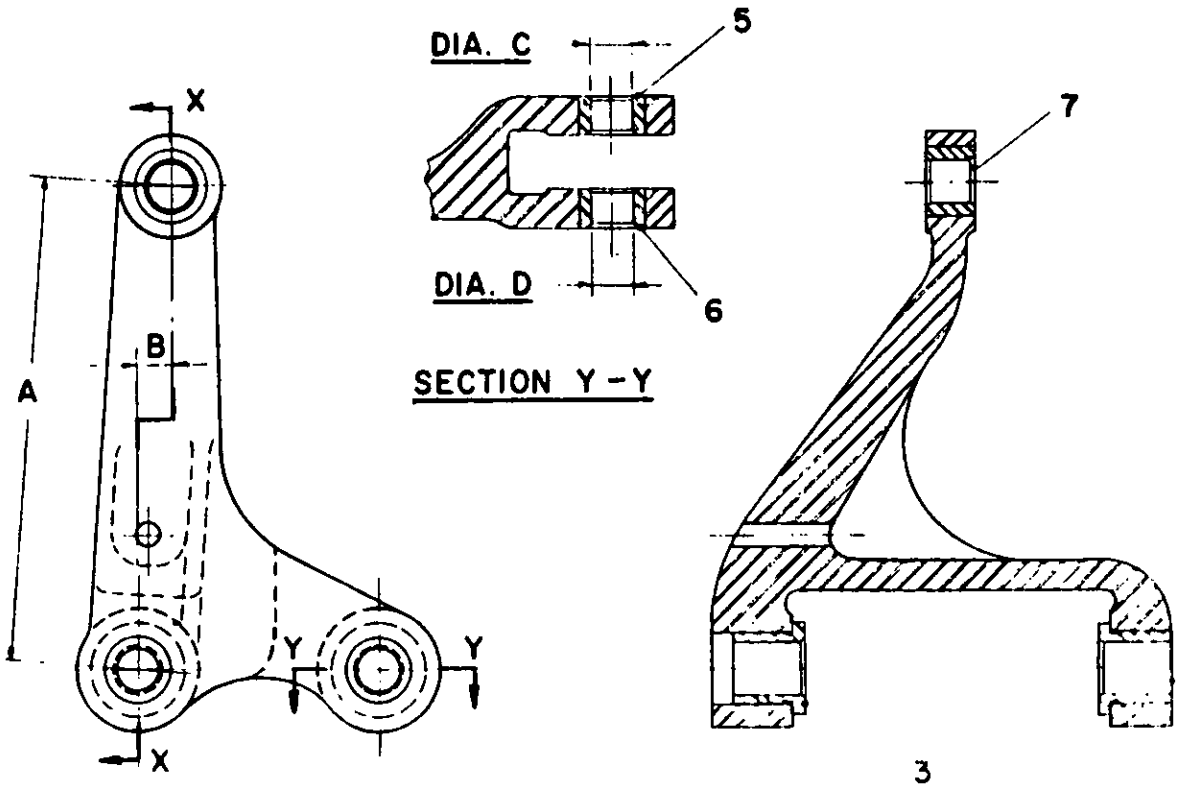


ITEM NO.	PART NUMBER TYPE 1.	TYPE 2.	
1.	E86-08812	E86-12081	HANDBRAKE CRANK ASSY R H
2.	E86-08813	E86-12082	HANDBRAKE CRANK ASSY. L.H.
3.	E86-04172	F86-12030	BUSHING
4.	E86-01746	F86-12030	BUSHING
5.	E86-01577	E86-01577	BUSHING
6.	E86-04192	E86-04192	BUSHING

TYPE 1. - USE WITH SHOULDER TYPE PIN
TYPE 2. - USE WITH STRAIGHT PIN

HANDBRAKE CRANK ASSEMBLIES

FIGURE 8



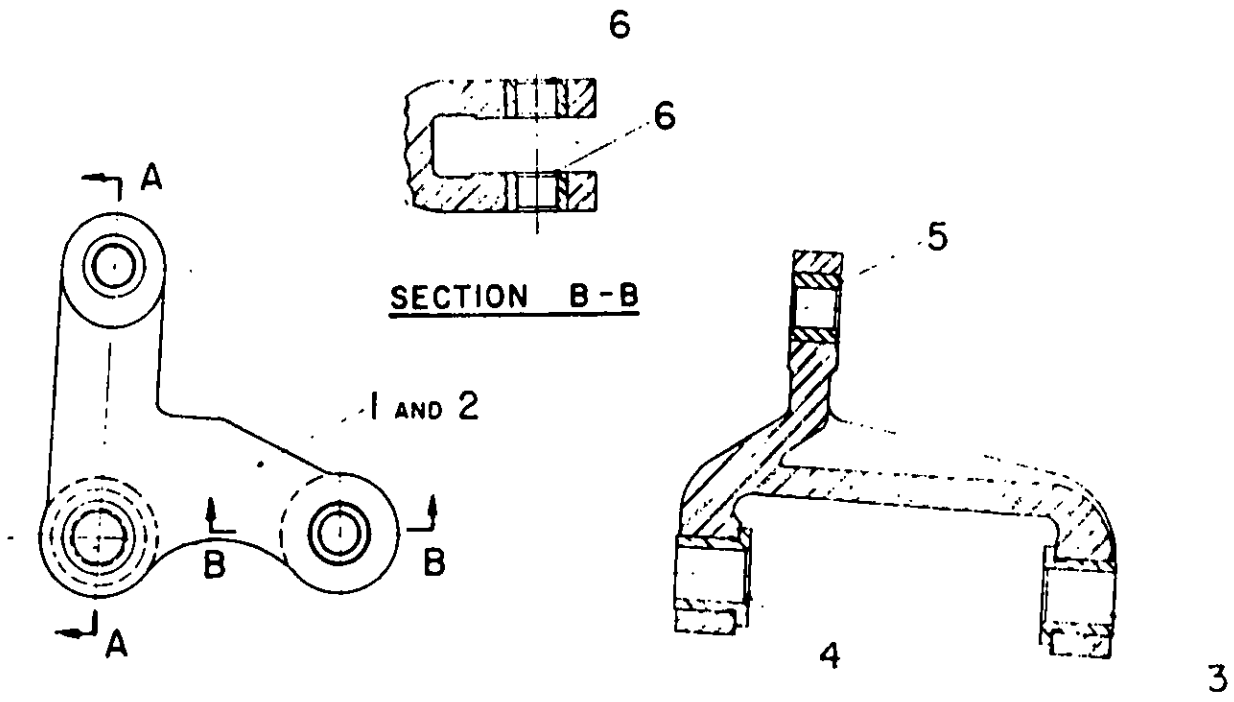
RIGHT HAND SHOWN
LEFT HAND OPPOSITE

ASSEMBLY NUMBERS			DIMENSIONS				PART NUMBERS				
TYPE	R H SHOWN	L.H.OPPOSITE	A	B	C	D	ITEM 3	ITEM 4	ITEM 5	ITEM 6	ITEM 7
1	E86-09716	E86-09717	10	3/4	7/8	7/8	E86-04172	E86-04171	E86-04192	E86-04192	E86-01577
2	E86-12068	E86-12069	10	3/4	7/8	7/8	F86-12030	F86-12030	E86-04192	E86-04192	E86-01577
1	E86-10550	E86-10551	8 1/4	5/8	7/8	7/8	E86-04172	E86-04171	E86-04192	E86-04192	E86-01577
2	E86-12083	E86-12084	8 1/4	5/8	7/8	7/8	F86-12030	F86-12030	E86-04192	E86-04192	E86-01577

TYPE 1. - USE WITH SHOULDER TYPE PIN
TYPE 2. - USE WITH STRAIGHT PIN

HANDBRAKE CRANK ASSEMBLIES

FIGURE 9



RIGHT HAND SHOWN
LEFT HAND OPPOSITE

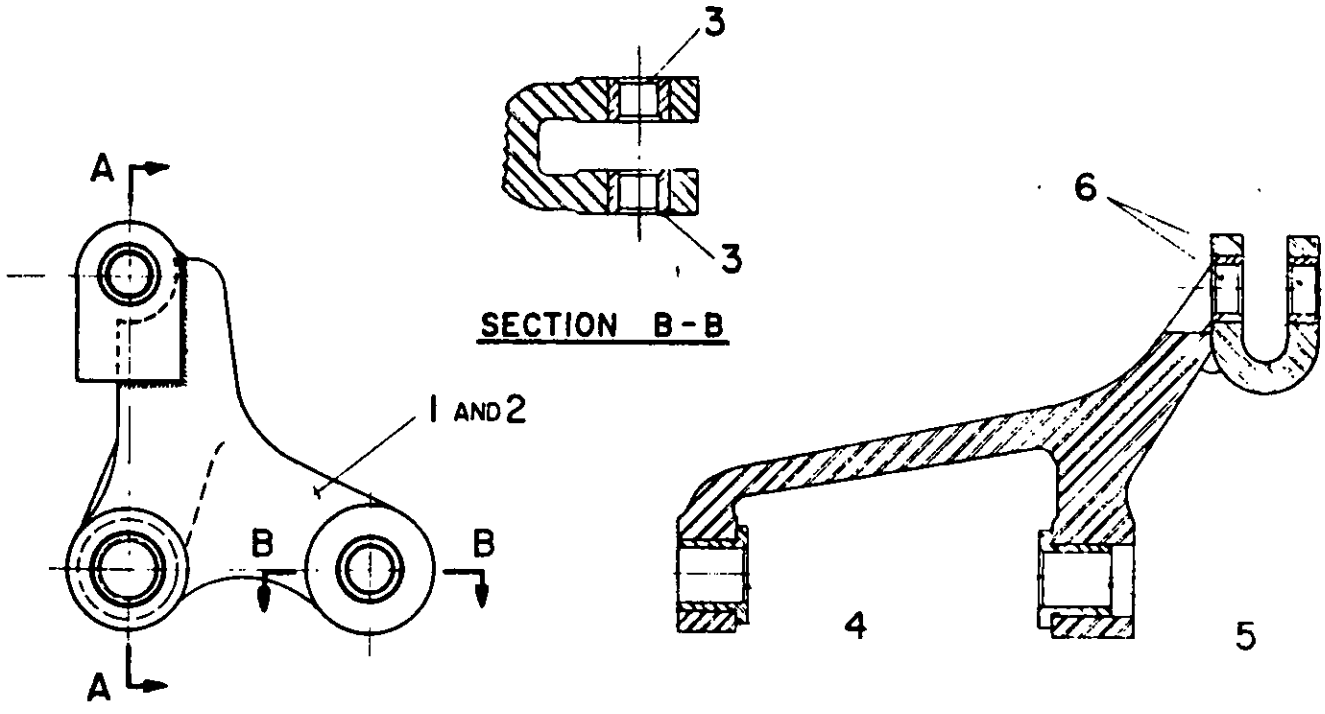
SECTION A-A

ITEM NO.	PART NUMBER TYPE 1.	TYPE 2	
1.	E86-09378	E86-12085	HANDBRAKE CRANK ASSY. R.H.
2.	E86-09379	E86-12086	HANDBRAKE CRANK ASSY. L.H.
3.	E86-04172	F86-12030	BUSHING
4.	E86-04171	F86-12030	BUSHING
5	E86-01577	E86-01577	BUSHING
6	E86-04192	E86-04192	BUSHING

TYPE 1. - USE WITH SHOULDER TYPE PIN
TYPE 2. - USE WITH STRAIGHT PIN

HANDBRAKE CRANK ASSEMBLIES

FIGURE 10



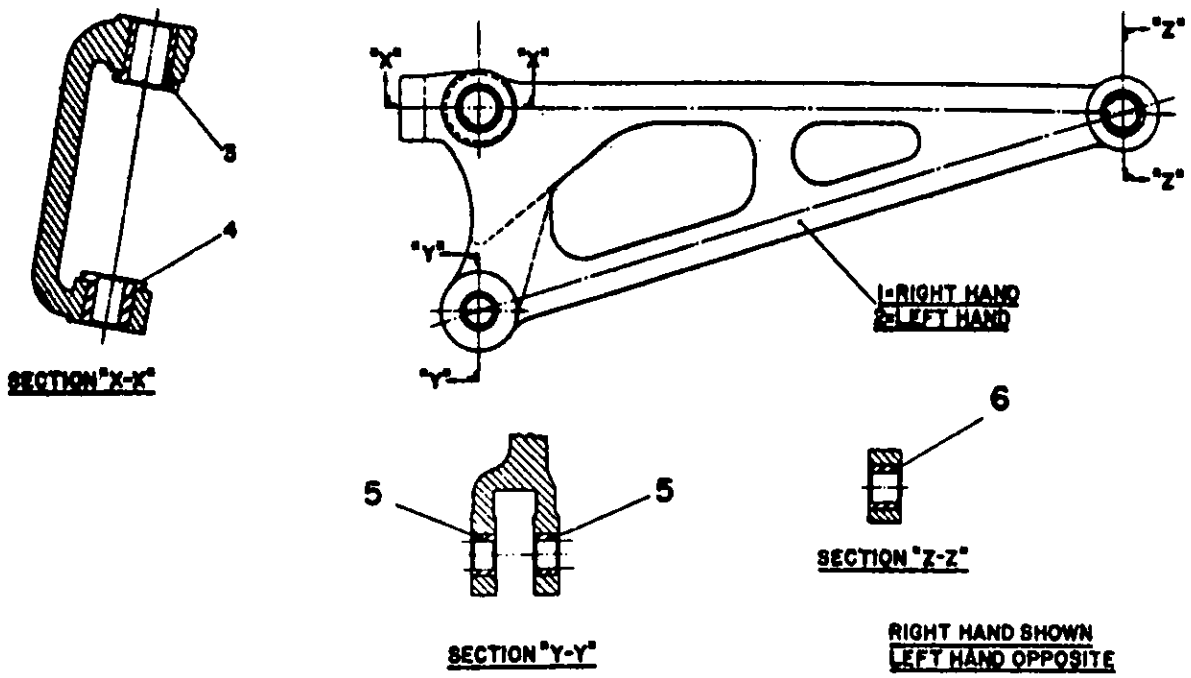
RIGHT HAND SHOWN
LEFT HAND OPPOSITE

ITEM NO.	PART NUMBER TYPE 1.	PART NUMBER TYPE 2	
1.	E86-06266	E86-12087	HANDBRAKE CRANK ASSY. R.H.
2.	E86-06267	E86-12088	HANDBRAKE CRANK ASSY. L.H.
3.	E86-04192	E86-04192	BUSHING
4.	E86-04172	E86-04172	BUSHING
5.	E86-01746	E86-12030	BUSHING
6.	E86-05011	E86-05011	BUSHING

TYPE 1 USE WITH SHOULDER TYPE PIN
TYPE 2. USE WITH STRAIGHT PIN

HANDBRAKE CRANK ASSEMBLIES

FIGURE 11



HAND BRAKE CRANK ASSEMBLIES

ITEM NO.	PART NO. TYPE 1	PART NO. TYPE 2	
1.	D86-05864	D86-12070	CRANK ASSEMBLY R.H.
2.	D86-05865	B86-12071	CRANK ASSEMBLY L.H.
3.	E86-01746	F86-12030	BUSHING
4.	E86-04172	F86-12030	BUSHING
5.	E86-04192	E86-04192	BUSHING
6.	E86-01577	E86-01577	BUSHING

TYPE 1 - USE WITH SHOULDER TYPE PIN

TYPE 2 - USE WITH STRAIGHT PIN

FIGURE 12

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER 31

DATE 12/19/66

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: TFM & Unit Type Disc Brakes - Bridge Bolt Locking Plate

This bulletin is issued to advise of release of Bridge Bolt Locking Plate, part number F86-09939.

We recommend these locking plates be used in the future for the following reasons:-

1. Eliminates the need for arc welding safety bar to heads of the bridge bolts.

2. Loose single bolt is more readily detected because each bolt is no longer supported by the other bolt through the welded safety bar.

Locking Plates F86-09939 may be obtained from The Budd Company. Quantity of 8 is required per car.

Install locking plate under bolt heads, torque bolts to 500 ft. lbs. and bend up corners of plate firmly against flat of nuts.

J. P. Gaughan, Manager
Customer Service Department

THE BUDD COMPANY
CUSTOMER SERVICE DEPARTMENT
PHILADELPHIA 15, PENNSYLVANIA

NUMBER ~~31~~ 32

DATE 7/24/67

DISC BRAKE & ROLOKRON SERVICE BULLETIN

SUBJECT: Brake Discs - Serial Numbers

REF:- Budd Drawings

B86-09370	Disc Assembly	28"	
B86-10425	" "	28"	(NYCTA R-34)
B86-09360	" "	26"	
B86-09768	" "	24"	(with Locking Plate Holes)
B86-11254	" "	24"	(without Locking Plate Holes)
B86-10633	" "	24"	(Industrial Installation)
B86-12187	" "	21"	(NYCTA Pioneer Trucks)

This bulletin is issued to advise of change in location of serial numbers and date manufactured on the disc assemblies.

This information was formerly stamped on the outer periphery of the disc casting and it became illegible after extended service.

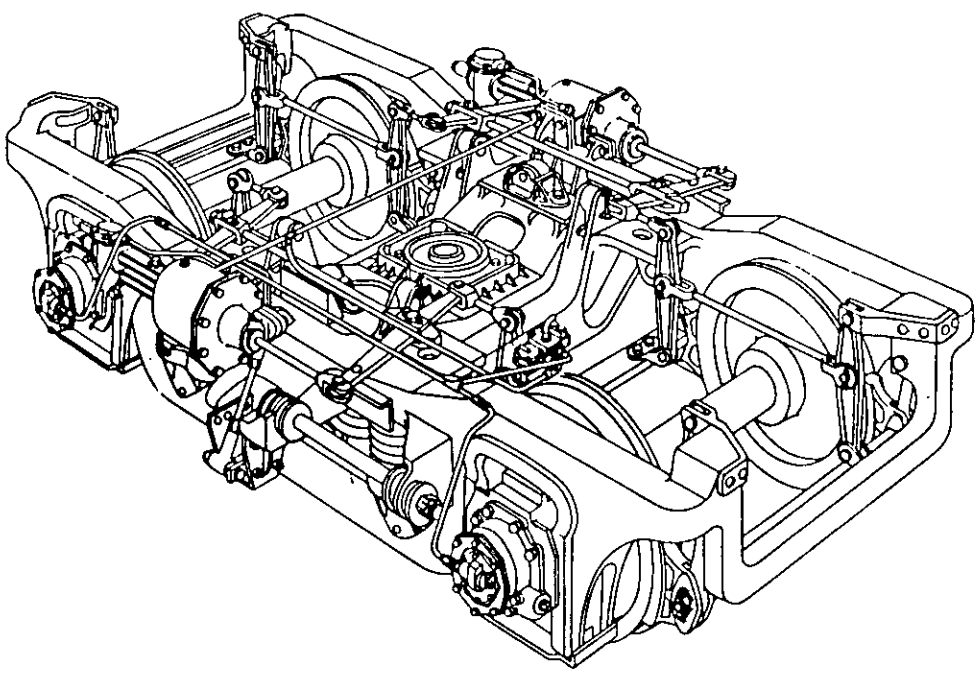
New location is on the machined surface of the stamped back plate. Refer to Figure 31-1 attached.

J. P. Gaughan, Manager
Customer Service Department

WABCO

MECHANICAL-PNEUMATIC WHEEL SLIP CONTROL for PASSENGER CARS
"3-AP" DECELOSTAT ® EQUIPMENT

Instruction Pamphlet



WESTINGHOUSE AIR BRAKE DIVISION
WILMERDING, PENNSYLVANIA WESTINGHOUSE AIR BRAKE COMPANY

CONTENTS

"3-AP" DECELOSTAT® EQUIPMENT

The "3-AP" DECELOSTAT equipment is an anti-wheel slide equipment that provides a mechanical-pneumatic means of improving braking on passenger cars by protecting against wheel sliding during brake applications. It functions automatically when a wheel slip occurs to rapidly decrease brake cylinder pressure to a low value, permitting the wheel speed to return to train speed. After an interval sufficient to enable the wheel speed to have regained train speed, brake cylinder pressure is quickly restored. Any re-occurance of wheel slipping causes the DECELOSTAT equipment to repeat its function. Further, the equipment operates similarly in either forward or reverse car movement. Following are the advantages obtained through the use of the 3-AP DECELOSTAT Equipment.

1. Reassures the engineman that wheel sliding will not occur during braking, even under adverse rail conditions.

2. Improves train retardation by preventing wheel sliding during brake applications.

3. Protects car wheels against flats caused by wheel sliding during braking.

4. The simple mechanical construction of the 3-AP DECELOSTAT equipment affords complete protection, is easily tested, and requires minimum maintenance.

PARTS OF THE EQUIPMENT

A set of 3-AP DECELOSTAT Equipment for one car consists of the following:

1. A P-3 DECELOSTAT mounted on the journal box of each axle. The DECELOSTAT recognizes a wheel slip in its early stages and operates to cause the P-3 DECELOSTAT Valve to soften brake action.

2. A B-3 DECELOSTAT Valve located on each truck. This valve when actuated by the DECELOSTAT quickly reduces brake cylinder pressure, allowing the wheel to return to speed and then promptly restores cylinder pressure to its previous value.

3. A piece of Flexible Hose which connects each DECELOSTAT to the DECELOSTAT pipe.

DESCRIPTION OF THE PARTS

P-3 DECELOSTAT CONTROLLER

The P-3 DECELOSTAT is mounted on one end of each truck axle and its function is to pilot the B-3 DECELOSTAT valve to quickly adjust brake cylinder air to a predetermined level when wheel sliding impends, and then quickly restore the brake cylinder pressure as the car wheel resumes train speed.

The P-3 DECELOSTAT as shown in the assembly view consists of the following portions:

(a) A drive shaft 110 and its spline 113 provide the means of driving the DECELOSTAT shaft 10 from the truck axle.

(b) The journal box adapter bracket 2 contains housing 13, in which are located the ball bearings 19 and 20 for mounting of the DECELOSTAT shaft 10. Inertia wheel 27 and 28 with its double row ball bearing 29 is mounted on shaft 10. Friction wheel 35 is attached to the inertia wheel by three cap screws 37

(c) Cam lever 42 attached to DECELOSTAT shaft 10 by four cap screws 47 drives the inertia wheel 27 through the cam roller 44, cam 32, clutch shoes 34, and friction wheel 35. When wheel slip occurs and the inertia wheel over-travels shaft 10, roller 44 moves up on cam 32 lifting roller 44 and shaft 43 around fulcrum pin 40 thus compressing spring 52 and moving pull rod 50 to contact and unseat pilot valve 70 to initiate the DECELOSTAT Valve operation.

(d) The pilot valve body housing 65 which covers the outer end of the DECELOSTAT contains: the DECELOSTAT operating volume, the pilot valve 70 which initiates the DECELOSTAT valve operation, choke 66 which permits reduction of the air pressure above diaphragm piston 73 by pilot valve 70 so that the diaphragm piston may be operated by the air pressure below, diaphragm piston 73 to operate the pilot pipe quick venting check valve 83, the pressure limiting check valve 81 for quick venting of the DECELOSTAT operating volume to a predetermined pressure permitting a timed reduction of the volume air through choke 67, the DECELOSTAT operating volume quick recharge check valve (Section C-C) and the internal exhaust valve 15 or the external exhaust valve 90.

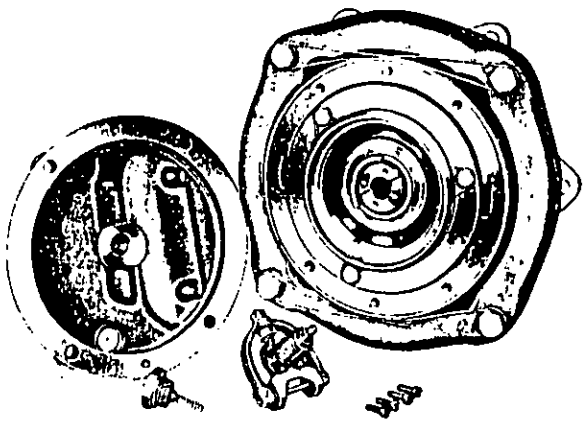
The P-3 DECELOSTAT, as shown in the assembly view, is inoperative and at rest. When the car is running, the truck axle rotates drive shaft 110 through the spline 113 and the DECELOSTAT shaft 10 connected to the drive shaft by the coupling cap 111. Cam roller lever 42 and roller 44 on shaft 43 rotate with shaft 10 and contact and drive cam 32, which through clutch shoes 34 drive friction wheel 35 and attached inertia wheel 27. The inertia wheel 27 is thus driven by shaft 10 as long as the car axle is turning and not retarded beyond a predetermined limit.

When a brake application is made and the car axle is retarded, drive shaft 110 and DECELOSTAT shaft 10 are likewise retarded. The inertia wheel 27 and 28 and friction wheel 35 continue to rotate at the original speed in ball bearing 29 and over-travel shaft 10 until clutch shoes 34 move cam 32 so that the cam drive slope moves away from cam roller 44 and the opposite cam slope contacts the roller. If the shaft retardation is at or below a normal rate the inertia force of the free wheel 27 and 28 is balanced by the force of spring 52.

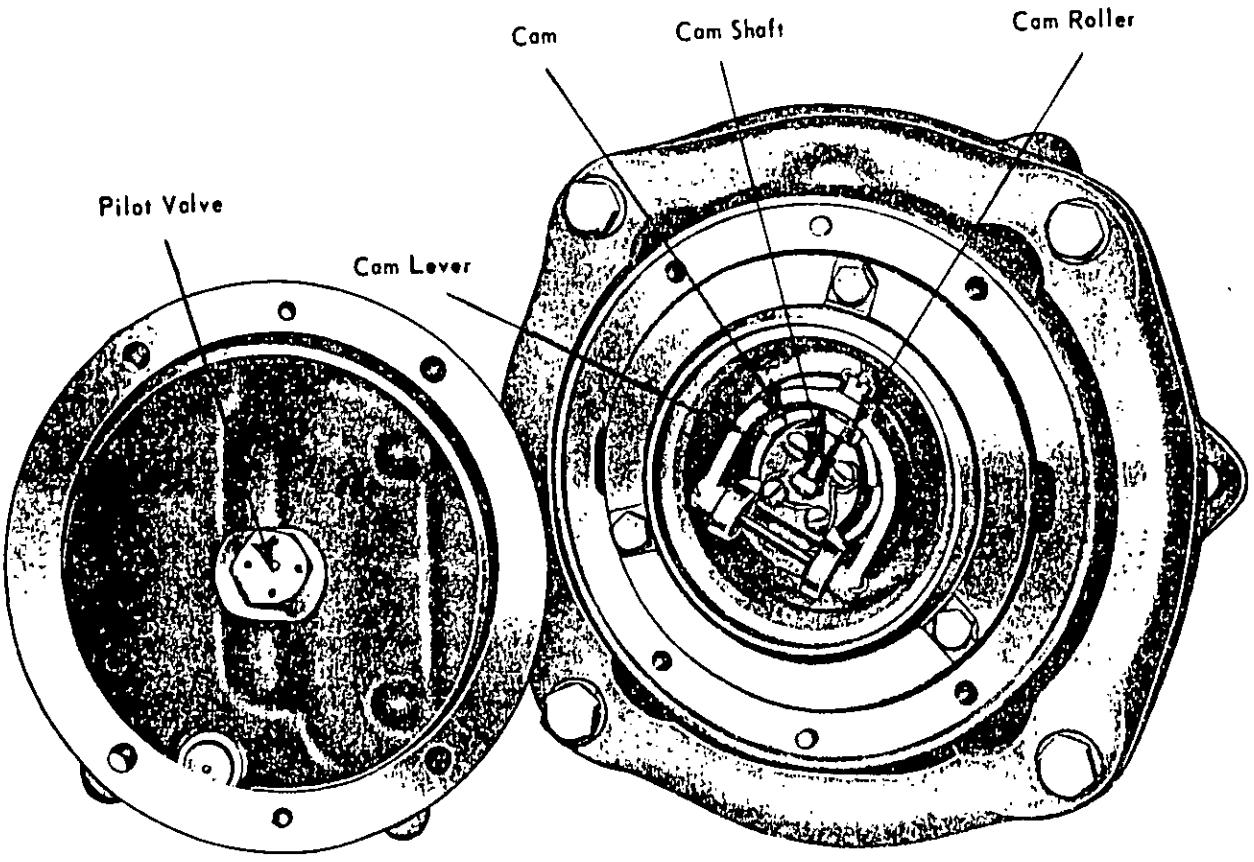
The DECELOSTAT inertia wheel thus takes a position corresponding to the instantaneous retardation rate. When the shaft retardation becomes excessive and reaches a predetermined value, the inertia wheel further overtravels shaft 10 causing cam roller 44 to move up on the cam slope. This rotates lever 42 and shaft 43 around fulcrum pin 40 which moves pull rod 50 over to unseat pilot valve 70 quickly venting the air above diaphragm 76. DECELOSTAT chamber volume air below moves diaphragm 76 upward unseating exhaust valve 83 to quickly vent the control pipe air to operate the B-3 DECELOSTAT valve for release of the brake cylinder air to a predetermined level.

Venting of the control pipe air also quickly vents the DECELOSTAT volume chamber air to a predetermined level past check valve 81, the remainder of which is exhausted through choke 67 after which spring 75 returns diaphragm 76 downward and spring 84 seats exhaust check valve 83. Thus when wheel retardation decreases and roller 44 moves off the cam slope, spring 52 moves rod 50 inward toward shaft 10. This permits pilot valve 70 to be seated and air pressure to build up through choke 66 to the top of diaphragm 76 and the control pipe. At a predetermined control pipe pressure the right hand side check valve (Section C-C) is unseated permitting quick recharge of the DECELOSTAT chamber volume.

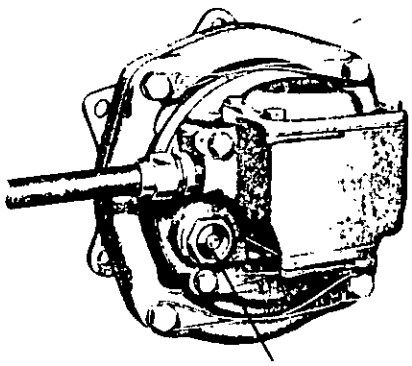
When the car brake is released the DECELOSTAT chamber air is quickly vented into the control pipe past check valve 81 and choke 67.



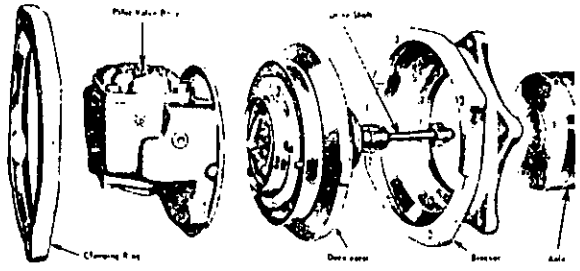
View of P-3 DECELOSTAT with Pilot Valve and cam lever removed, showing cam location



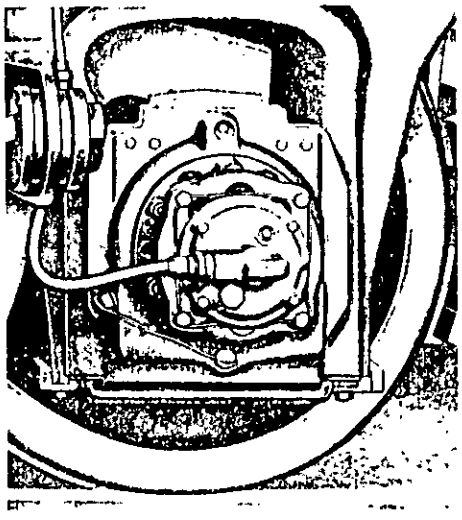
P-3 DECELOSTAT with pilot valve body removed, showing pilot valve and cam lever details



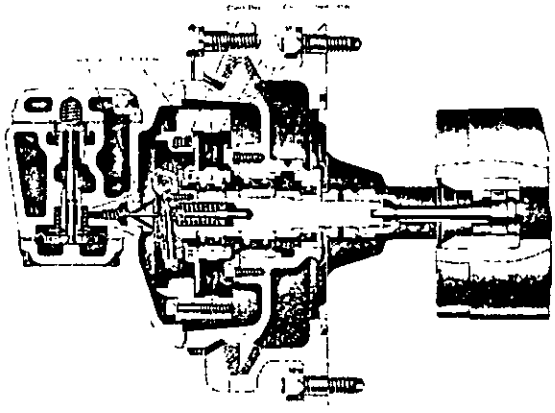
P-3 DECELOSTAT
Arrow Indicates Removable Exhaust Cap to Permit Testing of DECELOSTAT Equipment



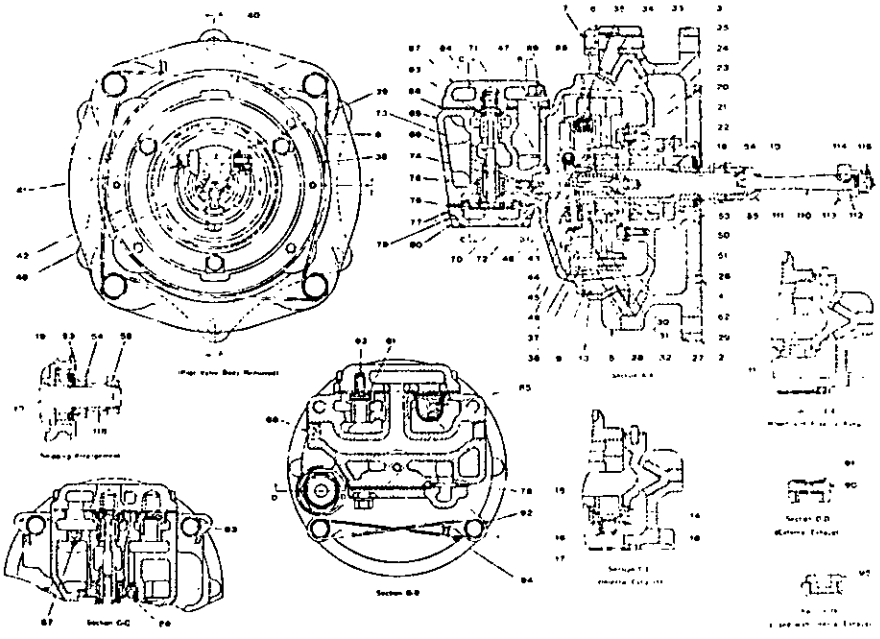
P-3 DECELOSTAT - Exploded View



P-3 DECELOSTAT Mounted on Journal Box



P-3 DECELOSTAT-Sectional View



P-3 DECELOSTAT-Assembly View

WABCO

B-3 DECELOSTAT VALVE

The B-3 DECELOSTAT Valve, mounted on the truck, operates to adjust and restore brake cylinder air as controlled by the P-3 DECELOSTAT when wheel slip occurs during a brake application. It consists of a Release Valve portion housed in body 20, a Protection Valve portion housed in body 40 and the pipe bracket portion 2, as shown in the assembly view.

The pipe bracket is bolted to the truck body and all pipe connections are made permanently to the bracket, therefore the pipe bracket need not be disturbed when removing or replacing the valve portions. Three choke plugs are located in the pipe bracket which are as follows:

1. A drilled choke which controls the flow of relay relay valve air to the chamber around piston spring 27 and to the chamber around valve spring 49, thus permitting a drop in air pressure in these chambers when check valve 48 is unseated due to wheel slip during a brake application. Relay valve air then moves piston 21 upward from its seat which rapidly vents the brake cylinder air to a predetermined level.

2. Choke plug 5 which controls the flow of relay valve air to the diaphragm piston spring and recharge check valve chambers and to the P-3 DECELOSTAT at a rate such that the valves of the P-3 DECELOSTAT can empty the DECELOSTAT control pipe air when wheel slip occurs during brake application and permit operation of the DECELOSTAT equipment. Another function of choke 5 is to protect against loss of brake cylinder air in case the control pipe to the P-3 DECELOSTAT is broken.

3. Choke plug 8 which is used in connection with the Protection Feature. It provides for the exhaust of pipe bracket chamber and the lower side of diaphragm 47 air, so that piston 46 may be returned to its normal inactive position permitting discharge check valve 48 to be seated.

The Release Valve portion, housed in body 20, adjusts the brake cylinder pressure as controlled from the P-3 DECELOSTAT when wheel slip occurs during brake application. It consists of the body 20, piston 21, piston seal 22, piston spring 27 and piston cover 28.

Piston 21 is held seated on its seal 22 by spring 27 under normal operating conditions. When wheel slip occurs and the air above piston 21 is vented, the relay valve air below the piston moves it upward off its seat venting the brake cylinder air to a predetermined level.

The Protection Valve portion attached to the left side of pipe bracket 2 is housed in body 40. Its purpose is to insure that the DECELOSTAT portion adjusts the brake cylinder pressure to a predetermined point once the DECELOSTAT equipment functions when wheel slip occurs. Further, it incorporates the DECELOSTAT protection feature which insures normal brake application and release in case the P-3 DECELOSTAT control pipe is broken. The Protection Valve portion consists of the following:

(a) Body 40 in which are housed the various parts of this portion.

(b) Diaphragm 47 which functions to unseat valve 48 when wheel slip occurs. Thus air from the top of piston 21 is vented permitting piston 21 to move upward and adjust brake cylinder pressure to a predetermined level.

(c) Diaphragm spring 45 which returns diaphragm follower 46 and diaphragm 47 downward when the air pressure on the lower face of diaphragm 47 drops to a predetermined level. This permits valve 48 to reseat and air pressure to build up on top of piston 21, thus seating piston 21 and cutting off the brake cylinder air flow to atmosphere.

(d) Discharge Check Valve 48, which when seated, permits normal functioning of the Release Valve air to and from the braking cylinders. However, when wheel slip occurs, valve 48 is unseated by diaphragm follower 46, thus venting the air from the top of piston 21. This permits piston 21 to move upward and adjust brake cylinder to a predetermined level.

(e) Valve spring 49 holds valve 48 seated when the diaphragm 47 is in its normal position.

(f) A charging check valve which permits quick charging of the pipe bracket chamber and the lower face of diaphragm 47 to insure air pressure for the operation of the DECELOSTAT valve, but prevents any back flow when wheel slip occurs.

(g) Timing check valve 69 which permits a quick release of the air in the pipe bracket chamber and on the lower face of diaphragm 47 when a DECELOSTAT cycle is initiated due to wheel slip. This provides for uniform DECELOSTAT functioning time regardless of pipe bracket chamber pressure.

(h) The release check valve which permits a release of the air in the pipe bracket chamber and on the lower face of diaphragm 47 during a normal relay valve release.

Thus the charging check valve is unseated permitting quick charging of the pipe bracket volume chamber, the lower face of diaphragm 47 and the chambers below the timing check valve 69 and the release check valve.

When wheel slip occurs the P-3 DECELOSTAT initiates the B-3 DECELOSTAT Valve to operate by venting the control pipe, with choke 5 in the DECELOSTAT Valve providing the necessary restriction to prevent loss of the

brake cylinder air and yet permit complete reduction of the control pipe air. Control pipe air on the upper face of diaphragm 47 is vented. The pressure on the lower side of the diaphragm 47 moves it upward to unseat discharge check valve 48 and vent air from the top of piston 21, a choke providing sufficient restriction to prevent recharging from the Relay Valve. Relay Valve air on the lower side of piston 21 moves it upward off its seat 22 and brake cylinder air is vented to exhaust, thus softening the brake and preventing wheel sliding.

Discharge check valve 48 is held unseated until (a) the air pressure on lower side of diaphragm 47 is first reduced to a predetermined pressure past timing check valve 69 and (b) exhaust check valve 83 in the P-3 DECELOSTAT is closed. This permits Relay Valve air to buildup in the control pipe and on top of diaphragm 47 thus moving piston 46 to its lower position. Spring 49 quickly seats the discharge check valve 48 to close the exhaust opening. Relay Valve air can then build up on top of piston 21 to cut off further exhaust of brake cylinder air. The brake cylinders are quickly reapplied to the Relay Valve pressure and the B-3 DECELOSTAT Valve is recharged as previously described.

When the brakes are released brake cylinder air flows back unrestricted to the Relay Valve where it is vented. At the B-3 DECELOSTAT Valve the air from the pipe bracket volume and connected chamber below diaphragm 47 is vented past the release check valve to the Relay Valve, as does DECELOSTAT control pipe air past the charging check valve and choke 5. The air on top of piston 21 returns to the Relay Valve through choke 6.

In case the P-3 DECELOSTAT control pipe is broken the Protection Feature of the B-3 DECELOSTAT Valve becomes operative. If the control pipe is broken after a brake application is made the DECELOSTAT equipment operates immediately in the same manner as when wheel slip occurs. The brake cylinder pressure is adjusted to a predetermined pressure and then restored due to choke 8 venting chamber D and volume N to the DECELOSTAT control pipe, so that piston 46 is returned to its lower position and discharge check valve 48 seated. Following this when a brake application is made Relay Valve air flows to the brake cylinders and to the top of release piston 21 and discharge check valve 48 as previously described. However, Relay Valve air flowing through choke 5 to further charge the B-3 DECELOSTAT Valve and the P-3 DECELOSTAT is lost through the broken control pipe. Thus air pressure can not build up below diaphragm 47, so that discharge check valve 48 can not be unseated to operate release piston 21 which insures normal flow of Relay Valve air to and from the brake cylinders. Choke 5 protects against excessive loss of Relay Valve air.

OPERATION OF THE EQUIPMENT

The "AP" DECELOSTAT equipment is shown Diagrammatically so as to make the connections and operation more easily understood. The Diagrammatic is not intended to show the actual construction of the operating devices. The "AP" DECELOSTAT equipment as shown in the Diagrammatic is in non-operative position with no air in the brake system.

When the car is running the car axle rotates drive shaft 110 through spline 113 and the DECELOSTAT shaft 10 connected to the drive shaft by the coupling cap. Cam roller lever 42 and roller 44 on shaft 43 rotate with shaft 10 with roller 44 contacting and driving cam 32, which through clutch shoes 34 drives friction wheel 35 and attached inertia wheel 27. The inertia wheel 27 is thus driven by shaft 10 as long as the car axle is turning and not retarded beyond a predetermined limit.

When a brake application is made Relay Valve air enters the B-3 DECELOSTAT through pipe 2 and flows unrestricted through passages 2, 2b and 1b to apply the brakes; through passages 2, 2a and chamber K to hold release check valve 48b seated, and through passages 2, 2b, 1b and 1a to chamber J holding timing check valve 69 seated. Relay Valve air also flows from passage 2 through choke 6 to passage 6 which leads to chamber A on top of release piston 21 and to chamber F on top of discharge check valve 48. Further, Relay Valve air from passage 2 flows through choke 5 to (a) passage 3 leading to chamber E on top of diaphragm 47 and piston 46 (b) chamber G where Relay Valve air lifts charging check valve 48a and quickly charges pipe bracket chamber N and chamber D on the lower side of diaphragm 47 and (c) control pipe 3 which leads to the P-3 DECELOSTAT.

At the P-3 DECELOSTAT, Relay Valve air from control pipe 3 flows through passage 3 and 3a: (a) to chamber J on top of the pressure limiting check valve 81, (b) to chamber F where Relay Valve air lifts charging check valve 83a and quickly charges the pilot valve body volume chamber and chamber B below diaphragm 76 to a predetermined pressure (c) to chamber E top of discharge check valve 83 and (d) through choke 66 to charge chamber C above diaphragm 76. As the brake application becomes effective the car axle is retarded, drive shaft 110 and DECELOSTAT shaft 10 with attached cam roller lever 42 are likewise retarded. The inertia wheel 27 and 28 and friction wheel 35 continue to rotate at the original speed on ball bearing 29 and over-travel shaft 10 until clutch shoes 34 move cam 32 so that the cam drive slope moves away from cam roller 44 and the opposite cam slope contacts the roller. If the shaft retardation is at or below a normal rate the inertia force of the free wheel 27 and 28 is balanced by the force of spring 52.

The DECELOSTAT inertia wheel thus takes a position corresponding to the instantaneous retardation rate. When the shaft retardation becomes excessive and reaches a predetermined value, the inertia wheel further over-travels shaft 10 causing cam roller 44 to move up on the cam slope. This rotates lever 42 and shaft 43 around fulcrum pin 40 which moves pull rod 50 over to unseat pilot valve 70 quickly venting the air in chamber C above diaphragm 76 since choke 66 restricts buildup from passage 3a. DECELOSTAT chamber volume air in chamber B moves diaphragm 76 and follower 73 upward unseating discharge valve 83 to vent the control pipe air and operate the B-3 DECELOSTAT Valve.

Venting of the control pipe air permits quick venting of the P-3 DECELOSTAT chamber B air past check valve 81 to a predetermined pressure the remainder of which is exhausted through timing choke 67. This timed exhaust from chamber B prevents the downward return of

piston 73 and seating of check valve 83 until after the DECELOSTAT cycle has initiated a brake cylinder release and permitted the car wheels to return to train speed. Then spring 75 returns diaphragm 76 downward and spring 84 seats check valve 83.

At the B-3 DECELOSTAT Valve, choke 5, provides the necessary restriction to prevent loss of brake cylinder air when the control pipe is vented. Control pipe air in chamber E on the upper face of diaphragm 47 is vented. The pressure on the lower side of diaphragm 47 moves it upward to unseat discharge check valve 48 and vent air from chamber F, passage 6 and chamber A on top of piston 21. Choke X provides sufficient restriction to prevent recharging from the Relay Valve. Relay Valve air in chamber B moves piston 21 upward off its seal 22 and brake cylinder air is connected to exhaust, thus softening the brake and preventing wheel sliding.

Discharge check valve 48 is held unseated until the air pressure in chamber D is reduced to a predetermined point and the P-3 DECELOSTAT discharge check valve 83 and pilot valve 70 are seated. The B-3 DECELOSTAT Valve chamber D air is quickly reduced through passage 4a, 4c, chamber L, past timing check valve 69, passage 1a, 1b, chamber B and C to exhaust. The DECELOSTAT check valve 83 is seated, as described above, and when the wheel retardation decreases and roller 44 moves off the cam slope spring 52 moves rod 50 inward toward shaft 10 permitting spring 69 to seat pilot valve 70. Thus Relay Valve air can then charge the control pipe and B-3 DECELOSTAT Valve chamber E which with spring 45 seats discharge check valve 83. Relay Valve air then builds up in chamber F and chamber A, seating piston 21 to cut off the exhaust of brake cylinder air. The brake cylinder is then quickly built up to Relay Valve air pressure and B-3 DECELOSTAT Valve and the P-3 DECELOSTAT are recharged as previously described.

When the brakes are released brake cylinder air flows back unrestricted to the Relay Valve where it is vented. At the B-3 DECELOSTAT Valve the air from chambers D, N, H, L and M lifts release check valve 48b and flows through passage 2a to the Relay Valve pipe 2.

Release of air from chamber H permits the control pipe and chamber E and chamber G air to lift check 48a and connect with chamber M to vent to the Relay Valve past check valve 48b, passage 2a and the Relay Valve pipe. Thus venting of air in chamber D prior to that of chamber E insures holding piston 46 in its lower position and prevents undesired operation of the DECELOSTAT during release.

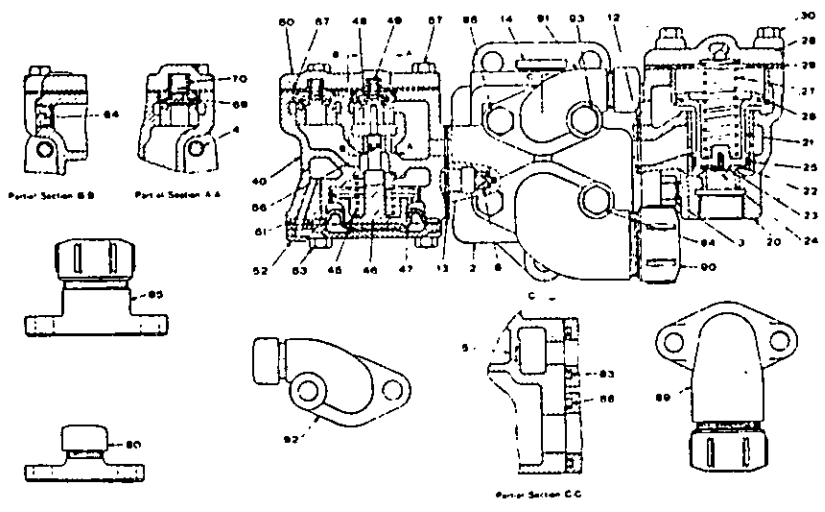
TESTING

To test the operation of the 3-AP DECELOSTAT Equipment a brake application is first made when the train is standing. Then remove the exhaust cap on the outside face of the P-3 DECELOSTAT which is indicated by the arrow on the view below. Insert a finger in the opening and turn the inertia wheel until an exhaust occurs, then remove the finger. Note that a complete operating cycle of the equipment occurs as follows:

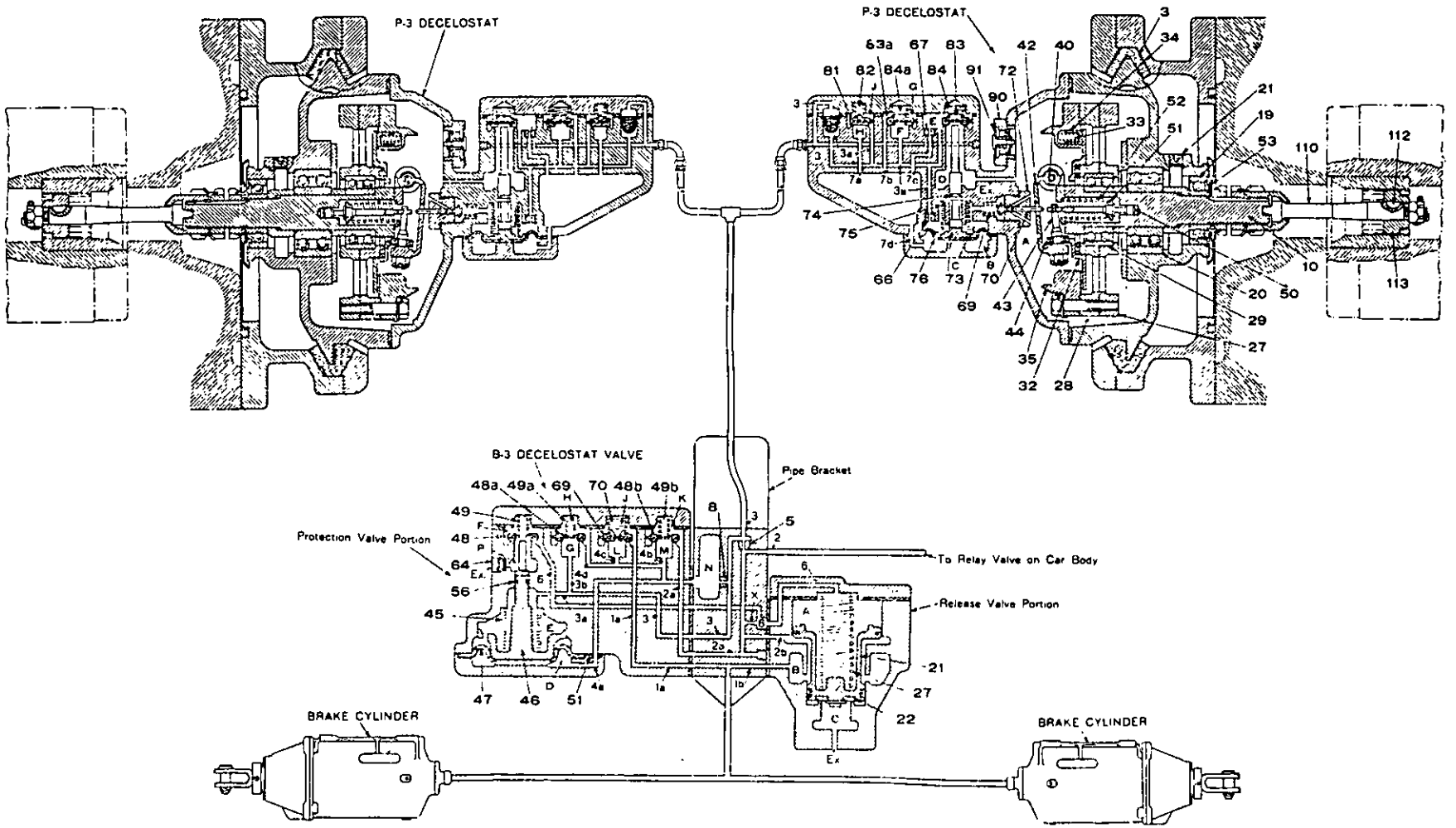
A blow of air from the P-3 DECELOSTAT exhaust occurs which is immediately followed by a heavy discharge of brake cylinder air at the B-3 DECELOSTAT Valve. When the heavy discharge of brake cylinder air stops, the brakes re-apply immediately.

Check the operation of the equipment for reverse operation in the same manner except turn the inertia wheel in the opposite direction.

To test the protection feature of the 3-AP DECELOSTAT Equipment the finger is inserted into the exhaust cap opening of the P-3 DECELOSTAT cover, as described above, but in this case after the inertia wheel is turned (in either direction) to cause an exhaust it is held in the exhaust position. It should be noted that a complete cycle of the DECELOSTAT operation takes place as described above, except that there is a brief time interval until the re-application occurs and a slight blow continues at the P-3 DECELOSTAT exhaust opening after the brakes are re-applied. When the finger is removed the exhaust of air at the P-3 DECELOSTAT stops. Thus, the 3-AP DECELOSTAT equipment is tested for operation for either direction of car travel.



B-3 DECELOSTAT Valve - Assembly View



Diagrammatic of the "AP" DECELOSTAT Equipment

WABCO
An American-Standard Company

"P-3"
DECELOSTAT® CONTROLLER

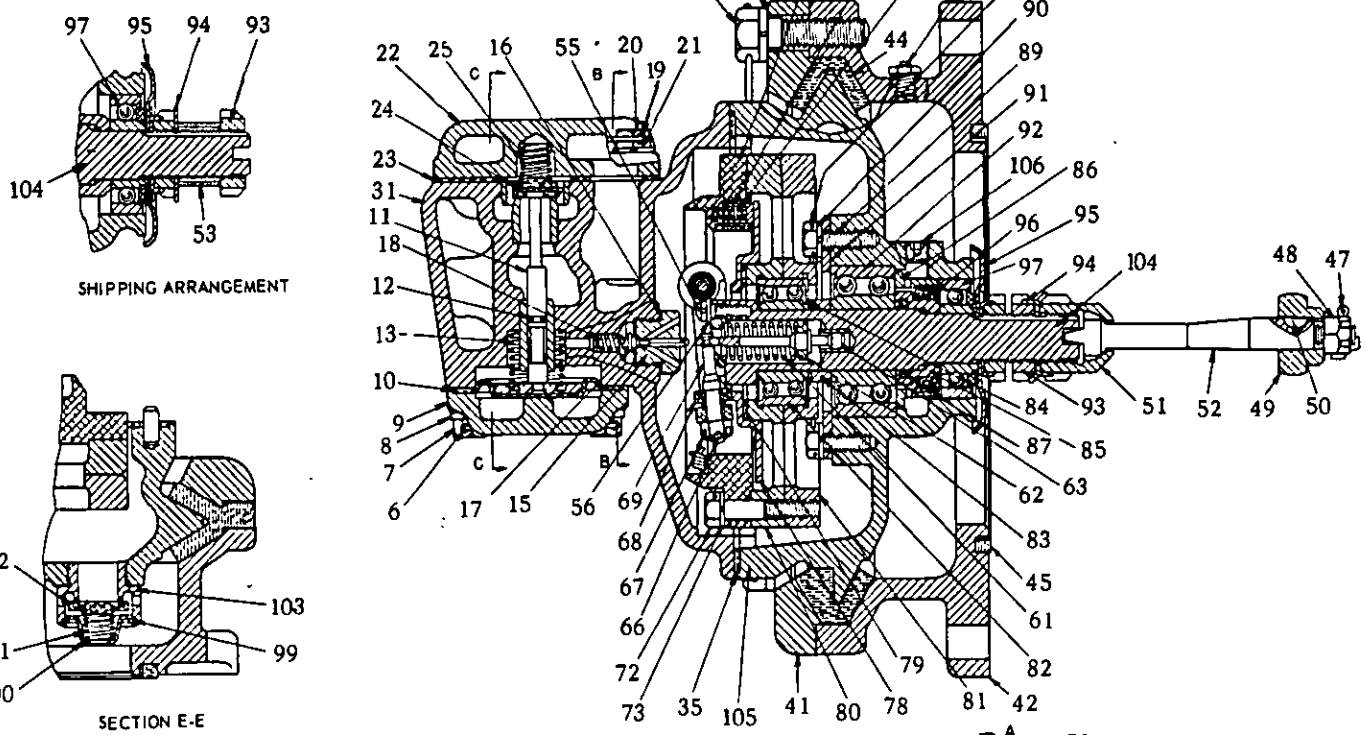
PARTS CATALOG

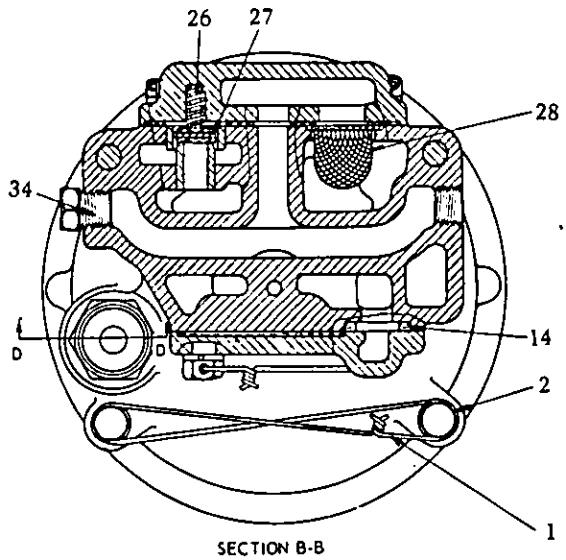
(SUPERSEDES ISSUE DATED MARCH, 1975)

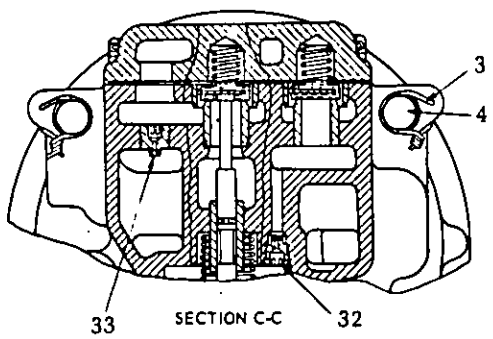
Westinghouse Air Brake Division

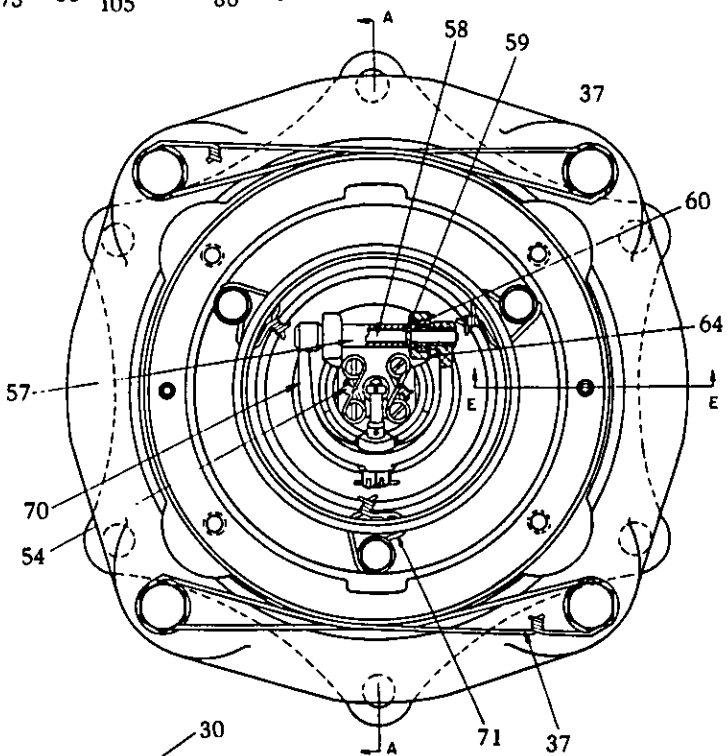
WESTINGHOUSE AIR BRAKE COMPANY/Wilmerding, Pennsylvania 15148

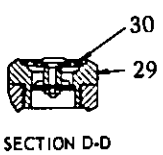
WABCO











(PILOT VALVE BODY REMOVED)

Figure 1

WABCO

"P-3" DECELOSTAT® CONTROLLERS

Assembly Pc.No.	Control Portion	Bracket with Clamp Ring	Shaft Adapter	Axle	Remarks
Ref.No.	Fig. 1	38	46		
533146	533144	529755	UN440596	5-1/2 x 10 6 x 11	AAR Std. Journal
532452	533144	530795	UN440596	5-1/2 x 10	Ill. C. R.R.
550860	533144	529755	UN440714	5-1/2 x 10 6 x 11	AAR Std. Journal
544146	555368	529755	UN440596	5-1/2 x 10 6 x 11	AAR Std. Journal
544251	555368	529755	UN440714	5-1/2 x 10 6 x 11	AAR Std. Journal
545840	555368	529755	UN440720	5-1/2 x 10 6 x 11	AAR Std. Journal
546202	535689	529755	546190 ▲	Adapter for 6 x 11 Timken Journal Replacement of Rolokron with AP-3 Decelostat	

▲ Additional Items Required, See page 5.

The following Repair Portions are also available

	533145	535690	550859	."P-3" DECELOSTAT CONTROLLER PORTION, Asy.
	533144	533144	533144	.PORTION, CONTROLLER, less Drive Shaft 1
	UN440596	UM440452	UN440714	.SHAFT, Drive 1
540113	553835	544252	544619	"P-3" DECELOSTAT CONTROLLER PORTION, Asy.
535689	533144	555368	555368	.PORTION, CONTROLLER, less Drive Shaft 1
---	UN440720	UN440714	UN440596	.SHAFT, Drive 1
529428	---	---	---	.GASKET, Supporting 1
554576	545841	551865	535633	"P-3" DECELOSTAT CONTROLLER PORTION, Asy.
555368	555368	555368	533144	.PORTION, Controller, less Drive Shaft 1
UN440720	UN440720	UN440783	UN440596	.SHAFT, Drive 1
529428	---	---	529428	.GASKET, Supporting 1
551369	548404	540114	541234	"P-3" DECELOSTAT CONTROLLER PORTION, Asy.
555368	555368	533144	533144	.PORTION, CONTROLLER, less Drive Shaft 1
UN440596	UN440714	UM440452	---	.SHAFT, Drive 1
529428	529428	529428	529428	.GASKET, Supporting 1

Approx. Net Weight 32 lbs.

"P-3" DECELOSTAT® CONTROLLER PORTION

Fig. & Ref.No.	Pc.No.		Parts Name	No. Req'd
1-	533144		"P-3" DECELOSTAT® CONTROLLER PORTION, ASY., less Drive Shaft (Incl. Ref. Nos. 1 thru 109)	
1-		535689	"P-3" DECELOSTAT CONTROLLER PORTION, ASY., with Checking Device, less Drive Shaft (Incl. Ref. Nos. 1 thru 112)	
1-		555368	"P-3" DECELOSTAT CONTROLLER PORTION, ASY., with OLDHAM Drive Coupling (Incl. Ref. Nos. 1 thru 106)	
1-1		540296	.WIRE, Lock, 15 in.	1
1-2		529722	.SCREW, Cap, H. Hd., 3/8 x 7/8 in.	2
1-3		534542	.WIRE, Lock, 5 in.	2

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"P-3" DECELOSTAT® CONTROLLER PORTION (Cont'd)

Fig. & Ref. No.		Pc. No.		Parts Name	No. Req'd
1-4		533136		.SCREW, Cap, H. Hd., 3/8 x 3-3/8 in.	2
1-5	533143	533143	544190	.PILOT VALVE, Asy. (Incl. Ref. Nos. 6 thru 34)	2
1-6		531691		..WIRE, Lock, 10 in.	1
1-7		536963		..SCREW, Cap, H. Hd., 3/8 x 1 in.	4
1-8		17173		..WASHER, Lock, 3/8 in.	4
1-9		533133		..COVER, Diaphragm	1
1-10		533097		..DIAPHRAGM	1
1-11		533125		..FOLLOWER, Diaphragm	1
1-12		533134		..O-RING, 5/16 in. O.D.	1
1-13		501006		..SPRING	1
1-14		99458		..GASKET, Ring	1
1-15		533135		..NUT, Cap, Pilot V.	1
1-16		533886		..SHIM, .006 in. Thick	3
1-17		534705		..VALVE, Pilot	1
1-18		530250		..SPRING, Valve	1
1-19		531691		..WIRE, Lock, 10 in.	2
1-20		536963		..SCREW, Cap, H. Hd., 3/8 x 1 in.	4
1-21		17173		..WASHER, Lock, 3/8 in.	4
1-22		533148		..COVER, Valve	1
1-23		533132		..GASKET, Cover	1
1-24		515215		..VALVE, Check	2
1-25		533137		..SPRING, Check Valve	2
1-26		524101		..SPRING, Valve (Press. Lim.)	1
1-27		532715		..VALVE, Check (Press. Lim.)	1
1-28		521663		..STRAINER, Wire	1
1-29	529610	529610	--	..VENT CAP NUT (Incl. Ref. 30)	1
1-29	--	--	542665	.CHECKING DEVICE (See Page 6)	1
1-30	513047	513047	--	...DIAPHRAGM, Vent	1
1-31		533142		..BODY, Pilot Valve (Incl. Ref. Nos. 31 thru 34)	1
1-32		504013		...PLUG, Choke, 1/8 NPT (#61 Dr.)	1
1-33		900946		...PLUG, Choke, 1/4 NPT (#57 Dr.)	1
1-34		505842		...PLUG, Pipe, 3/8 NPT	1
1-35		529427		.GASKET, Housing	1
1-37	▫ 531741	531741	531741	.WIRE, Lock, 20 in.	2
1-38	529775	▫	530795	.BRACKET with CLAMPING RING, Asy. (Incl. Ref. Nos. 39 - 43)	1
1-39		529721		..SCREW, Cap, H. Hd., 1/2 x 1-3/4 in.	4
1-40		15951		..WASHER, Lock, 1/2 in.	4
1-41		529617		..RING, Clamping	1
1-42	562172	▫	530796	..BRACKET with Relief Fitting	1
1-43		555057		...FITTING, Relief.	1
1-44		529428		.GASKET, Supporting.	1
1-45		529175		.GASKET, Ring, 6-7/8 in. O.D.	1
1-46		▫		.DRIVE SHAFT, Asy. (Incl. Ref. Nos. 46 thru 52)	1
1-47				..COTTER, 3/8 x 5/8 in.	
1-48				..NUT	
1-49				..SPLINE, Drive Shaft	
1-50				..KEY, #2	
1-51				..CAP, Coupling	
1-52				..SHAFT, Drive	
1-53	531872	--	531872	.THREAD PROTECTOR (Shipping Only)	1
1-54		533674		.WIRE, Lock, 5 in. Long.	2
1-55		533110		.SCREW, Mach. Ov. Fil. Hd., .216 x 5/8 in.	4
1-56		519821		.WASHER, Lock, #12.	4
1-57		550549		.SLEEVE	1
1-58		550548		.PIN, Fulcrum	1
1-59		524620		.RING, Packing	2
1-60		533120		.BEARING, Ball	2

Fig. & Ref. No.		Pc. No.		Parts Name	No. Req'd
1-61		533069		.SPRING, Cam Lever	1
1-62		533067		.SEAT, Spring	1
1-63		533068		.ROD, Pull	1
1-64		533036		.LEVER, Fulcrum	1
1-65		533054		.LEVER, Cam Roller (Incl. Ref. 66 thru 70)	1
1-66		521200		..COTTER, 1/16 x 1/2 in.	1
1-67		77787		..NUT, Hex, 1/4 in.	1
1-68		526804		..ROLLER, Cam	1
1-69		533053		..SHAFT, Cam Roller	1
1-70		533052		..LEVER, Cam Roller	1
1-71		533674		.WIRE, Lock	2
1-72		536962		.SCREW, Cap, H. Hd., 5/16 x 1-5/8 in.	3
1-73		9469		.WASHER, Lock, 3/8 in.	3
1-74		533122		.INERTIA WHEEL (Incl. Ref. Nos. 71, 72, 73 and 75 thru 82)	1
1-75		533123		..WHEEL, Friction.	1
1-76		533075		..SHOE, Clutch	3
1-77		533108		..SPRING, Clutch	3
1-78		533058		..CAM.	1
1-79		533892		..SHIM, Clutch Plate	1
1-80		533038		..WHEEL, Inertia, Drilled	1
1-81		533891		..WHEEL, Inertia, Threaded	1
1-82		533121		..BEARING, Double Row	1
1-83		533061		.WASHER, 1-5/16 x 1 x .398 in.	
1-84		537046		.SHIM, 1-5/16 x 1 x .010 in.	3
1-85		554999		.SLEEVE, Small	1
1-86		555000		.SLEEVE, Small	1
1-87		524719		.RING, Packing, 1-1/4 in.	1
1-88		536967		.WIRE, Lock, 15 in. Long	1
1-89		536961		.SCREW, Cap, H. Hd., 5/16 x 3/4 in.	6
1-90		9469		.WASHER, Lock, 3/8 in.	6
1-91		533073		.DISC, Retainer	1
1-92		526801		.BEARING, Ball, Double Row	1
1-93	533128	--	533128	.NUT, Lock	2
1-94	532045	--	532045	.WASHER, Lock	2
1-95		533074		.PLATE, Baffle	1
1-96		555056		.SEAL, Oil	1
1-97		526802		.BEARING, Ball, Single.	1
1-98		531147		.NUT, Cap, Ex. Valve (Incl. Ref. Nos. 99 thru 103)	1
1-99		531150		..RING, Retaining	1
1-100		533147		..SEAT, Spring	1
1-101		94581		..SPRING, Check V.	1
1-102		529900		..VALVE, Check	1
1-103		531145		..BODY, Cap Nut	1
1-104		533119		.SHAFT	1
1-105		533035		.HOUSING, Controller (Incl. Ref. No. 106)	1
1-106		515794		..PLUG, Fluted Socket, Pipe, 1/8 in.	1
1-109	--	543075 ▲	--	.COUPLING, Drive	1
1-110	--	543076 ▲	--	.NUT, Special.	1
1-111	--	534542 ▲	--	.WIRE, Lock	1
1-112	534352	--	534352	.TAG, Instructions . (N.S.)	1

▲ Additional Items Required for Pc. No. 546202, Assembly.

□ NOTE: Not a part of the "P-3" Decelostat Controller Portion, but of the complete device; See Assembly Pc. No. Index.

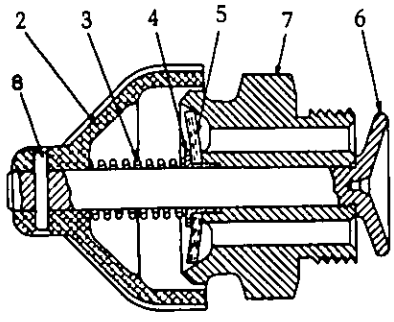


Figure 1

"P-3" DECELOSTAT® CHECKING DEVICE

Fig. & Ref. No.	Pc. No.	Parts Name	No. Req'd
1-	542665	"P-3" DECELOSTAT CHECKING DEVICE, Asy. (Incl. Ref. 1 thru 7)	
1-1	545705	.PIN, .081 x 3/4 in.	1
1-2	542670	.KNOB	1
1-3	542669	.SPRING	1
1-4	542667	.RETAINER, Vent Diaphragm . . .	1
1-5	541827	.DIAPHRAGM, Vent	1
1-6	542668	.SHAFT	1
1-7	542666	.BODY, Device	1

This page supersedes P. C. 3227-11P, dated 11-20-53.

WABCO

An American-Standard Company

Printed in U.S.A.

WABCO
WESTINGHOUSE AIR BRAKE CO
a subsidiary of
AMERICAN-STANDARD

"B-3" TYPE DECELOSTAT VALVES

(Supersedes issue dated November, 1969)

Parts Catalog

WESTINGHOUSE AIR BRAKE DIVISION
WILMERDING, PENNSYLVANIA

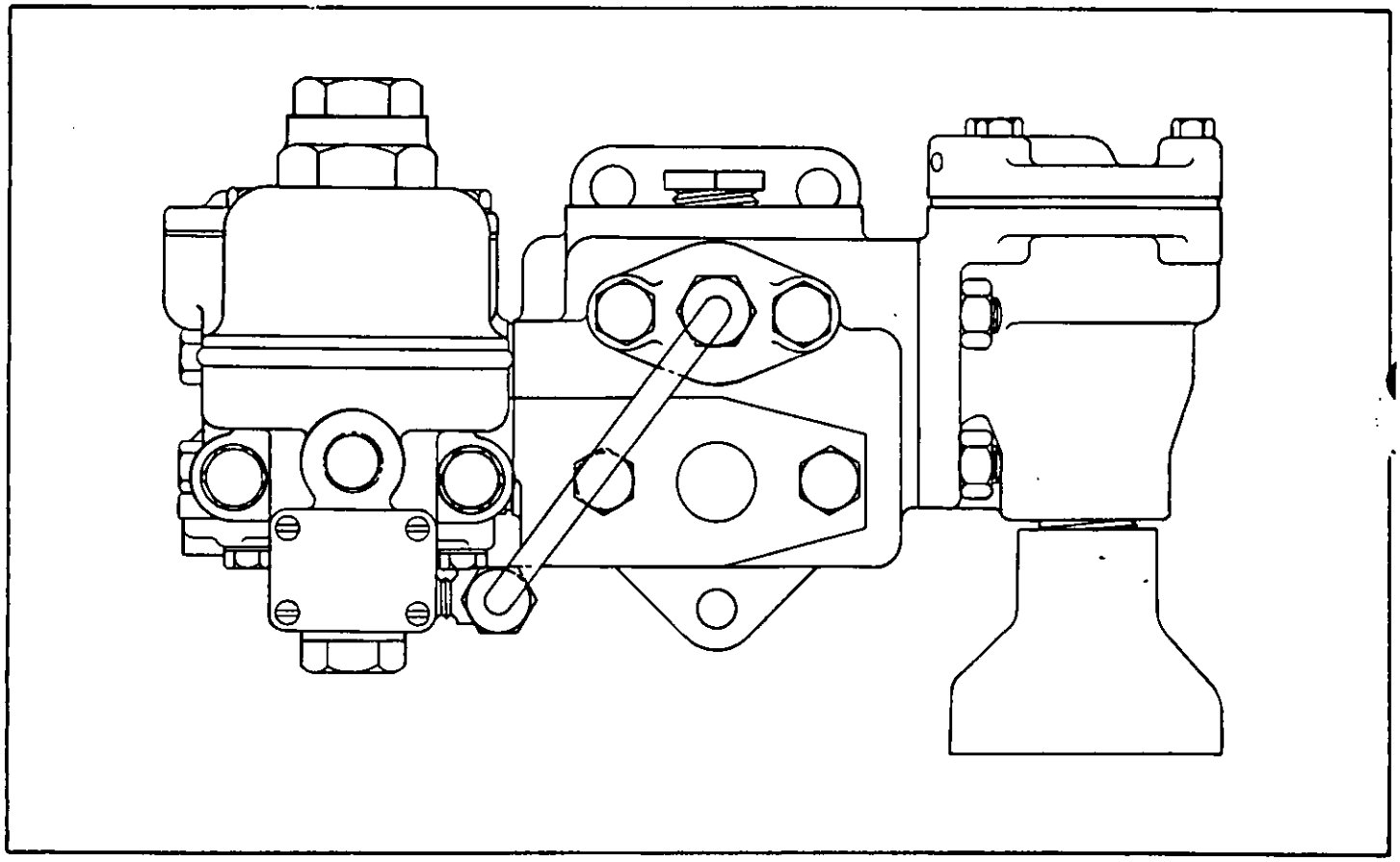
WABCO

"B-3" TYPE DECELOSTAT VALVES-INDEX

TYPE	Pc.No.	Release Valve	Portions: Pipe Bracket	Portions: Pipe Bracket with Tube	Magnet ▲: Pc.No.	Magnet ▲: Volts	Protection Valve	Pages
B-3	533356	533334	533338	.....	.....	..	533355	3, 5, 6
	533492	533334	533497	.....	.....	..	533355	3, 5, 6
B-3-C	566735	533334	.....	566739	529327	32	533355	3, 5, 7
	574304	533334	.....	574308	528569	64	533355	3, 5, 7
	575966	575968	• 575967	.....	529327	32	.....	3, 8

▲ NOTE: Part of Pipe Bracket Portion Asy. Detail Parts for Magnets may be found in Parts Catalog 3228-1

• NOTE: Indicates Pipe Bracket less connecting Tube and Fittings.



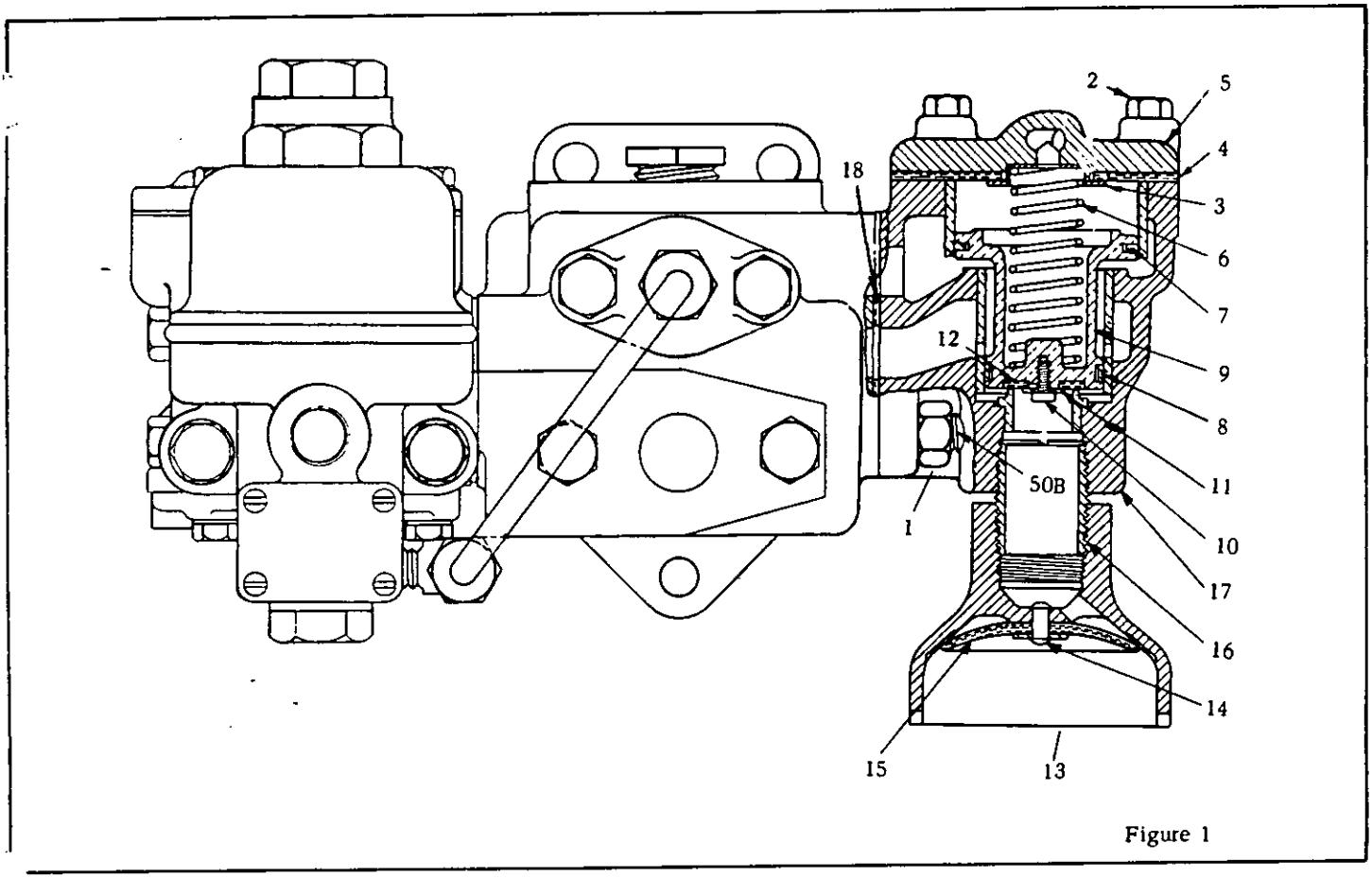


Figure 1

RELEASE VALVE PORTION

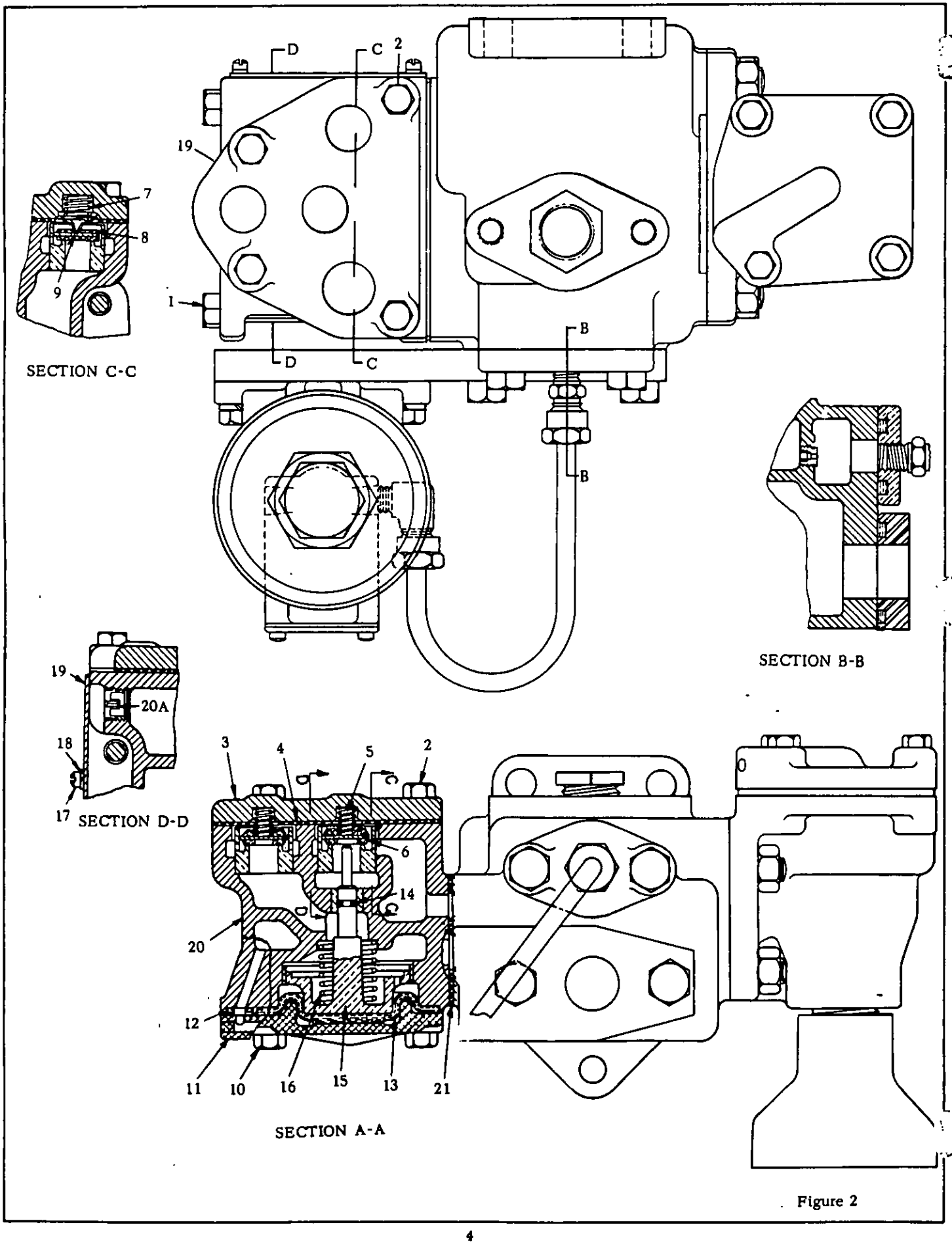
Fig. & Ref.No.	Pc.No.	Parts Name	No. Req'd
	533334 575968	RELEASE VALVE PORTION, ASY.	
1-1	†2505	.NUT, Hex., 1/2 in.	4
1-2	17129	.SCREW, Hex.Hd.Cap, 3/8 x 1-5/8 in.	4
1-3	552346	.RETAINER, Gasket	1
1-4	533333	.GASKET, Top Cover	1
1-5	533331 575963	.COVER, Top	1
1-6	569160	.SPRING, Piston	1
1-7	§	.RING, Piston, 2-1/2 in. Dia.	1
1-8	§	.RING, Piston, 1-5/8 in. Dia.	1
1-9	520320	.PISTON, Asy.	1
1-10	500430	..SCREW, Retainer	1
1-11	27660	..WASHER, 9/16 in. O.D. . .	1
1-12	501331	..SEAL, Piston	1
1-13	532456	.VENT PROTECTOR, Asy. .	1
1-14	571140	..RIVET, Pop, 3/16 x 1/2 in.	1
1-15	502465	..SEAL, Vent	1
1-16	536419	.NIPPLE, Pipe, 1 x 1-1/2 in..	1
1-17	533329	.BODY, Release Valve	1
1-18	††533336	GASKET, Body	1

† NOTE: Part of Pipe Bracket, Fig. 3

†† NOTE: Not a part of any Portion, but a part of the Complete Device.

§ NOTE: We are prepared to furnish the following Repair Rings for the Release Valve Piston:

Fig. & Ref.No.	Size O.D.	Pc.No.	Remarks
1-7	2-1/2 in.	505865	Standard and 1st Repair
		505866	2nd Repair
		505867	3rd Repair
		505868	4th Repair
1-8	1-5/8 in.	504236	Standard and 1st Repair
		530728	2nd Repair


D
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SECTION D-D
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SECTION A-A

Figure 2

PROTECTION VALVE PORTION

Fig. & Ref.No.	Pc.No.	Parts Name	No. Req'd
2-	533355	PROTECTION VALVE PORTION, ASY.	
2-1	† 555416	.SCREW, Hex.Hd.Cap, 3/8 x 4-3/4 in.	4
2-2	3210	.SCREW, Hex.Hd.Cap, 3/8 x 1-1/4 in.	4
2-3	533345	.COVER, Check Valve	1
2-4	533346	.GASKET, Check Valve Cover	1
2-5	533347	.SPRING, Check Valve	3
2-6	535022	.VALVE, Check	3
2-7	536515	.SPRING, Valve Check	1
2-8	534528	.SEAT, Check Valve	1
2-9	534663	.VALVE, Check	1
2-10	15784	.SCREW, Hex.Hd.Cap, 3/8 x 1-1/8 in.	4
2-11	527566	.COVER, Bottom	1
2-12	523619	.GASKET, Ring	1
2-13	522980	.DIAPHRAGM	1
2-14	534662	.O-RING, 3/8 in. O.D.	1
2-15	533348	.FOLLOWER, Diaphragm	1
2-16	569675	.SPRING, Return	1
2-17	521309	.SCREW, Ov.Fil.Hd., .190 x 1/2 in.	3
2-18	33775	.WASHER, Lock, .190 in.	3
2-19	537055	.SHIELD, Exhaust	1
2-20	533354	.BODY, Protection Valve	1
2-20A	503476	..EXCLUDER, Wasp	1
2-21	† 533337	GASKET, Body	1

† NOTE: Not a part of any Portion, but of the Complete Device.

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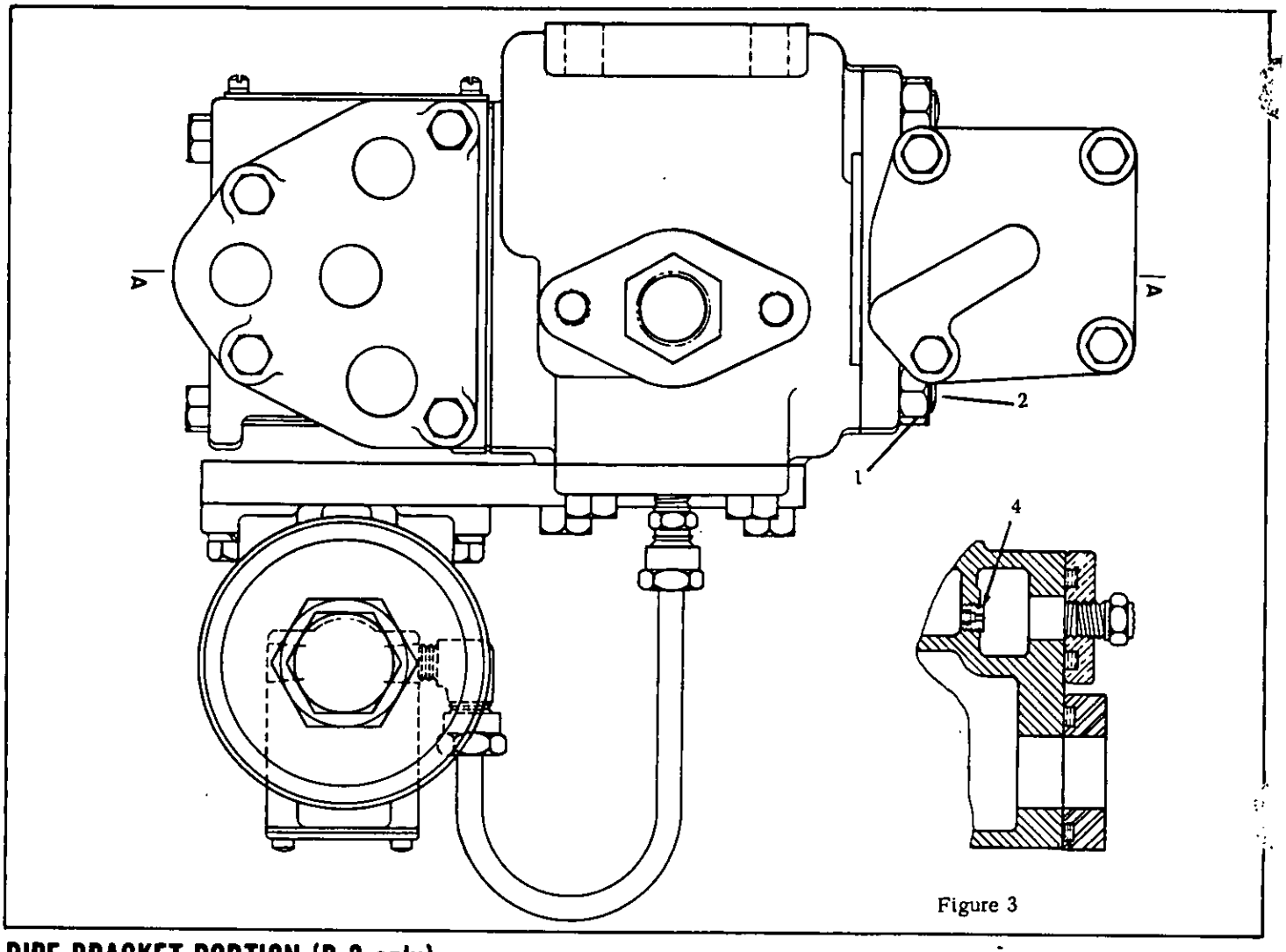

Figure 3

PIPE BRACKET PORTION (B-3 only)

Fig. & Ref.No.	Pc.No.	Parts Name	No. Req'd
3-	533358 533497	PIPE BRACKET PORTION, ASY.	
3-1	2505	.NUT, Hex., 1/2 in. (Fig.1, Ref. 1)	4
3-2	500871	.STUD, 1/2 x 1-3/4 in. . . .	4
3-3	6983	.BUSH, Reducing, 1 to 3/4 in. (Not Shown)	1
3-4	78727	.PLUG, Choke, 1/8 in. (1/8 Dr.)	1
3-5	534163	.PLUG, Choke, 1/4 in. (#70 Dr.) (Not Shown)	1

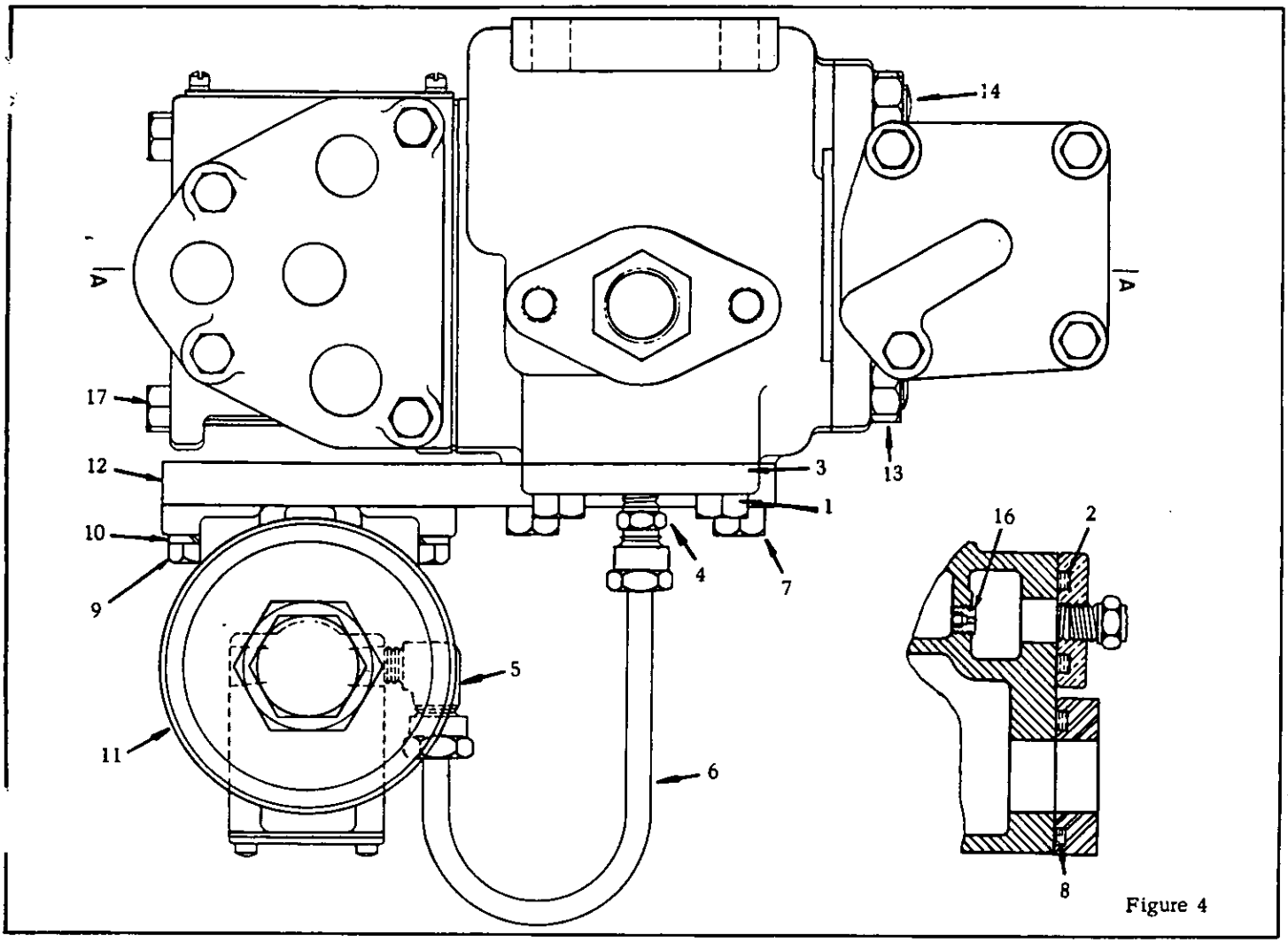

Figure 4

PIPE BRACKET PORTION (B-3-C only)

Fig. & Ref.No.	Pc.No.	Parts Name	No. Req'd
4-	566739 574308	PIPE BRACKET PORTION, ASY.	
4-1	3134	.SCREW, Hex.Hd.Cap, 1/2 x 1-1/4 in.	2
4-2	93840	.GASKET, Fitting, 1/2 in.	1
4-3	574305	.PAD, Tapped, 1/2 in. (1/4 NPT)	1
4-4	541507	.FITTING, Stud, Threaded 3/8 in. O.D.	1
4-5	541506	.FITTING, Elbow, Threaded, 3/8 in. O.D.	1
4-6	566741	.TUBE, 3/8 in.	1
4-7	5951	.SCREW, Hex.Hd.Cap, 1/2 x 1-1/2 in.	2
4-8	93986	.GASKET, Mounting Strap	1
4-9	3134	.SCREW, Hex.Hd.Cap, 1/2 x 1-1/4 in.	2
4-10	15951	.WASHER, Lock	2
4-11	529327	.MAGNET, FB-2 (32 Volt) See P.C. 3228-1	1
4-11	528569	.MAGNET, FB-2 (64 Volt) See P.C. 3228-1	1
4-12	566740	.STRAP, Mounting	1
4-	567547	.PIPE BRACKET, Asy.	1
4-13	2505	..NUT, Hex., 1/2 in. (Fig. 1, Ref. 1)	4
4-14	500871	..STUD, 1/2 x 1-3/4 in.	4
4-15	6983	..BUSH, Reducing, 1 to 3/4 in. (Not Shown)	1
4-16	517999	..PLUG, Choke, 1/8 in. (1/16 Dr.)	1
4-17	534163	..PLUG, Choke, 1/4 in. (#70 Dr.) (Not Shown)	1
4-	♦ 576441	SCREW, Cap, 1/2 x 2 in.	2

♦ NOTE: Used to secure the Mounting Valve Strap and Flange Fitting furnished by customer to the Pipe Bracket. Not a part of the Pipe Bracket, but a part of the Complete Device

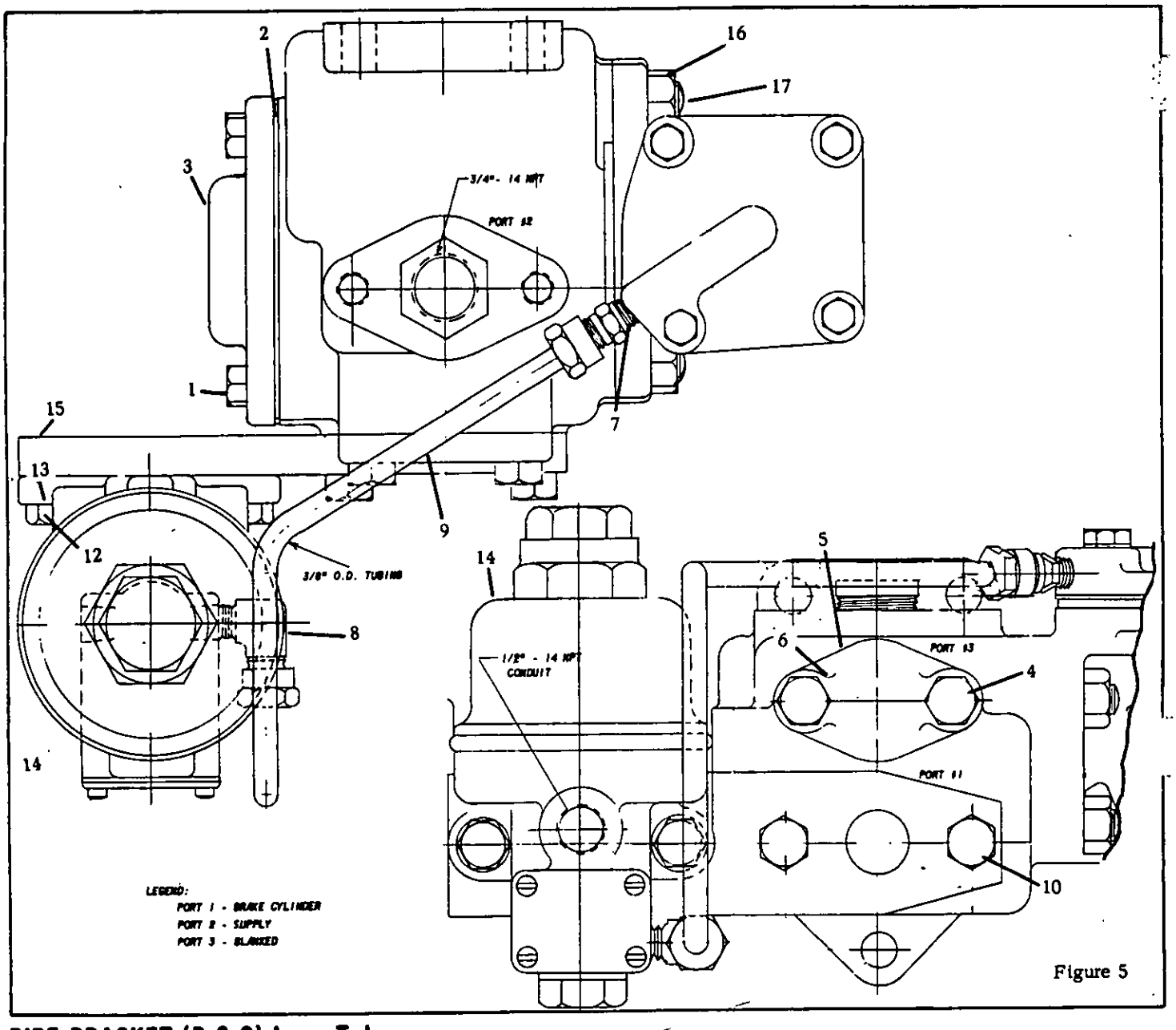

Figure 5

PIPE BRACKET (B-3-C) Less Tube

Fig. & Ref.No.	Pc.No.	Parts Name	No. Req'd
5-	575967	PIPE BRACKET PORTION, ASY.	
5-1	514274	.SCREW, Hex.Hd.Cap, 3/8 x 1 in. . .	4
5-2	533337	.GASKET	1
5-3	565964	.COVER	1
5-4	3134	.SCREW, Hex.Hd.Cap, 1/2 x 1-1/4 in.	2
5-5	93840	.GASKET, Fitting, 1/2 in.	1
5-6	507620	.PAD, Blanking	1
5-7	† 541507	.FITTING, Stud Threaded, 3/8 in. O.D.	1
5-8	† 541506	.FITTING, Elbow Threaded, 3/8 in. O.D.	1
5-9	† 575965	.TUBE, 3/8 in. O.D.	1
5-10	5951	.SCREW, Hex.Hd.Cap, 1/2 x 1-1/2 in.	2
5-11	93986	.GASKET, Mounting Strap (Not Shown)	1
5-12	3134	.SCREW, Hex.Hd.Cap, 1/2 x 1-1/4 in.	2
5-13	15951	.WASHER, Lock	2
5-14	529327	.MAGNET, FB-2 (32 Volt) See Parts Catalog 3228-1	1
5-15	566740	.STRAP, Mounting	1
5-	567547	.PIPE BRACKET, Asy.	1
5-16	2505	..NUT, Hex., 1/2 in. (Fig. 1, Ref. 1)	4
5-17	500871	..STUD, 1/2 x 1-3/4 in.	4
5-18	6983	..BUSH, Reducing, 1 to 3/4 in. (Not Shown)	1
5-19	517999	..PLUG, Choke, 1/8 in. (1/16 Dr.) (Not Shown)	
5-20	534163	..PLUG, Choke, 1/4 in. (#70 Dr.) (Not Shown)	1

† NOTE: Not a part of the Pipe Bracket Portion, but of the Complete Device.

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7.5 Brake Condition Indication System

These cars are not equipped with brake applied and released pressure switches, unlike later series cars.

The 2900 series cars are equipped with 4 local brake applied indicators along the side sill. This is the standard HEP installation. Refer to the main manual for details.

7.6 Maintenance and Overhaul Procedures

The WABCO manuals included here are for components unique to the 2900 series; CF brakes and 3-AP Decelostat. All other brake components are discussed in the main manual, section 7.6.

7.7 Brazing Piping Procedure

Refer to Main Manual.

7.8 Drawing List

Function	Drawing Number
Air Brake Schematic	D-03-441

C-8-1
C-9-1
C-10-1
C-11-1

CHAPTER 8 HANDBRAKE

Refer to Main Manual

CHAPTER 9 FOOD SERVICE EQUIPMENT

N/A

CHAPTER 10 TRUCKS

Refer to Main Manual

CHAPTER 11 COUPLER AND DRAFT GEAR

Refer to Main Manual

CHAPTER 12 WATER SYSTEM

LIST OF ILLUSTRATIONS

12.0 General - Refer to Main Manual

12.1 Undercar and Interior Equipment - Refer to Main Manual

12.2 Water Cooler - Refer to Main Manual

12.3 Water Heater

The 2900 series cars are equipped with a single 16 gallon upright water heater located under the liner locker near the center of the car. The heaters are equipped with pressure/temperature relief valve, set at 125 psig and 210°F. For freeze protection, the water heaters are equipped with an Ogontz automatic drain valve, opening at 39°F water temperature. The units also have a manual drain valve, and have a feed shut off valve.

12.3.1 Hatco 16 Gallon Upright Water Heater

This is an upright unit with a 480V Kw heater element. The control system is 120V, produced from the 480V contactor feed by a small control transformer located within the heater control box. See figure 12.1 and 12.2.

NOTE: This heater is identical to that used on successive orders except for the control transformer.

Hatco uses a water sensing probe and relay for low water burnout protection. The probe extends into the tank. Since water is a conductor of electricity, when the probe touches water, a circuit is made to the low water relay (LWR), picking it up. Closure of the relay completes a circuit to the thermostat, enabling it to energize the water heater contactor. The contractor controls the 2 heater elements to heat the water. The thermostat is set at 135°F.

There are also 2 high temperature limit thermostats (ECO) in the contactor coil circuit to protect against excessive water temperature. The control circuits are 120 VAC, elements 480 VAC. The contactor and LWR are contained in the front box on the water heater.

In the unlikely event that the LWR will not pick up, short terminal 3 to 5 of the LWR. If the relay then picks up, the fault is the water probe, which may be covered with scale, and should be cleaned.

The water heater tank must be grounded to the carbody with a wire. For tests, refer to test Spec PQ-79-1 test 12.3 To service the unit, make sure to turn off the water heater breaker in the electric locker.

12.3.2 TET 10, 18 and 50 Gallon Heaters

N/A

12.3.3 TET 1 Gallon Heater

N/A

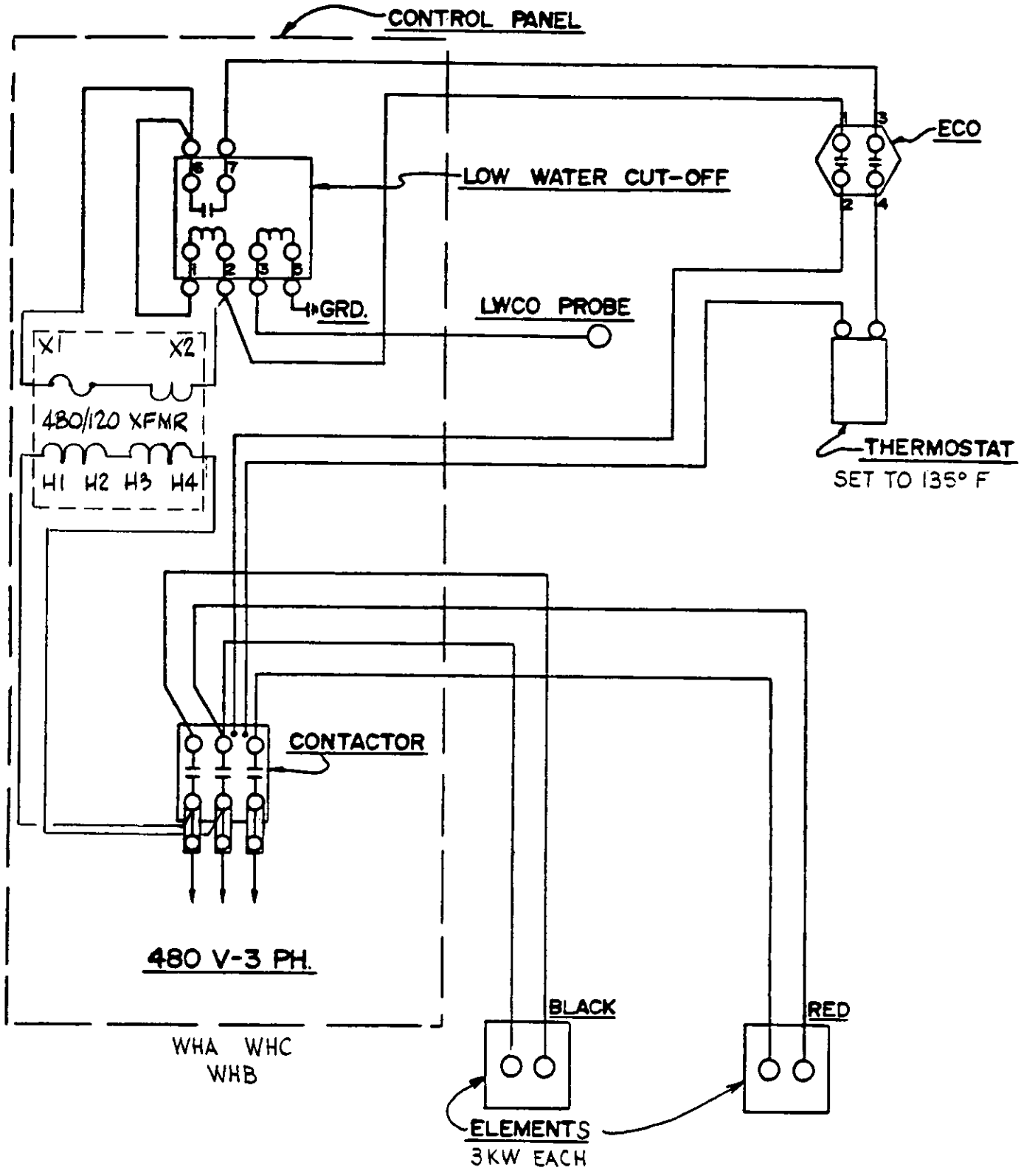
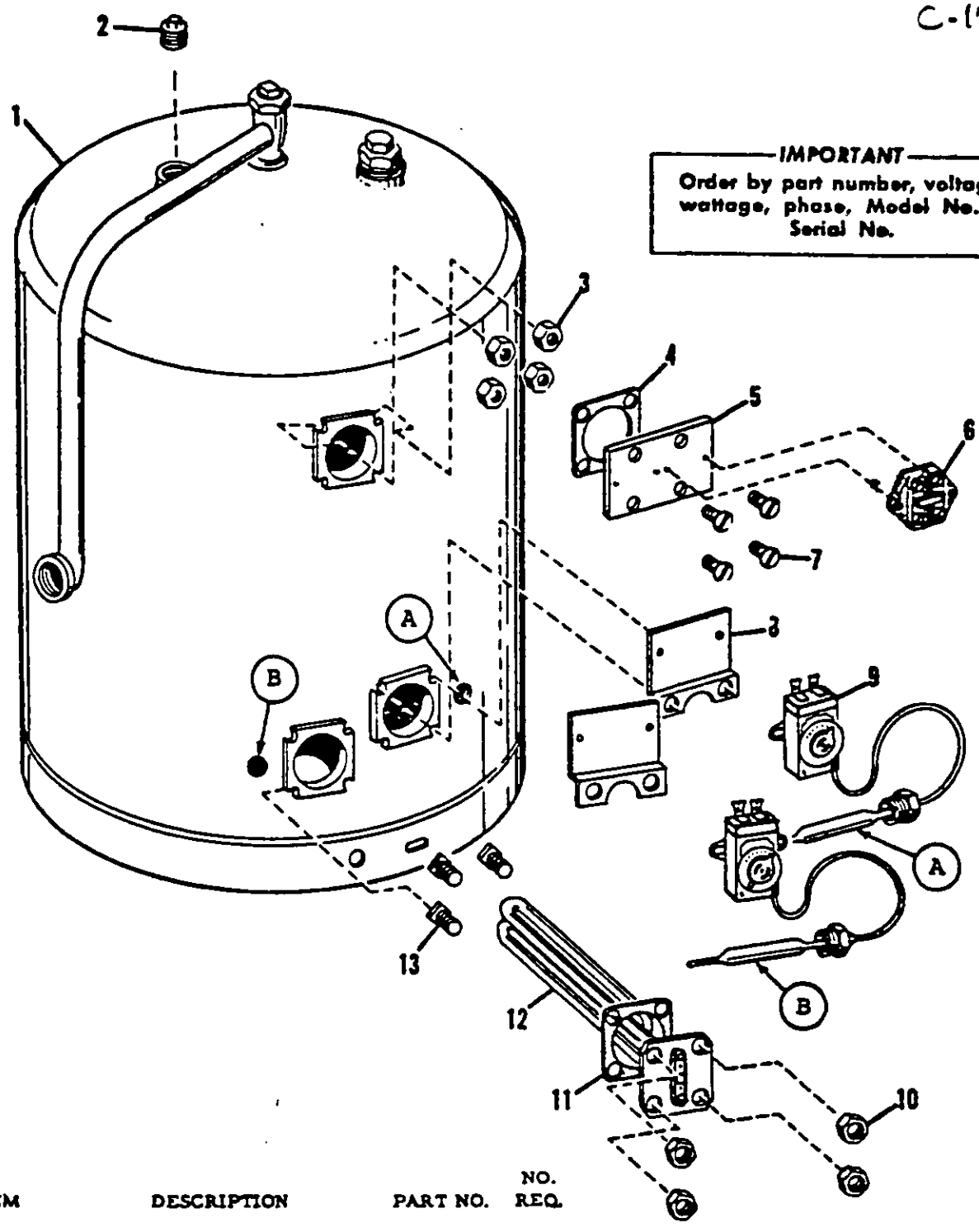


FIG. 12.1

HATCO ELECTRICAL SCHEMATIC



IMPORTANT

Order by part number, voltage, wattage, phase, Model No. & Serial No.

ITEM	DESCRIPTION	PART NO.	NO. REQ.
1	Tank, galvanized.....	GH1-373	1
	Tank, Castone (not shown)	HC1-172	1
2	3/8" Pipe Plug.....		1
3	ECO Mtg. Brkt. Nuts (3/8"-16 Hex Jam Nuts)		4
4	ECO Mtg. Brkt. Gasket.....	1-16717	1
5	ECO Mtg. Brkt.....	HC1-199	1
6	ECO High Temperature Limit Switch.....	HL-4934	2
7	3/8" - 16 x 3/4" Fl. Hd. MS.....		4
8	Thermostat Mtg. Brkt.....	HC1-136	2
9	Thermostats	S-5-12	2
10	3/8" - 16 Hex Nuts, cp.....		8
11	Element Gasket (1 per element) .	1-16717	2
12	Heating Element, Flange Type Booster Rating 6kw. Element Rating 3000 watt	TG2303-480 VOLT	2
13	3/8" - 16 x 3/4" Sq. Hd. cp MS (4 per element).....		8

FIG. 12.2A

HATCO PARTS LIST

Figure 12.2B
HATCO 16 GALLON WATER HEATER

ITEM	QTY	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1		16 Gallon Water Heater Complete 480 V 6KW 3Phase	HATCO		25B9008678	
2		ECO High Temperature Limit Switch	HATCO	HL 4934		
3		Thermostat	HATCO	S-5-12		
4		Element Gasket	HATCO	1-16717		
5		Heater Element 3KW, 480 Volt	HATCO	TG 2303 480 Volt		
6		Pressure/Temperature Relief Valve 125 PSI/210°F 3/4"	WATTS	100XL	23P6005954	
7		Vacuum Relief Valve 3/4"	WATTS	36A	23L9010715	
8		"Ogontz" Automatic Drain Valve	OGONTZ	PP 39FRH	23A9000040	
9		Water Heater Contactor "WHC" (Replaces Allen Bradley Contactor	GE	CR205C022	25E9011692	
10		Water Heater Contactor Coil 120 VAC	GE	150D21G22		
11		Water Heater Contactor Contacts	GE	546A301G2		
12		Transformer, Control	Micron	B-160BTZ13		
13		Fuse, for Transformer	Bussman	BBS-1		
14		Low Water Relay "LWR" 120 V Primary, 220 V Secondary	B&W	TYPE-L		
15		LWR Relay Water Probe Rod 316 SS RV	B&W	Rod 316SS PVC Insulator	25K9007995	
16		Thermometer/Pressure Gage 0-200 PSI, 60-200° .50 NPT	Marshaltown	FIG 107	23N9012942	

12.4 Insulation

Refer to Main Manual.

12.5 Water System Food Service Areas

N/A

12.6 Water Draining, Filling and Flushing Instructions

Refer to Main Manual.

12.7 Drawing List

Function	Drawing Number
Water Heater Electrical Schematic	D-04-440-Sht. 5A
Water Piping Schematic, 2900-41	D-03-442
2980-97	D-03-443

C-13-1
C-14-1
C-15-1
C-16-1

CHAPTER 13 Toilet Appointments

Refer to Main Manual

CHAPTER 14 MISCELLAENOUS EQUIPMENT

Refer to Main Manual

CHAPTER 15 PERIODIC INSPECTION AND MAINTENANCE SCHEDULES

Refer to Main Manual

CHAPTER 16 RETROFITS

Refer to Main Manual

Amtrak

Maintenance Manual G-79-6

Supplement

Section D

10400-03 Wheel Car

This book is meant as a supplement to the Amtrak Maintenance Manual #G-79-6. Most details of these cars are described in the main manual; things unique to these cars are described here in the supplement.

Figure 0.1
Maintenance Manual
Revisions

DATE	CHAPTER	PAGES	CHANGES

Table of Contents

PREFACE

CHAPTER 1 GENERAL

CHAPTER 2 CAR BODY

CHAPTER 3 HEATING AND VENTILATION

CHAPTER 4 LIGHTING

CHAPTER 5 COMMUNICATION SYSTEM

CHAPTER 6 ELECTRICAL SYSTEM

CHAPTER 7 BRAKE SYSTEM

Refer to Main Manual

CHAPTER 8 HANDBRAKE

Refer to Main Manual

CHAPTER 9 FOOD SERVICE EQUIPMENT

N/A

CHAPTER 10 Trucks

Refer to Main Manual

CHAPTER 11 COUPLER AND DRAFT GEAR

Refer to Main Manual

CHAPTER 12 WATER SYSTEM

N/A

CHAPTER 13 TOILET APPOINTMENTS

N/A

CHAPTER 14 MISCELLANEOUS EQUIPMENT

Refer to Main Manual

CHAPTER 15 PERIODIC INSPECTION AND MAINTENANCE SCHEDULES

Refer to Main Manual

CHAPTER 16 RETROFITS

Refer to Main Manual

CHAPTER 1 GENERAL

Page

i List of Illustrations

1.0 General

This manual is prepared for the 4 head end power wheel cars. Cars were modified in late 1981 at Amtrak facilities in Beech Grove, Indiana; engineering was provided by Equipment Engineering, Amtrak, Washington, DC.

The maximum operating speed for these cars is 105 MPH.

The cars were converted from diesel bagdorm cars. Unnecessary equipment was stripped, and the cars rewired for standard HEP train service.

Standard HEP Equipment Used:

1. Power trainlines, receptacles and jumpers.
2. 480 volt power junction box.
3. Communication trainline receptacles and jumpers.
4. Batteries and battery charger.
5. Conductors signal pushbuttons.
6. Marker lamps.
7. Circuit Breakers.
8. Truck Ground Straps.
9. Wire.

Since these cars will be used basically as unoccupied freight cars, they have minimal equipment.

Features Unique to These Cars:

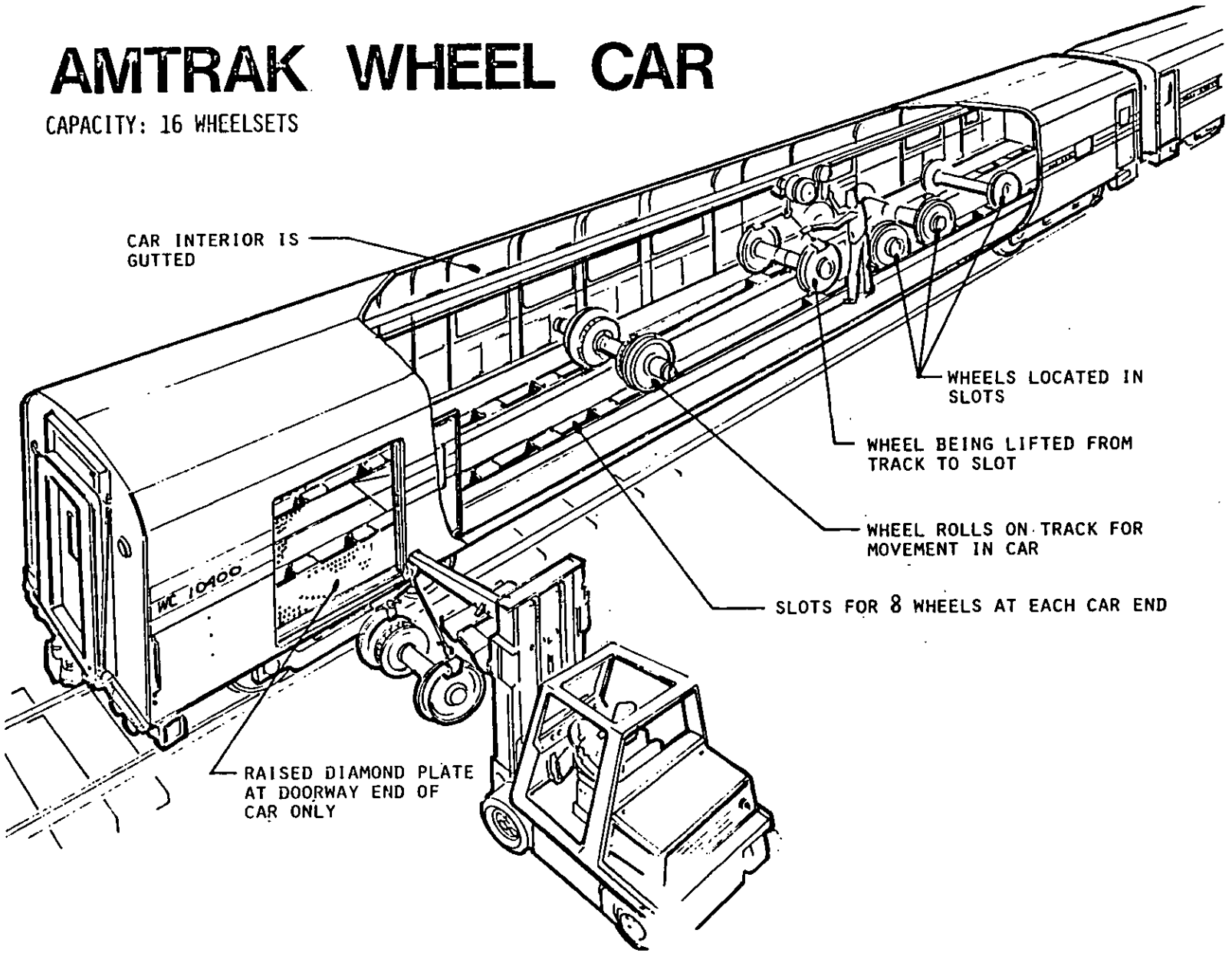
1. Wheel Hoist.
2. Electrical System (except std. 480 and 27 PT T/L).
3. Car lighting available from standby power, 230V-3Ø or 120-1Ø.
4. Electric and switch locker located in vestibule.
5. Can be coupled to Superliners or hi-level cars without modifications required.
6. No PA system.
7. No Loop Relays.
8. Looping procedure of 27 Point cable.
9. No Heating.
10. Transformers.

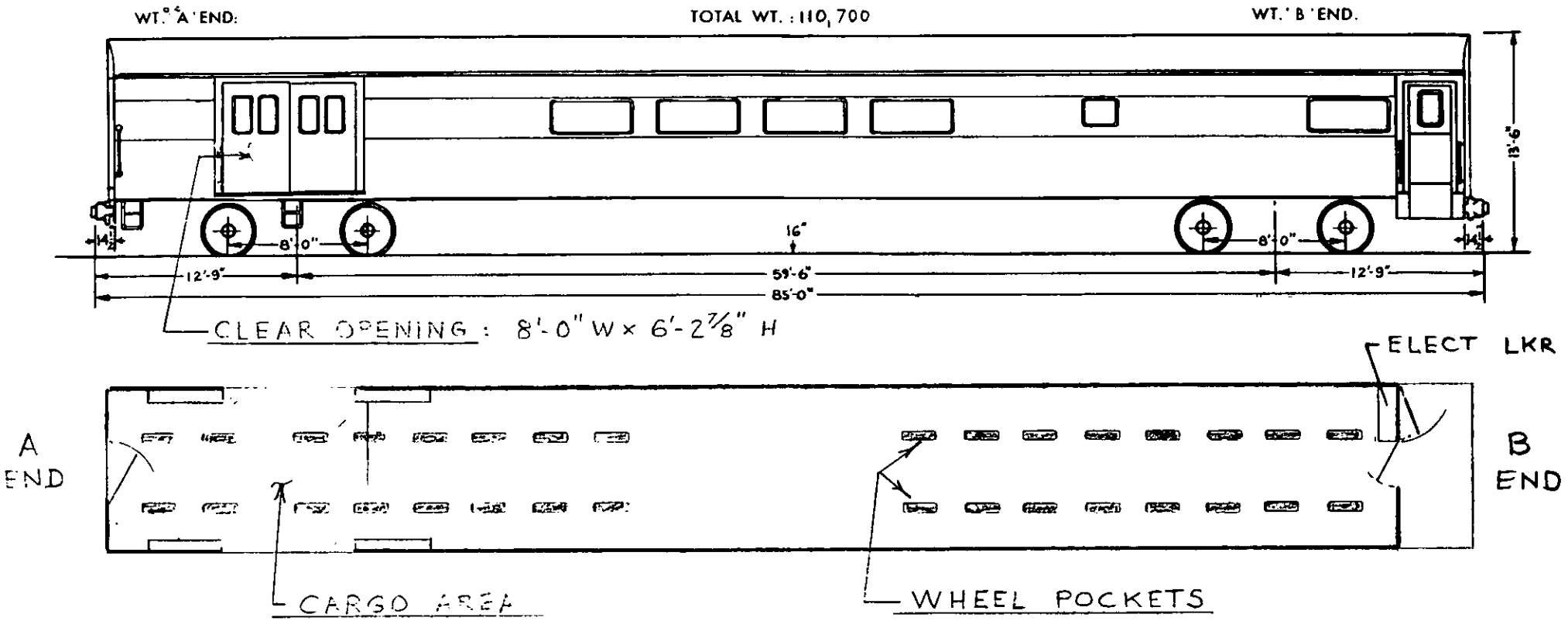
1.1 Car Numbers

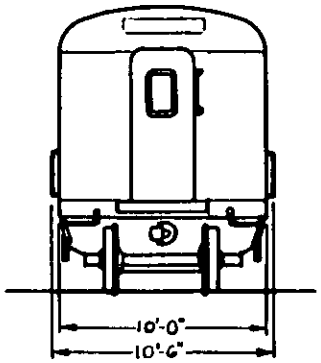
QTY	New HEP Number	Original Number	Year Built	Builder
4	10400-03	1400-28	1954	St. Louis Car

Figure 1.1

Conceptual View of Wheelcar







CARS 10400-03

TYPE WHEEL CAR

CAPACITY 16 WHEEL SETS

Figure 1.2

Floor Plan

CHAPTER 2 CARBODY

2.0 General

This chapter is meant as a supplement to Chapter 2 in the main manual, and describes items unique to these cars.

2.1 Structure

The carbody has been modified to accommodate the wheel car requirements:

1. Interior of car stripped.
2. Floor equipped with track to allow moving of wheels within the car.
3. Floor equipped with slots to hold wheels in position for shipping.
4. Diamond plate flooring installed at side loading doors to aid in loading/unloading.
5. Traveling hoist installed, overhead on lengthwise rail for wheel movement.
6. Electric locker moved to vestibule for easy access and increased cargo space.
7. Structural reinforcement to accommodate heavy wheel weight.
8. Sliding loading doors, one per side.

2.2 Faceplate and Diaphragms

The diaphragm and faceplate was removed from each end of the car to allow unrestricted coupling to Superliner and hi-level cars. In addition, this required covering the lifting lugs on each end of the car with a plate.

2.3 Doors

The car maintains the original body end doors and vestibule side doors. The cargo loading doors were enlarged from the original. The electric locker door is new.

2.4 Sash and Glazing

Car windows were maintained to give natural illumination to the car when power is not available, Emergency sashes are not used since the car is not occupied.

2.5 Vestibule Steps and Trap Door

The original steps and trap were maintained. Refer to main manual for details.

2.6 Trainlines and End Connections

2.6.1 Power Trainlines - 480 Volt

The power trainlines on these cars are the standard installation. Refer to the main manual for details.

2.6.2 Communication Trainline

The 27 point communication trainline is similar to the standard application except:

1. No brake applied and released pressure switches are used.

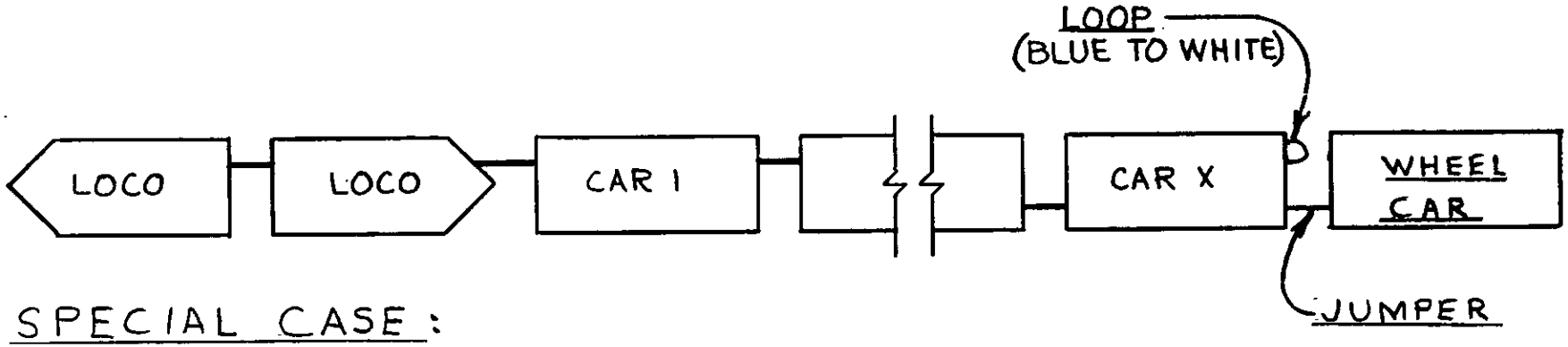
2. No loop relays are used.

Note: If a wheel car is the last car in the train, the 27 point trainline jumpers must be installed as shown in figure D-2.1.

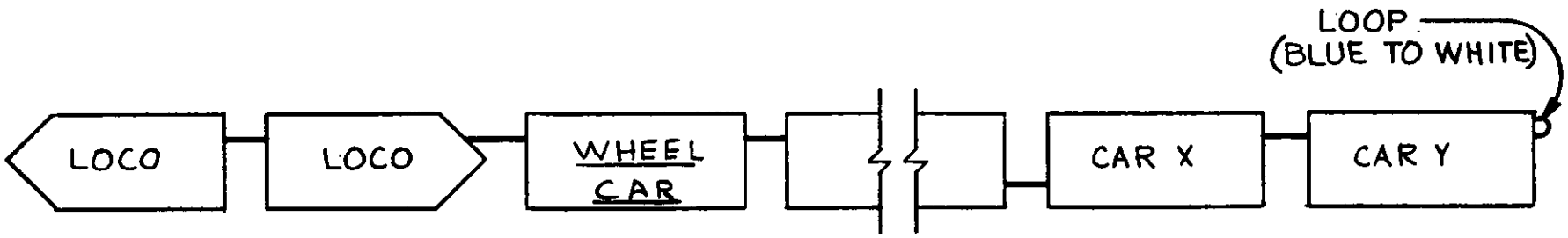
If the wheel car is used anywhere else in the train, normal jumper procedures should be followed.

2.6.3 Battery Trainline

The car is equipped with the standard battery trainline connections.



SPECIAL CASE:

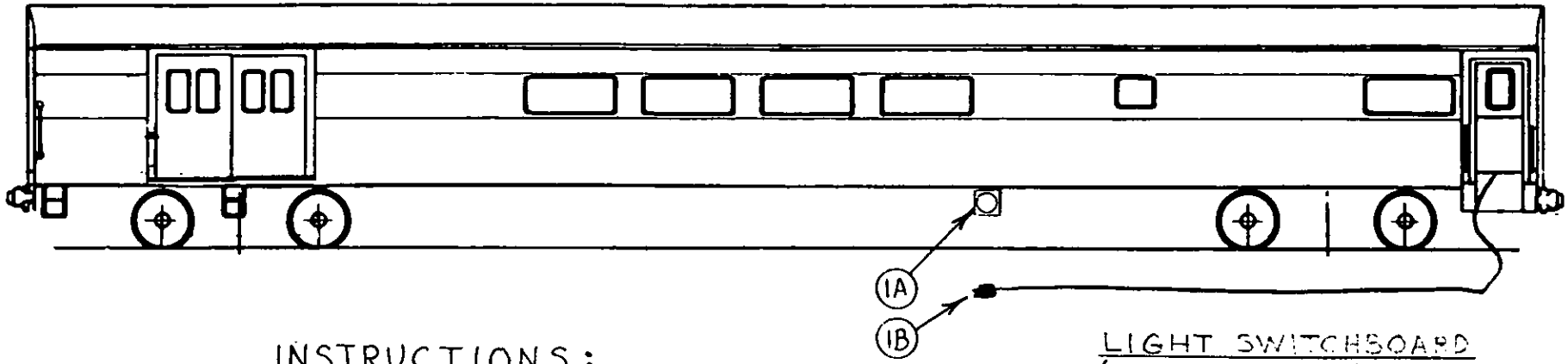


NORMAL CASE: ONE JUMPER BETWEEN EACH CAR, LOCOMOTIVE, AND CAR TO LOCOMOTIVE. JUMPER CAN BE ON EITHER SIDE OF CAR.

FIGURE 2.1

27 POINT COMMUNICATIONS CABLE CONNECTIONS

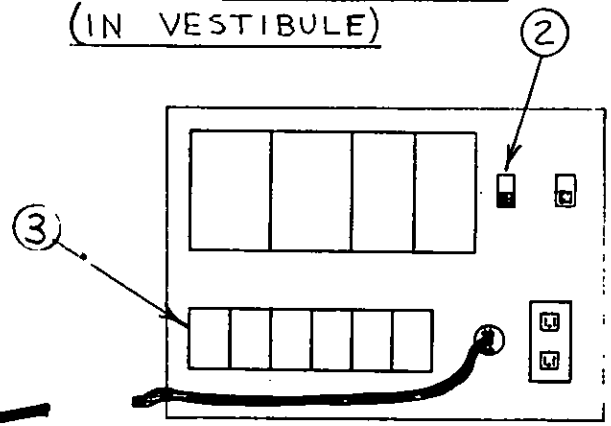
FIG 2.2 WAYSIDE POWER CONNECTIONS

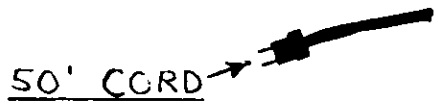


INSTRUCTIONS:

1. CONNECT CAR TO YARD POWER:
   - OR { A. 230 V STANDBY POWER.
   - OR { B. 120 V OUTLET (WHEEL CAR IS EQUIPPED WITH 50' CORD).
2. SELECT 230V OR 120V ON LIGHT SWITCH BOARD.
3. TURN ON CAR LIGHTS AS DESIRED.

LIGHT SWITCHBOARD (IN VESTIBULE)





ITEM	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1	Standby Receptacle	Pyle-National	KZPD-1056042R	25A9001666	
2	Standby Plug	Pyle-National	KBPD-107542R		
3	Receptacle, Male Twistlock	Hubbell			
4	Plug, Female Twistlock	Hubbell			
5	Plug, Male Twistlock	Hubbell			
6	Cable, (50 Feet) Type 50, 12 Gauge, 300V, 2 conductor	---	---	25P9004942	

2.6.4 Wayside Standby Power (see figure D-2.2)

230 V

The car is equipped with 2-230V standard wayside receptacles. By connecting yard power to either of these points, car lighting will be provided, as well as a 120V convenience outlet source.

120V

The car is also equipped with a 50 foot extension cord with 120V plug, stored in the electric locker. The car can also be lighted by connecting this cord to yard power.

2.6.5 64V Battery Standby

The car is not equipped with standby battery charging receptacles.

2.6.6 Brake System Trainlines

The car is equipped with standard brake trainline connections:

Main Reservoir
Brake Pipe

Refer to the main manual, Chapter 7 for further details.

2.7 Interior Furnishings

The interior of the car has been stripped. A traveling hoist has been installed to facilitate moving wheels within the car. Refer to figure D-2.3 for loading procedure, and Fig. D-2.4 for hoist instructions and part list.

DESCRIPTION	MANU.	MANU. #	AMMS #
Trolley Hoist, Low Head Room with Geared Trolley	McMaster-Carr (Coffing)	3313W25 AG6135	

Fig. D-2-3

Wheelcar Loading & Unloading Procedure (taken from SMP-25003)

I. PREPARATION

Step 1. Car Placement - Wheelcar should be placed in such a position that allows for safe access, including clearances, during all loading/unloading activities. The approach to the car should be level enough and without bumps to prevent the wheelset from slipping or "jumping" during loading/unloading.

Step 2. Select Property Forklift - Wheelsets are loaded/unloaded with special fork extension; therefore, the forklift selected for loading the wheelsets should be of sufficient size - taking into account the cantilever affect and the lifting height.

Step 3. Use Proper Number of Personnel - To assure the safe loading/unloading.

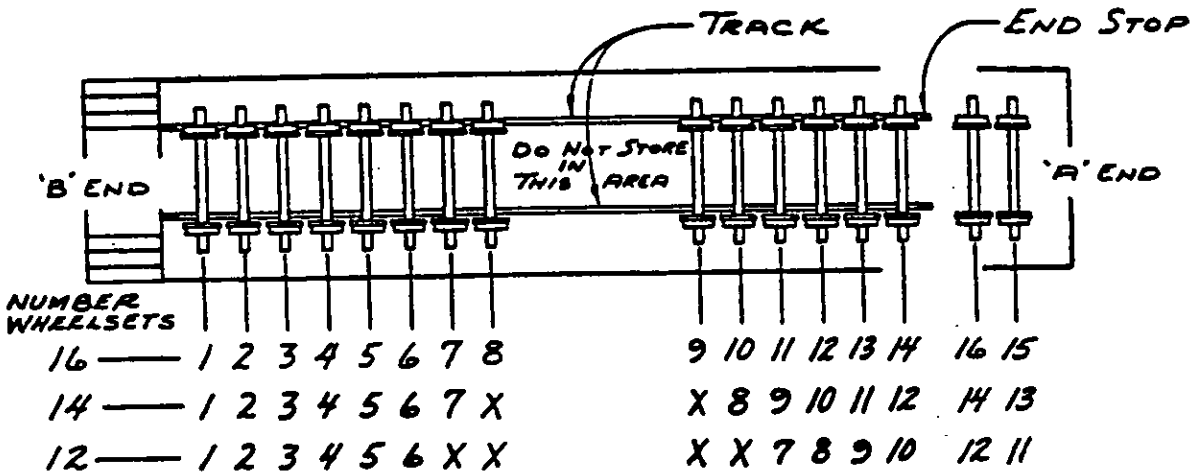
Step 4. Use Trained or Experienced Personnel - Be sure personnel selected know how to load/unload the car - if they have never done it - review the procedures - don't assume they know how to do it.

Step 5. Insure car is clean and free of debris. This will help prevent injuries from slipping and/or tripping.

Step 6. For loading: Be sure all wheel well covers are installed. Covers are to be removed only when wheelset is ready to be placed in wheel wells. Covers are supplied for wheel wells for the three end pair of wheels on A end of Car. (Loading End).

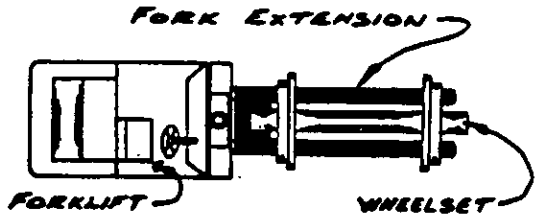
II. LOADING - WHEN TRANSPORTING WHEELSETS ONLY

Loading Sequence Diagram



Step 1. Place special fork extension on forklift. Be sure the extension is mounted over the forklift as far as it will go.

Step 2. Pick up wheelset in line with fork extension. (See diagram below.)



Step 3.0 Loading B (Vestibule) End and partial A End. Wheelsets 1 through 14 for 16 wheelsets.

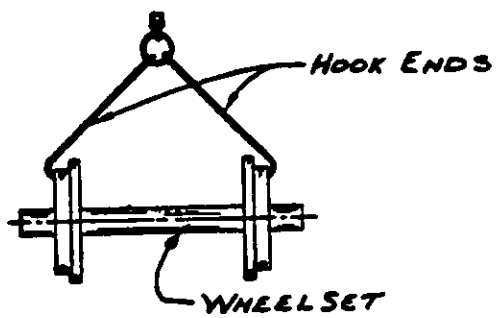
Step 3.1 Transport wheelset to car and place wheelset on track inside of car. Remove forks.

Step 3.2 Square wheelset with track by rolling wheelset against end stops. If this is not done the wheelset may be skewed and not roll readily or it may go off the track.

Step 3.3 Roll wheel slowly to position. Be sure overhead crane is well enough beyond position to avoid personal injury.

Step 3.4 Place overhead crane over center of wheelset axle.

Step 3.5 Place hook ends over and inside the wheelset wheels as shown.



Step 3.7 Raise wheelset enough to clear track and swing into position over wheel wells - lower wheel set into wheel wells - be careful to avoid having person in a position where swinging or falling set could cause personal injury. Remove crane hooks.

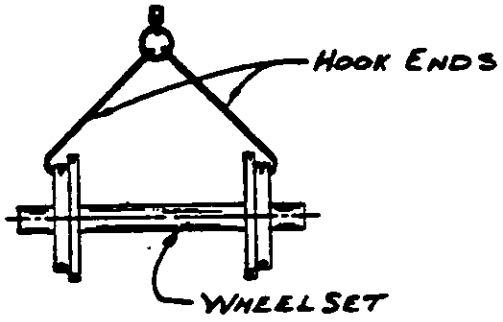
Step 4.0 Loading other wheelsets at A End - two wheelsets must be loaded at A End beyond track - sets number 15 & 16 as shown in loading sequence for 16 wheelsets.

Step 4.1 Transport wheelset to car and place inside car. DO NOT REMOVE FORKS.

Step 4.2 Remove wheel well covers to receive wheelsets - hang the covers in the appropriate place. (Covers only in A end Doorway area)

Step 4.3 Place crane over center of wheelset axle.

Step 4.4 Place hooks over and inside wheelset wheels as shown.



Step 4.5 Lift wheelset from forks.

Step 4.6 Remove forks from car.

Step 4.7 Move wheelset via crane to position over wheelwells.

Step 4.8 Lower wheelset into wheelwells. Remove hooks.

Step 5. Be sure equal number of wheelsets are at each end of car when loading is completed. (See loading sequence diagram.)

Step 6. After loading all wheelsets secure crane hooks.

Step 7. Be sure all material is adequately secured.

Step 8. Secure all doors.

NOTE: Nothing is to be loaded in the center area of the car; i.e., the space between the wheelset groups at each end of the car. (See loading sequence diagram).

LOADING PROCEDURES

1. Load equal quantities of same style of wheels at each end of car.
2. Always load heaviest wheels at ends of car with lighter wheels toward center of car.
3. What car has less wheels than capacity, equal weight should be at extreme ends of car.
4. Do not over load capacity.

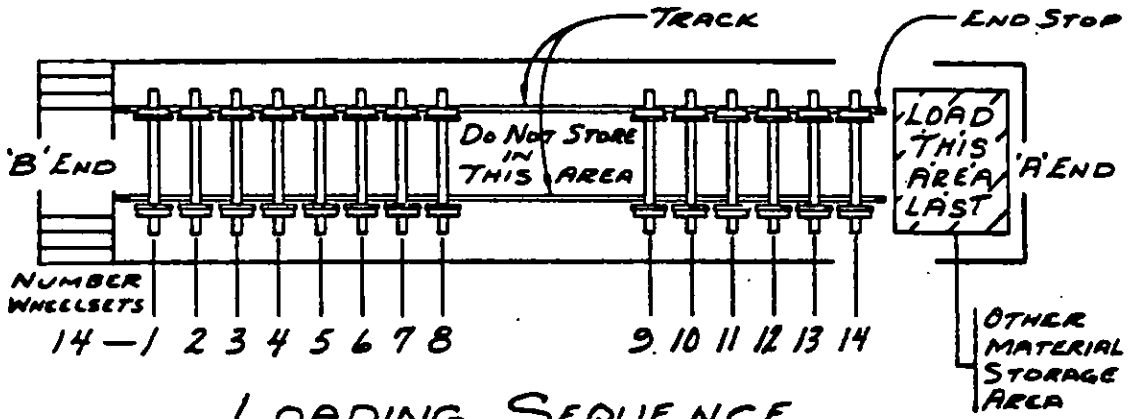
WHEEL WEIGHTS

Type	Weight	Total Wheels that may be loaded in kind
9115	3200	16
Amfleet	3500	16
9123	3700	16
Superliner	4000	16
F-40	4000	16
9083	4200	16
P-30	4500	14

Load Capacity - 68,000 lbs.

III. LOADING - WHEN TRANSPORTING WHEELSETS AND OTHER MATERIAL

Other truck components and certain materials can be transported via a wheelcar; however, careful consideration must be given to equal weight distribution at each end of the car. Material other than wheelsets can be transported only in the area as shown in the loading sequence diagram below.



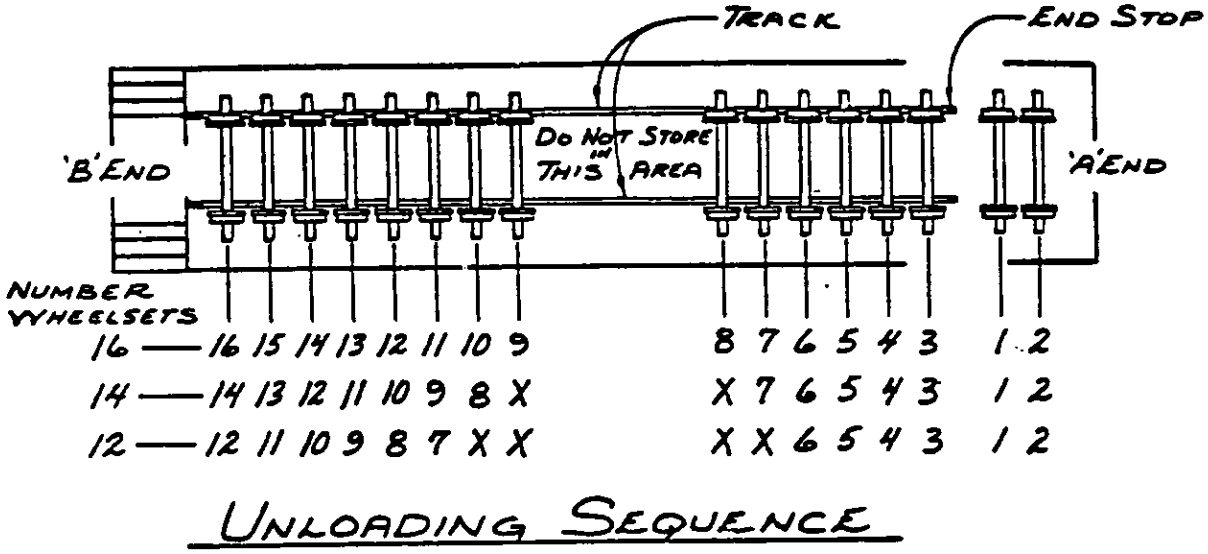
LOADING SEQUENCE

NOTE: When loading less than 14 wheelsets and other material, wheel wells left vacant will depend upon the number of wheelsets and the weight of the other material. The wheelcar must have the least concentration of weight toward the center of the car and the largest concentration of weight toward and/or over the car trucks - the total car load is to be equally distributed over the car trucks.

For correct method of loading wheelsets see Section I, Steps 3.1 through 3.7.

IV. UNLOADING - WHEN WHEELSETS ONLY ARE TRANSPORTED

Unloading Sequence Diagram.



UNLOADING SEQUENCE

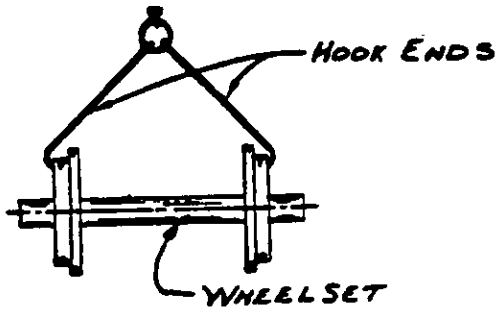
Step 1. Place special fork extension on forklift.

Step 2.0 Unloading wheelsets at A End - sets number 1 & 2 as shown in unloading sequence for 16 wheelsets.

Step 2.1 Place wheelset crane over center of wheelset axle.

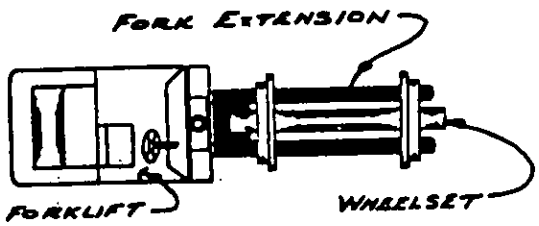
Step 2.2 Position fork inside car in such a manner to receive wheelset from crane.

Step 2.3 Place crane hook ends over and inside wheelset wheels as shown.



Step 2.4 Raise wheelset enough to clear wheel wells and move toward unloading position.

Step 2.5 Position wheelset over forks and lower wheelset onto forks as shown.



Step 2.6 Remove crane hook ends from wheelset.

Step 2.7 Clear crane from wheelset.

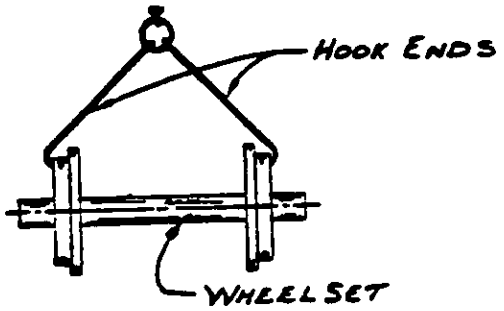
Step 2.8 Remove wheelset from car.

Step 2.9 Replace wheel well cover before unloading other wheelset. Covers are supplied for wheel wells for the three end pair of wheels on A end (Loading End).

Step 3.0 Unloading wheelset adjacent to track - (wheelsets 3 thru 14 for 16 wheelsets - see unloading sequence diagram for proper order of unloading.)

Step 3.1 Place crane over center of wheelset axle.

Step 3.2 Place hook ends over and inside wheelset wheels as shown.

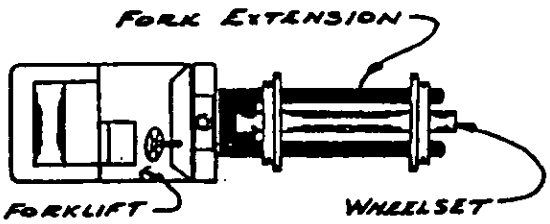


Step 3.3 Raise wheelset enough to clear track and swing into position over track - lower wheelset onto track - remove hooks.

Step 3.4 Roll wheelset slowly on track toward end stops at A End.

Step 3.5 Position wheelset in order for forklift to pickup and without causing damage to end stops or door area. Keep personnel sufficiently clear of wheelset and forks to prevent injury.

Step 3.6 Position forks in line with wheelset as shown and raise wheelset.



Step 3.7 Remove wheelset from car.

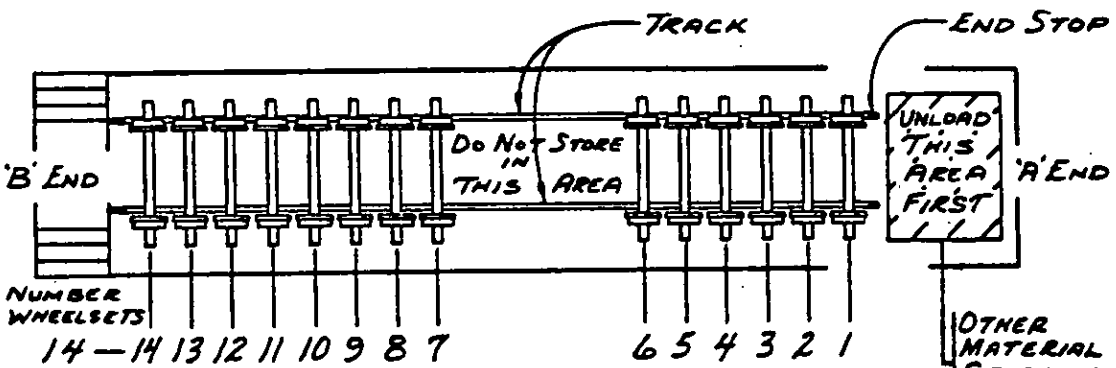
Step 3.8 Replace wheel well cover before unloading next wheelset.

Step 4. Secure crane hooks.

Step 5. Secure car doors.

V. UNLOADING - WHEN UNLOADING WHEELSETS AND OTHER MATERIALS

When unloading wheelsets and other materials, unload the other material first as shown in the unloading sequence diagram below.



UNLOADING SEQUENCE

For correct method of unloading wheelsets, see Section IV, Steps 3.1 through 3.8

Figure D-2.4

Traveling Hoist

Instructions and Part List

2.8 Safety Appliances

Refer to main manual.

2.9 Dead Heading

Refer to main manual.

2.10 Interior and Exterior Finishes

Refer to main manual.

2.11 Signs

Refer to main manual.

2.12 Drawing List

Drawing Function	Drawing #
Floor Plan	E-00-1425
Exterior Markings	X-002-5029
Loading Door	E-00-1423

CHAPTER 3 HEATING, VENTILATION AND AIR CONDITIONING

3.0 General

Since the car is an unoccupied car, it has no heating, ventilation nor air conditioning system.

CHAPTER 4 LIGHTING

4.1 General

The car is equipped with vestibule, ceiling and loading door lights, in addition to the standard HEP marker lights.

4.1.1 Power Source

Power for car lighting comes from either of 4 sources:

1. Head end power (via transformer)
2. Battery (charged from HEP)
3. 230V Wayside Power — See section
4. 120V Wayside Power — 2.6.4

4.1.2 Controls and Operation

All lighting controls are contained in the electric locker located in the vestibule. In normal operation, all circuit breakers except battery trainline should be on. Refer to figure 4.1.

The wayside voltage selector switch is used to select the voltage of wayside power from which the car is power when in the yard 230V 3 phase, or 120V single phase.

The marker light switch selects between A-end, B-end and OFF.

To lay up a car at the end of a run turn off ONLY the following circuit breakers:

1. Ceiling lights
2. Marker lights

4.1.3 Night Lights

N/A

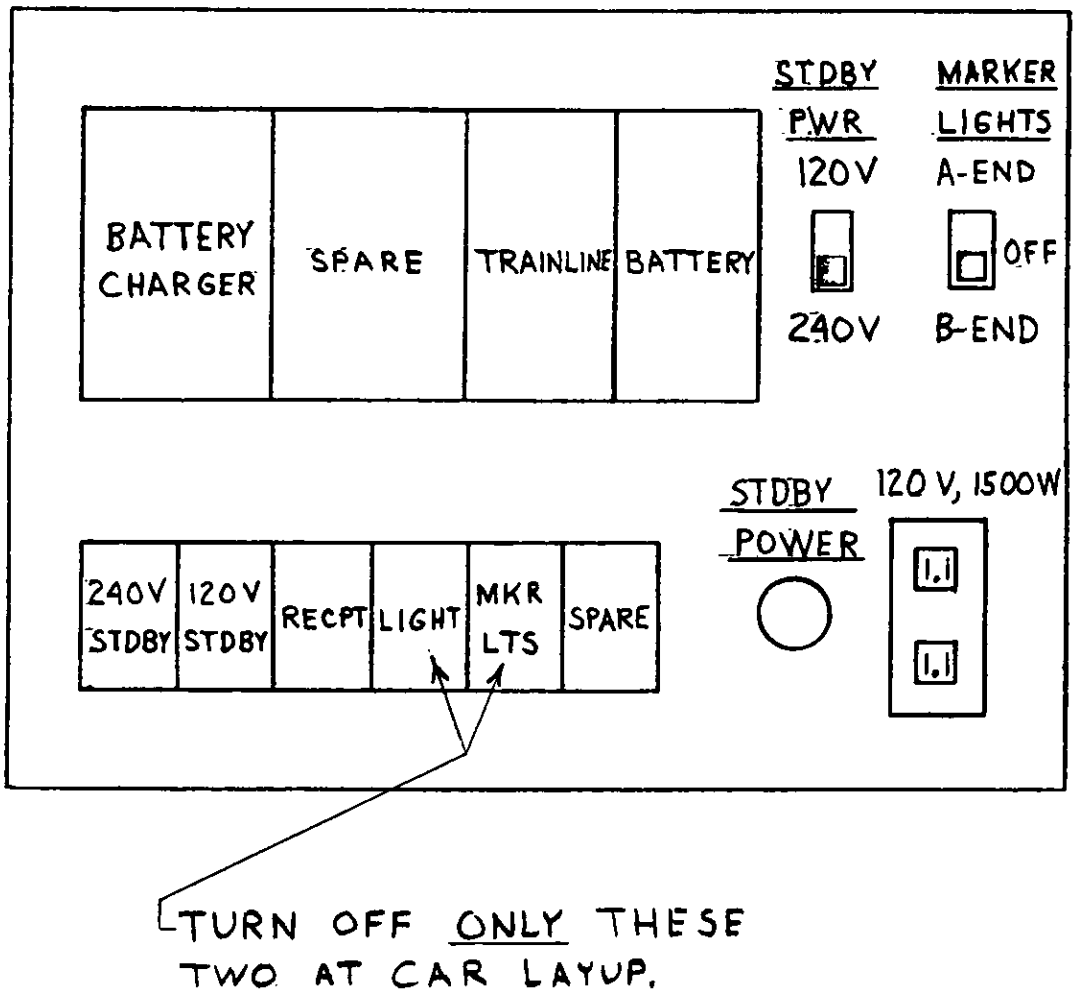
4.1.4 Emergency Lights

All car lighting will operate off the battery during a HEP outage. (Note, the battery gets charged only when HEP power is on, not from wayside 230 or 120V.

4.2 Lamp Schedule

QTY	TYPE	NOTES	USED FOR
4	60/PAR/2/R	Red	Marker Light
10	50W 80V A19	Inside Frosted	All Other Lights

FIG 4.1 LIGHTING SWITCHBOARD



4.3 Interior Fixtures

Interior fixtures are as follows:

#	LOCATION	MANU.	MANU. #	AMMS #
1.	Vestibule	Luminator	L6482	See Main Manual
2.	Ceiling	Kenall	3737	
3.	Locker	Translite	194550001	25A9003768
4.	Marker	Luminator	0103086001	25H9011540

4.4 Marker Lights

The car is equipped with the standard 4 marker lights with resistors and selector switch located in the electric locker. Refer to main manual for details.

4.5 Interior Consist Number Signs N/A

4.6 Exterior Consist Number Signs N/A

4.7 Switches

Two switches are used for lighting, both in the electric locker:

#	FUNCTION	TYPE	MANU.	MANU. #	AMMS #
1.	230/120V Selector	4PDT	Arrow Hart	80899	23K9012523
2.	Marker Light Selector	DPDT Center Off	Arrow Hart	80634	25A9002684

4.8 Convenience Outlet

One duplex convenience outlet is provided in the electric locker. It operates only when car is on Wayside Power and can provide 1500 watts.

4.9 Drawing List

Function	Drawing #
Electrical Schematic	SK-C-071681-1

CHAPTER 5 COMMUNICATION SYSTEM

5.0 General

The car is equipped with 2 standard conductor signal pushbuttons. Refer to main manual for details.

The car does not have loop relays, and accordingly requires a different 27 point jumper procedure than normal. Refer to section 2.6.2.

Since the car is unoccupied, it is not equipped with a PA system.

Drawing List

Function	Drawing #
27 Point Communication Schematic	SK-C-071681-2

CHAPTER 6 ELECTRICAL SYSTEM

6.1 General

Because the car is unoccupied, the electrical system is minimal. The trainline systems are essentially the standard HEP installation, while the rest of the system is unique to these cars. Nearly all electrical parts are standard HEP components; refer to the main manual for details.

All car lighting operates on 75V. If the car is on HEP mode the battery charger provides this voltage when HEP is available, or the battery if it is not. If the car is powered from wayside power, either 230 or 120 VAC, a transformer and variac provides 75 VAC to the lighting. A transfer contactor selects between HEP or standby power.

6.2 480 Volt Power Distribution and Cable System

The car uses the standard system - refer to main manual.

6.3 27 Point Communication Trainline

The car uses a system modified slightly from standard:

1. No loop relays
2. No dummy receptacles
3. No brake applied and released pressure switches

With these exceptions, the car is standard. Refer to main manual for details.

6.4 Battery and Charging System

Standard 64 Volt system - refer to main manual.

6.5 Transformers (See figure 6.2)

The car uses only 2 transformers, contained in the electric locker:

1. 240/120 to 120V at 2 KVA
   Used to convert 230V wayside into 120V for car use. Also used as an isolation transformer for the variac.
2. 120V to 75V Variac
   Used to provide 75 VAC to the car lighting from 120 VAC source. It is powered only when car is on wayside power.

ITEM	VOLTAGE	RATING	MANU.	MANU. #	AMMS #
1	120/240 to 120	2 KVA	GE	9T51Y32	
2	120IN,0-130 Out Variac	15 Amps	STACO	3PN1510	

6.6 Lighting Switchboard

The lighting switchboard is contained in the electric locker, accessed from the vestibule. Refer to figure 6.1. It consists of circuit breakers and switches for:

1. Ceiling lights
2. Marker lights
3. Convenience receptacle
4. 240 standby
5. 120 standby
6. Marker light selector switch
7. Wayside voltage selector switch

In addition, the panel is equipped with a duplex 120V convenience receptacle (1500 watt maximum) and a male receptacle for attaching the car to yard 120V power.

To lay up a car at the end of a run, merely turn off the following circuit breakers:

1. Marker light
2. Ceiling lights

6.7 Electric Locker

The electric locker, located off the vestibule, contains all car circuit breakers, switches and transformers. Refer to figure 6.2.

6.7.1 480 Volt Circuit Breaker Panel

The 480 Volt switchboard has 3 circuit breakers:

1. Battery charger (only 480V car load)
2. Battery trainline
3. Battery

The functions of these breakers is standard to all HEP cars. Refer to figure 6.1 for parts.

FIG 6.3 LIGHTING SWITCHBOARD

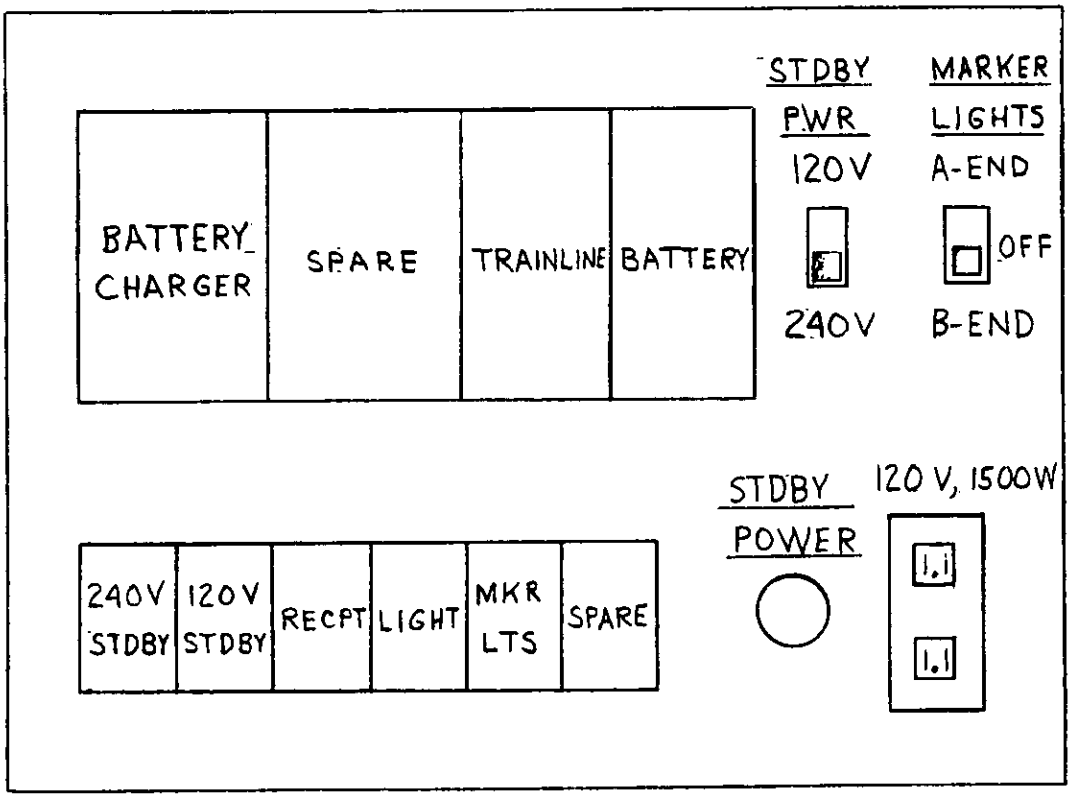


Figure 6.2A

ELECTRIC LOCKER COMPONENTS

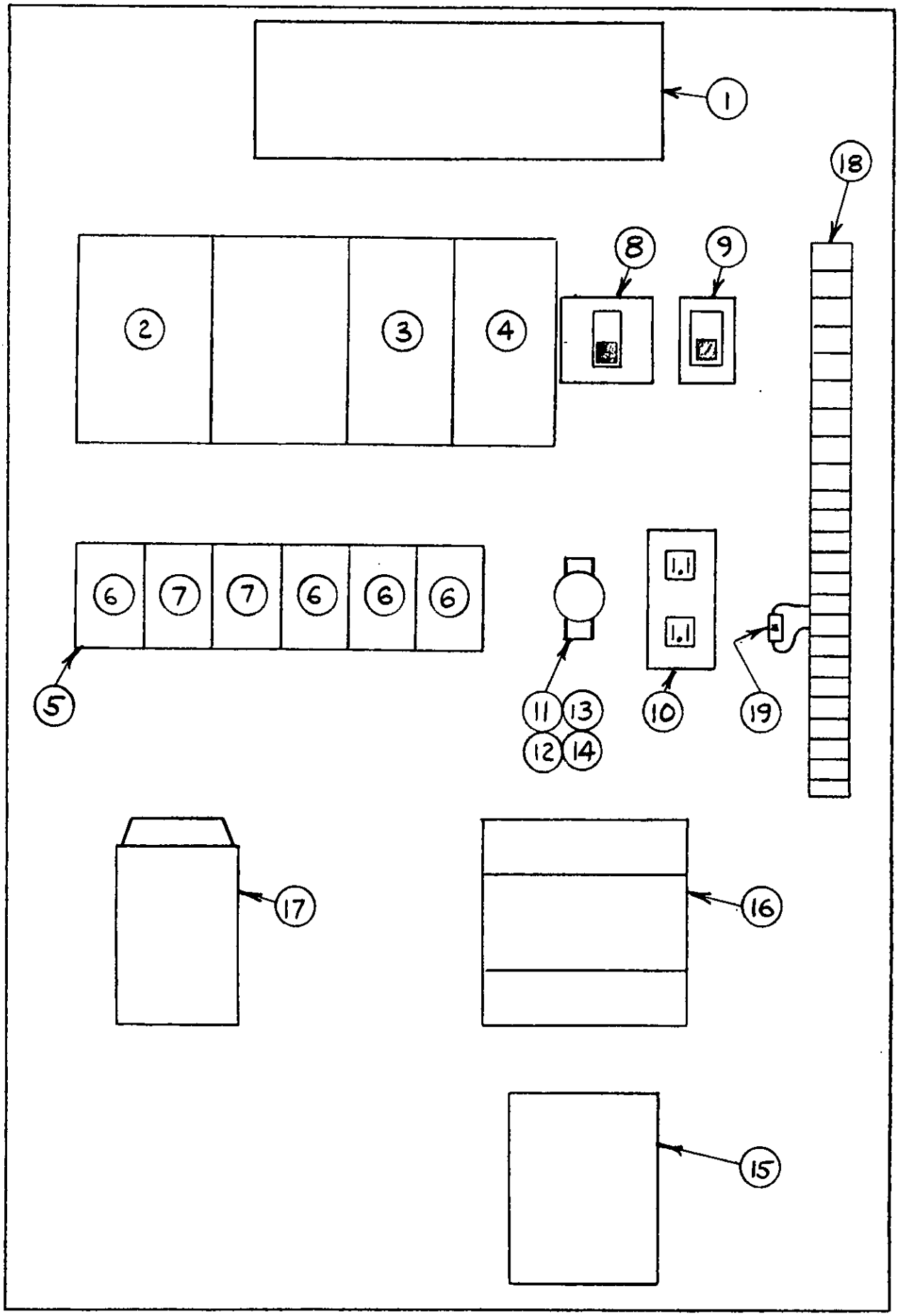


Figure 6.2B
ELECTRIC LOCKER PART LIST

ITEM	DESCRIPTION	MFG	MFG #	AMT #	AMMS #
1	Marker Light Resistor Panel	Shop	D-00-686	---	---
2	Circuit Breaker 10A 480V 3 Pole	Westinghouse	EHB3010	25X4010844	
3	Circuit Breaker 50A 240V 2 Pole	Westinghouse	EB2050	25H9009075	
4	Circuit Breaker 60A 240V 2 Pole	Westinghouse	EB2060	25L4010715	
5	Clip, Circuit Breaker Holddown	Westinghouse	624B100G14.	25X9010469	
6	Circuit Breaker 15A 240V 2 Pole	Westinghouse	QC2015-H	25H4010783	
7	Circuit Breaker 20A 240V 2 Pole	Westinghouse	QC2020-H	25D4010784	
8	Switch, Toggle, 4 PDT	Arrow Hart	80899	25K9012523	
9	Switch, Toggle, DPDT Center Off	Arrow Hart	80634	25A9002684	
10	Receptacle, Duplex	Bryant	GFR83	25L9012346	
11	Receptacle, Male Twistlock	Hubbell			
12	Plug, Female Twistlock	Hubbell			
3	Plug, Male Twistlock	Hubbell			
4	Cable, (50 Feet) Type SO, 12 Gauge, 300V, 2 conductor	---		25P9004942	
5	Transfer Relay, DPDT	Vapor	37741141	25H4013800	
	Transformer 240 x 120 to 120V 2KVA	GE	9T51Y32		
	"Variac" 120 to 0 - 130V 15 Amp	Staco	3PN1510		
	Terminal Block — Refer to Main Book, Section 6.1.2				
	Diode 6A, 800 PIV	International Rectifier	60S8	25H9008685	

6.7.2 Contactors

The car has only one contactor, TR1 which is used to connect car lighting loads to either 75VAC or DC. It is energized only when the car is on wayside power, at which time it supplies 75VAC to the lighting. Refer to figure 6.2.

6.7.3 A/C Starting Panel

N/A

6.7.4 Contactor and Overload Relay Maintenance

Refer to section 6.7.4 of the main manual for details.

6.7.5 E-5 Decelostat

N/A

6.7.6 Marker Light Resistor Panel

The car is equipped with the standard marker light resistor panel. Refer to section 6.7.6 of the main manual.

6.7.7 Annunciator Power Supply

N/A

6.8 Food Service Electric Locker Panels

N/A

6.9 Service Procedures

Refer to main manual for details.

6.10 Drawing List

Function	Drawing #
Electrical Symbols	D-04-414
480V Trainline Schematic	D-01-524
480V J-Box	E-00-1019
27 Point Communication Trainline	SK-C-071681-2
Single Line Schematic	SK-C-071681-1
Marker Light Resistor Panel	D-00-686
Car Wiring Schematic	
Overhead Conduit	
Undercar Conduit	

CHAPTER 7 BRAKE SYSTEM

Refer to Main Manual

CHAPTER 8 HANDBRAKE

Refer to Main Manual

CHAPTER 9 FOOD SERVICE EQUIPMENT

N/A

CHAPTER 10 TRUCKS

Refer to Main Manual

CHAPTER 11 COUPLER AND DRAFT GEAR

Refer to Main Manual

CHAPTER 12 WATER SYSTEM

N/A

CHAPTER 13 TOILET APPOINTMENTS

N/A

CHAPTER 14 MISCELLANEOUS EQUIPMENT

N/A

CHAPTER 15 PERIODIC INSPECTION AND MAINTENANCE SCHEDULES

Refer to Main Manual

CHAPTER 16 RETROFITS

Refer to Main Manual