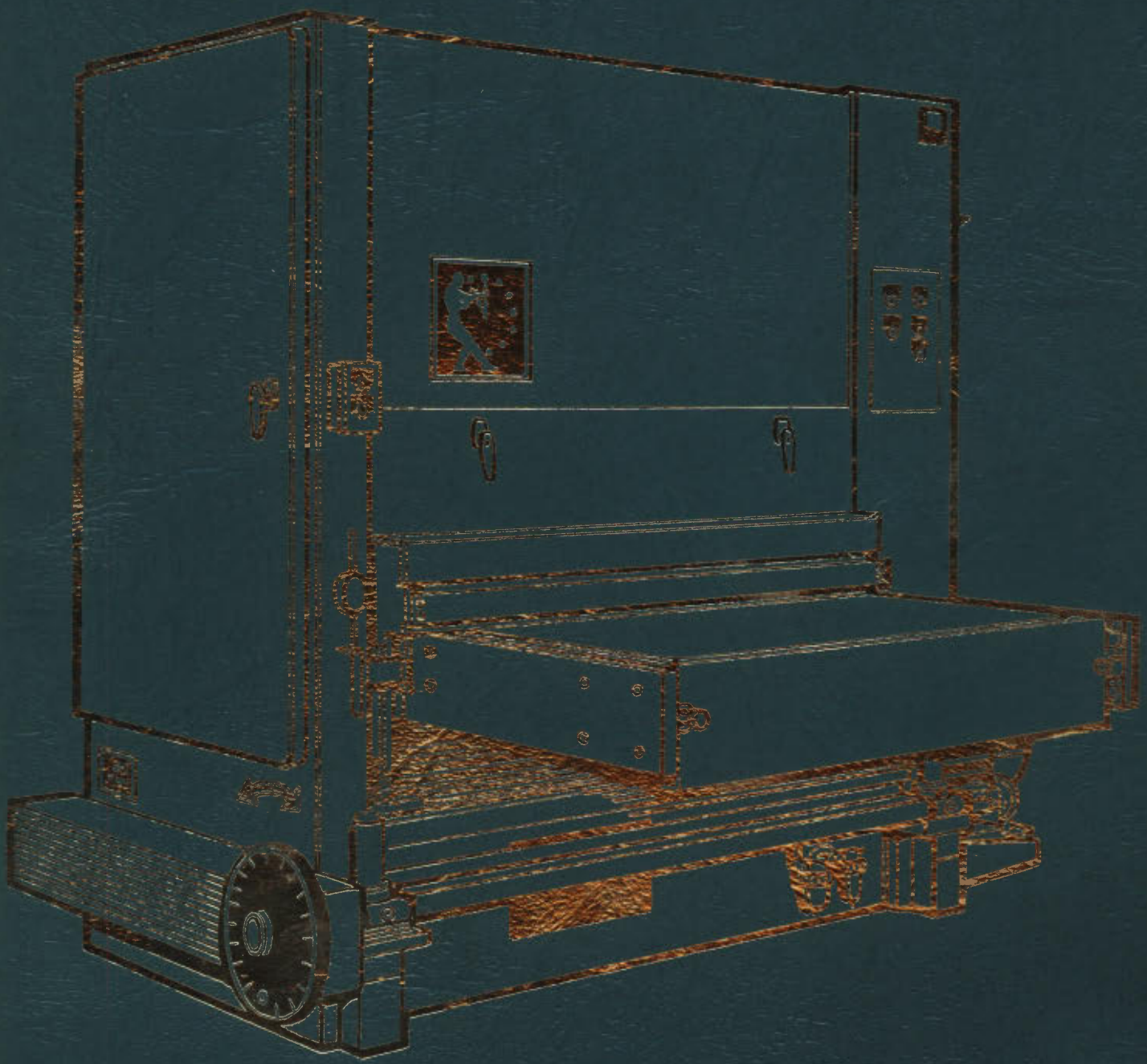
owners manual
500 series



TIMESAVERS, INC. 5270 Nelson Court • Minneapolis, Minnesota 55422
(612) 537-3611 • TELEX 29-0284 • Cable: TIMESAVERS

BUELL DOOR COMPANY
305 S. Haskell
Dallas, Texas 75226

MODEL 552-1 A
SERIAL NO. 6333
SHIPPED -

PARTS, SERVICE, ETC.
CONTACT:

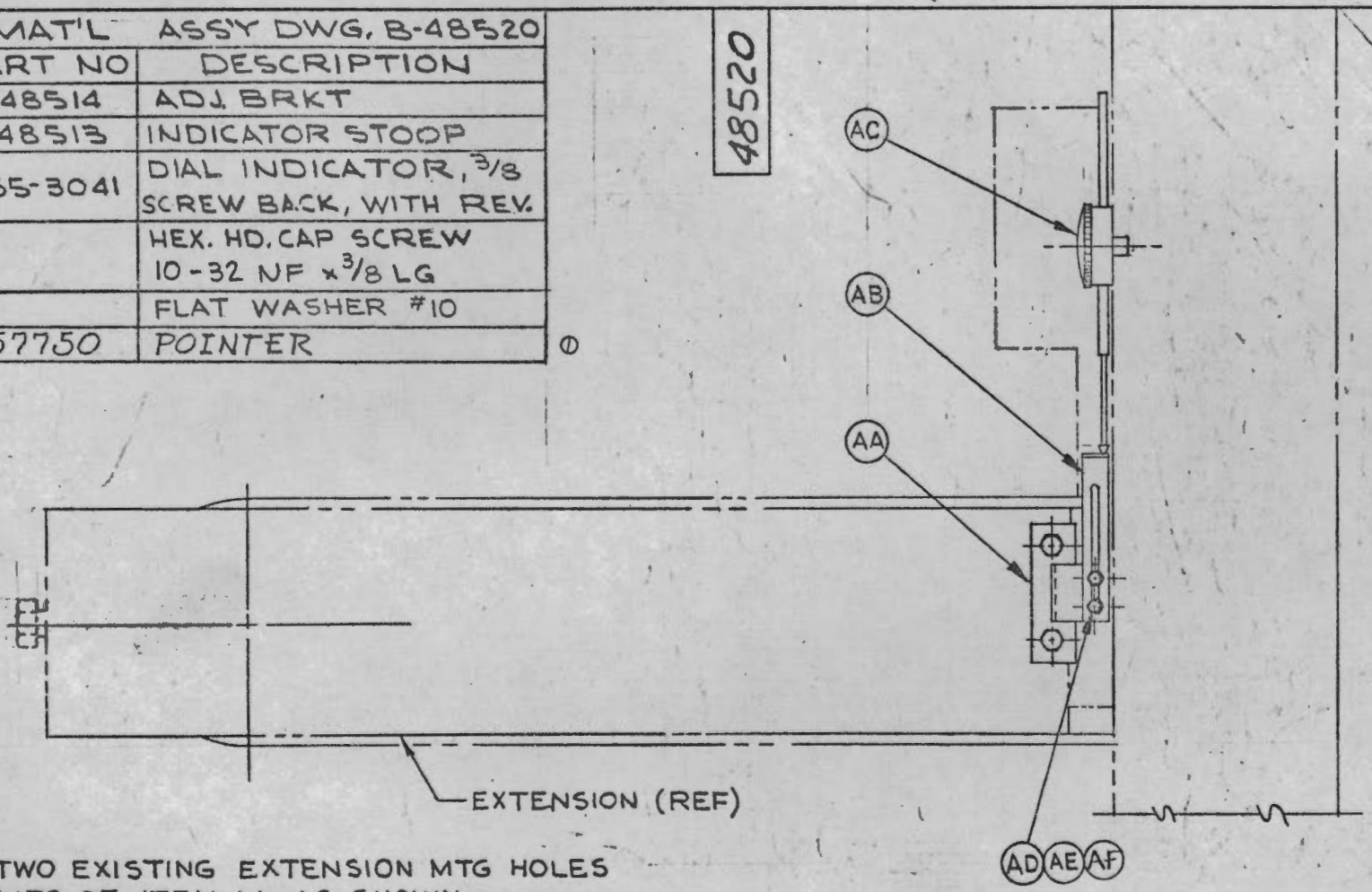
Service Dept. - Timesavers, Inc.
Minneapolis, Minn. 55422
612 - 537-3611

WHEN ORDERING PARTS, PLEASE
REFER TO MACHINE SERIAL NUMBER

BILL OF MAT'L ASS'Y DWG. B-48520

ITEM	QTY	PART NO	DESCRIPTION
AA	1	A-48514	ADJ. BRKT
AB	1	A-48513	INDICATOR STOOP
AC	1	*655-3041	DIAL INDICATOR, 3/8 SCREW BACK, WITH REV.
AD	2		HEX. HD. CAP SCREW 10-32 NF x 3/8 LG
AE	2		FLAT WASHER #10
AF	1	A-57750	POINTER ①

48520



NOTE:
USE TWO EXISTING EXTENSION MTG HOLES FOR MTG OF ITEM AA AS SHOWN

DO NOT SCALE DRAWING — WORK TO DIMENSIONS GIVEN

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B/M

WEIGHT:	
USED ON	TOP HEAD
CHANGE DATE	
SCALE	1/4
DRAWN BY	R. Knecht
DATE	2-23-72

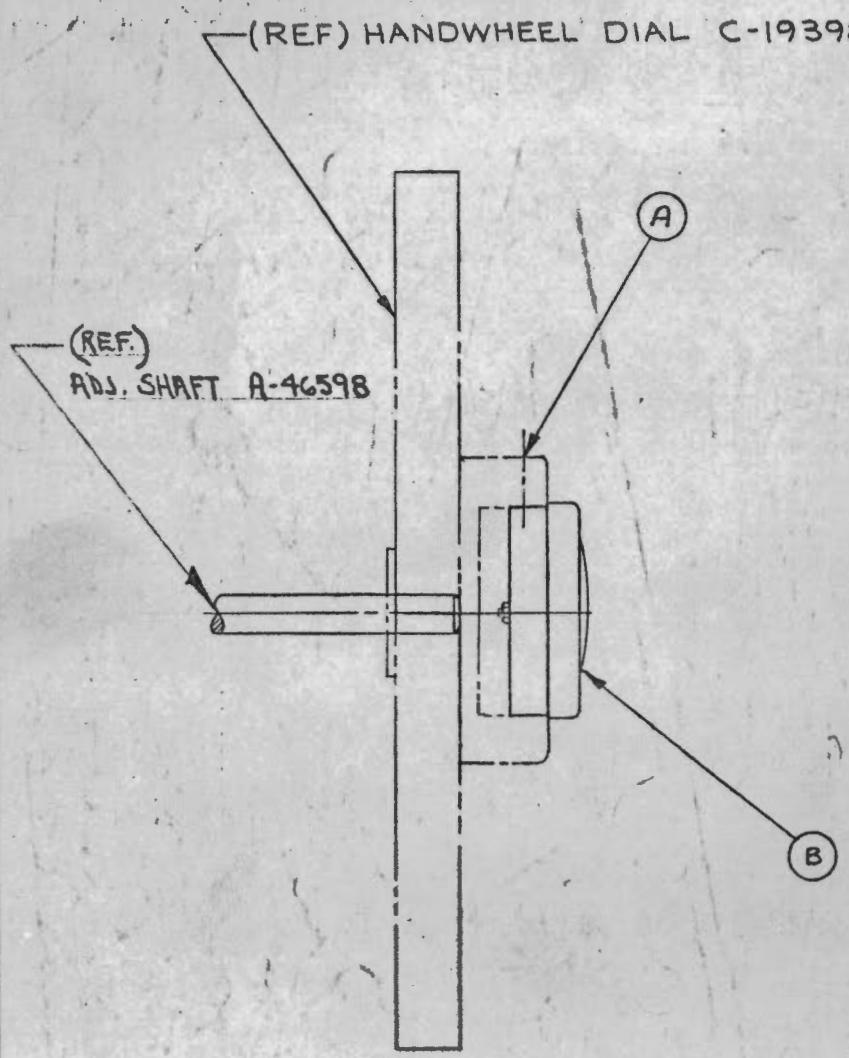
TIMESAVERS, INC.
5270 HANSON COURT
MINNEAPOLIS, MINNESOTA 55422

UWA 4-29-74
①ADDED AF" ECO #0254

REVISIONS	
MATERIAL	NOTED
EXCEPT AS NOTED:	
TOLERANCE	
FINISH	

DIAL INDICATOR ASSEMBLY

48520



49363

ITEM	QTY	DESCRIPTION	PART NO.
A	1	SOC SET SCR 1/4-20NC x 3/4 LG.	-
B	1	SIKO MECH INDICATOR	S80N/50-2 SD # 1000T

B/M

MICROFILMED 3-14-73

① HSG. BECAME PART OF HAND WHEEL

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WEIGHT:		
USED ON		REVISIONS
CHANGE DATE		MATERIAL
SCALE	1/2	EXCEPT AS NOTED:
DRAWN BY	HG	TOLERANCE
DATE	5-1-72	FINISH

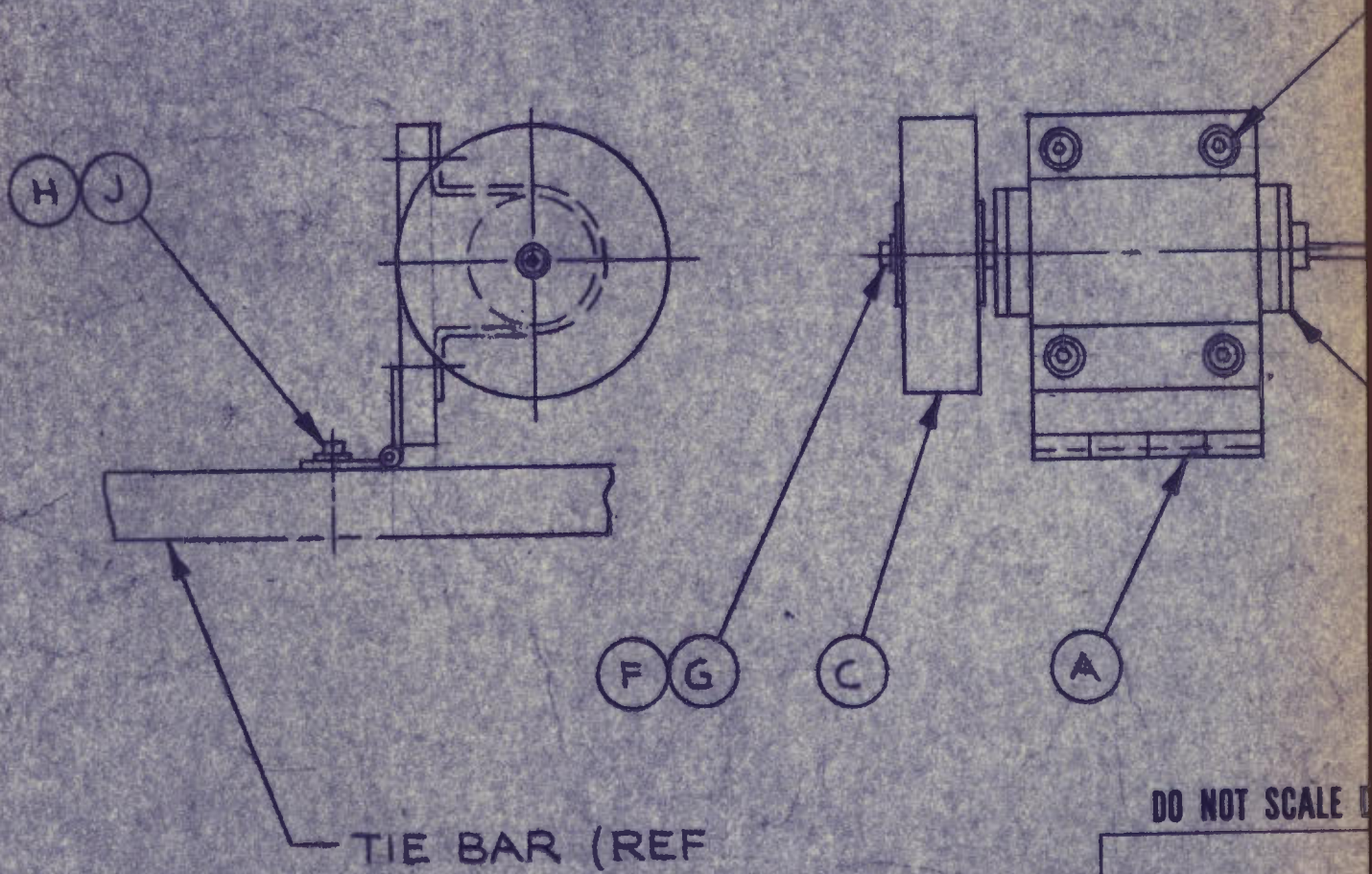
TIMESAVERS, INC.
5270 HANSON COURT
MINNEAPOLIS, MINNESOTA 55422

INDICATOR HOUSING ASSY

49363

BILL OF MATERIAL - ASSEMBLY DWG. NO. B-18751

ITEM	QTY.	PART NO.	DESCRIPTION
A	1	A-48752	Hinge base
B	1	A-32122	Modified tachometer 0-200 FPM
C	1	#RP-20	Garland rubber contact wheel
D	4		Socket head cap screw #10-32NF x 3/8 lg.
E	4		Lock washer #10
F	1		Round head cap screw #6-32NF x 3/8 lg.
G	1		Lock washer #6
H	2		Socket head cap screw 1/4-20NC x 3/8 lg.
J	2		Lock washer 1/4



DO NOT SCALE

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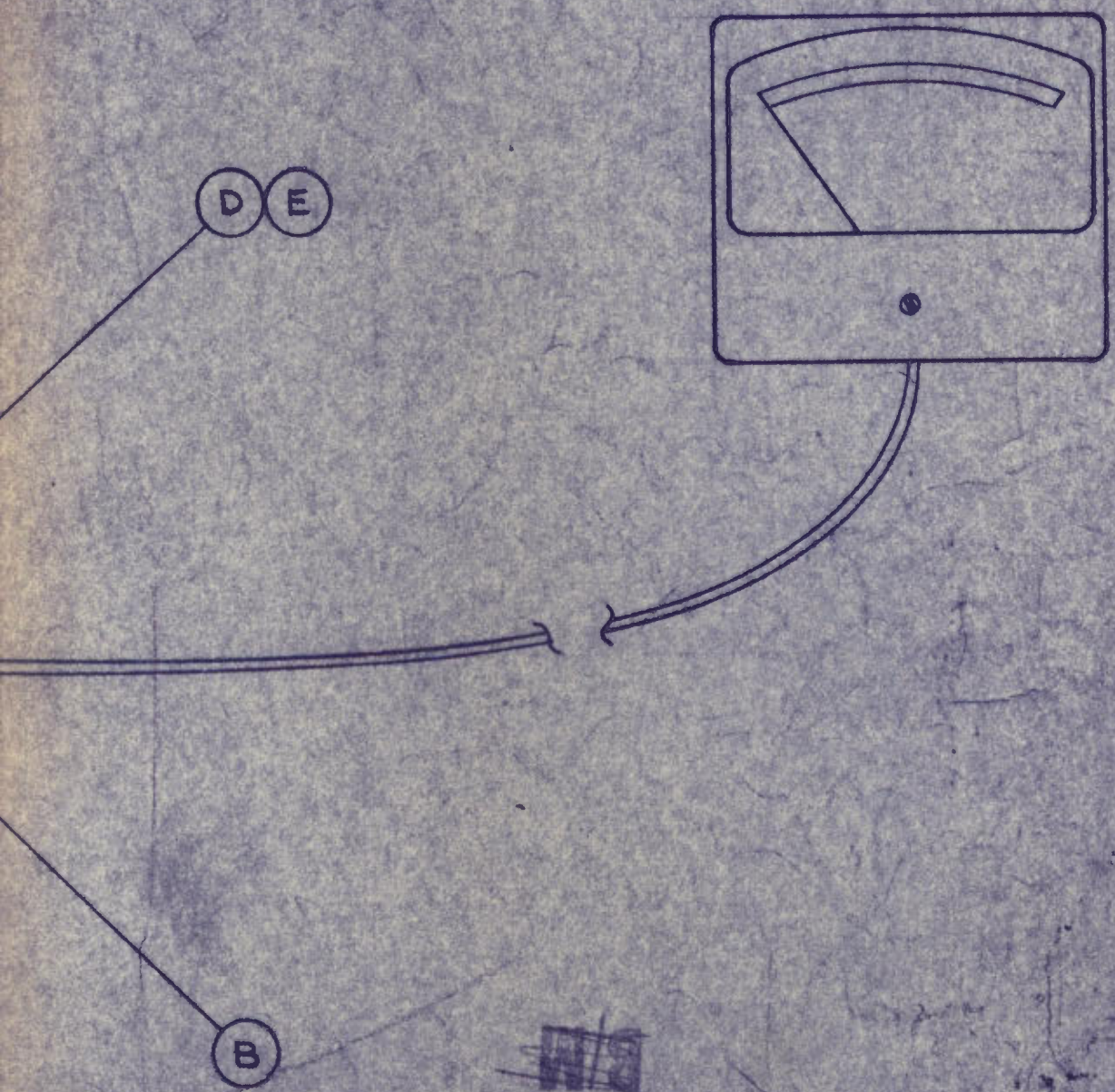
for any purpose,
request

48751



AWING — WORK TO DIMENSIONS GIVEN

NOTICE

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B/M

MICROFILMED

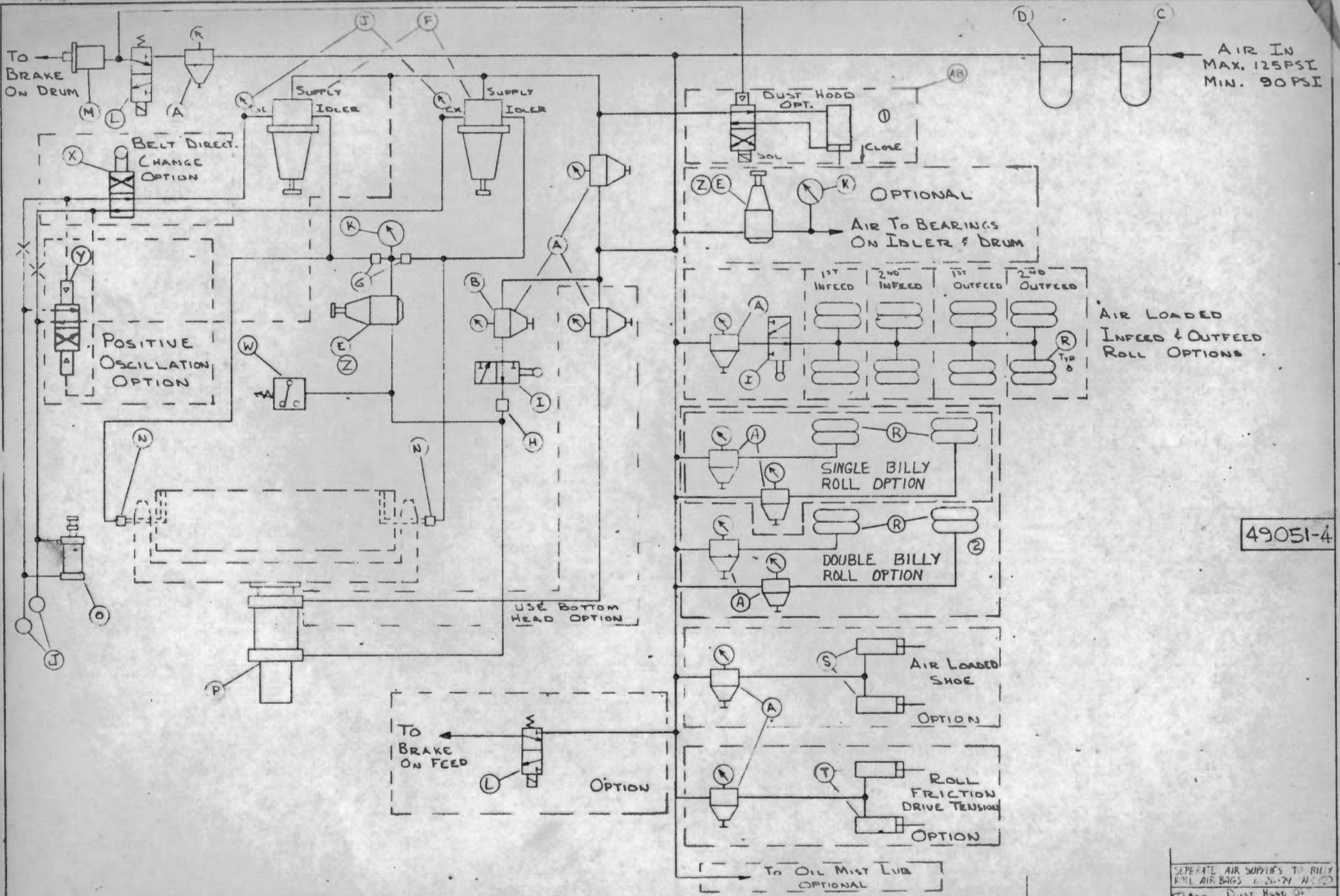
WEIGHT:		REVISIONS
USED ON		MATERIAL
CHANGE DATE		EXCEPT AS NOTED:
SCALE	1/2	TOLERANCE
DRAWN BY	HG	FINISH
DATE	3-14-72	

TIMESAVERS, INC.
5270 HANSON COURT
MINNEAPOLIS, MINNESOTA 55422

FEED SPEED INDICATOR ASSY

48751

-1, -2-3



49051-4

* THESE LINES OUT WHEN POSITIVE OSCILLATION USED CONNECT AS PER DOTTED LINES

DO NOT SCALE DRAWING — WORK TO DIMENSIONS GIVEN

NOTICE

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WEIGHT:	
USED ON	
CHANGE DATE	
SCALE	
DRAWN BY	GEH
DATE	4-23-73

TIMESAVERS, INC.
527 HANSON COURT
MINNEAPOLIS MINNESOTA 55422

SEPERATE AIR SUPPLIES TO BILLY ROLL AIR BAGS 6-26-74 HEG

① ADD. DUST HOOD OPT. 1-8-74 GEH

REVISIONS
MATERIAL
EXCEPT AS NOTED
TOLERANCE
FINISH

AIR DIAGRAM

49051-4

ENGR.	DATE	500 MODEL	CUSTOMER	SERIAL #	SHEET	BILL/MAT'L No.
SWAGGERT	3/11/74	552-1A	BUELL DOOR	6333	7 OF 7	

THE FOLLOWING ITEMS ARE OPTIONAL OR SPECIAL

PART No.	DESCRIPTION	QTY.	E	B	P	M	T
	PANEL BRUSH ASSY.						
C-48473	MOTORIZED LIFT ASSY.	1					
B-48751	FEED SPEED IND. ASSY.	1					
	COVER PLATE						
B-48520	DIAL IND. ASSY.	1					
	CONSTANT PASSLINE ASSY.						
	DRESSING TOOL ASSY.						
	RISER						
D-52462	ANTI-KICKBACK ASSY.	1					
	INFEED GUIDE SHOE						

ENGR.	DATE	500 MODEL	CUSTOMER	SERIAL #	SHEET	BILL/MAT'L No.
SWAGGERT	3/11/74	552-1A	BUELL DOOR	6333	6 OF 7	

PART NO.	DESCRIPTION	QTY	L	B	P	M	T
✓ D-57257	CENTER BAR ASSY.	1					
D-47867	CONTACT DRUM	1					
	DIA: 10¼ DURO: 57C						
—	DUST HOOD ADAPTOR						
P.	MOTOR: 125 HP. TEFC 405T FRAME 1800 RPM	REF.					
5V-9.00 P-80400-5-90	DRIVE BELTS (MATCHED SET)	10					
10-5V-14.0 P-80005-10-14	MTR SHEAVE REQUIRES P. BUSHING	1 **					
10-5V-9.0 P-80005-10-90	DRUM SHEAVE REQUIRES P. BUSHING	1 **					
✓ D-51178-2	INFEED SHOE ASSY.	1					
✓ D-48162-2	OUTFEED SHOE ASSY.	1					
4545 P-80314-54	VT BUSHING 3 3/8 B (MTR)	1 **					
3535 P-80312-47	VT BUSHING 2 15/16 B (DRUM)	1 **					

ENGR.	DATE	500 MODEL	CUSTOMER	SERIAL #	SHEET	BILL/MAT'L No.
SWAGGERT	3/1/74	552-1A	BUELL DOOR	6333	5 OF 7	

PART NO.	DESCRIPTION	QTY	L	B	P	M	T
P-	CONV. BELT: APPROX 55 DURO 9/32 THK T5 225, ENDLESS 52" WIDE x 198 LG	1 **					
C-56310	FEED DRIVE ASSY.	1					
C-55779-1	JACK ASSY.	2					
D-56300	CONVEYOR BED ASSY.	1					
C-48307	EXTENSION ASSY.	1					
—	CONVEYOR BRUSH ASSY.	1					
53967	HYDRAULIC BASIC MACHINE ASSY.	1					
D-31902-41	HYDRAULIC RESERVOIR ASSY.	1					

CUSTOMER BUELL DOOR MODEL: 552-1A S/N 6333

QTY.	ITEM	DESCRIPTION
1	1	Power Pack 50-Gal. #D-31902-41
1	2	10 HP, 1800 RPM, FR. 215T
1	3	Vickers pump #PVB 10RSY-30-CC-10
1	4	Vickers check #DT8P1-06-65
1	5	Vickers air bleed #ABT-03-10
1	6	Parker hyd. motor #810EP1UUAA
1	7	Flow Ezy #50-1 1/2-100-RV/3
1	8	Char-Lynn #1F30-3-15
1	9	Worchester ball valve # 3/4-444YB
1	10	Christy fluid filled gauge 2000 PSI
1	11	Lovejoy coupling #L-110 c/w 1 3/8 B & 7/8B
1	12	Parker #20-16F50G5-S
1	13	Parker #16-3/4 F50G-S
1	14	Blk pipe nipple 3/4 x 6
1	15	Blk pipe nipple 3/4 x 4
1	16	Blk pipe nipple 1-1/4 x 3
1	17	Blk pipe nipple 1-1/4 x close
1	18	Blk 90° elbow 3/4
1	19	Blk reducer bushing 1/4 x 1/2
1	20	Blk reducer bushing 1-1/4 x 3/4
2	21	Imp. East. tee #25VJ-12
3	22	Imp. East. nipple #25SA-12
1	23	Imp. East. reducer #25SB-12x04
1	24	Imp. East. reducer #24SB-12x06
1	25	Imp. East. nipple #24SA-06
4	26	Imp. East. adapter #60TA-12x12
2	27	Imp. East. adapter #60UA-04x04
2	28	Imp. East. reducer #24SB-16x12
1	29	Imp. East. elbow #769FS-1/2
1	30	Imp. East. connector #768FS-3/8 x 1/2
1	31	Blk 90 reducing elbow 1-1/2 x 1-1/4
1	32	Hose assy #J4-HA12-12MB x 12 MB x 96"
1	33	Hose assy #J4 -HA12-12MB x 12MB x 96"
1	34	Hose assy #R7-HA04-04MB x 04MB x 96"

QTY.	ITEM	DESCRIPTION

WEIGHT:

USED ON	C-35004-16	REVISIONS
CHANGE DATE		MATERIAL
SCALE		EXCEPT AS NOTED:
DRAWN BY	GEH	TOLERANCE
DATE	2-28-74	FINISH

TIMESAVERS, INC.
MINNEAPOLIS 22, MINNESOTA

HYDRAULIC PARTS LIST

6333

CUSTOMER BUELL DOOR MODEL: 552-1A S/N 6333

QTY.	ITEM	DESCRIPTION
3	A	Watts regulator #364-2G
1	B	Watts mounting nut #163Y51
1	C	Watts filter #602-3MD
1	D	Watts oil removal filter #604-4
1	E	Moore regulator #41 1/8 IPS
2	F	Timesavers relay #B-23015
2	G	Weatherhead #3325X2 w/ .042 orifice
1	H	Weatherhead #11003175 w/ .089 orifice
1	L	Pneu-trol slide valve #SL-10
1	J	Gage 2" face 200 PSI
1	K	Gage 2" face 15 PSI
1	L	Bellows valve #K055-1-005 115V
1	M	Mico booster #12-021-025
2	N	Rotary joint #A-25850
1	O	Tracking cylinder #B-23395-1
1	P	Tension cylinder #D-47235
1	W	Barksdale pressure switch #E11H-H190
1	Z	Regulator mounting bracket #A-TOP-819
1		Air panel #C-55129
1	AB	ALLEN AIR #AV-2x2-3VS-E-APR-PK
		Brake On Feed Option
0	L	Bellows valve #K055-1-005 115V
		Oil Mist Option
0	U	See electrical diagram
		Air to Bearing Option
0	E	Moore regulator #41 1/8 IPS
0	K	Gage 2" face 15 PSI
0	Z	Regulator mounting bracket #A-TOP-819
		Air Loaded Infeed Option
0	A	Watts regulator #364-2G
0	R	Firestone Airide #16
0	I	Pneu-trol slide valve #SL-10
		Air Loaded Outfeed Option
0	R	Firestone Airide #16
		Air Loaded Billy Roll Option
0	A	Watts regulator #364-2G
0	R	Firestone Airide #16
		Air Loaded Shoe Option
0	A	Watts regulator #364-2G
0	S	Starz cylinder #5DW2
		Roll Friction Drive Option
0	A	Watts regulator #364-2G
0	T	Allen-Air cylinder, Type A 2" B. x 3" B. c/w #245 clevis
		Belt Direction Change Option
0	X	Barksdale valve #9021-M
		Positive Oscillation Option
0	Y	Bellows valve #P084-2015
		Bottom Head Option
0	A	Watts regulator #364-2G

USED ON	C-49051-4	REVISIONS	
CHANGE DATE		MATERIAL	
SCALE		EXCEPT AS NOTED	
DRAWN BY		TOLERANCE	
DATE		FINISH	

TIMESAVERS, INC.
MINNEAPOLIS 22, MINNESOTA

AIR PARTS LIST

6333

CUSTOMER: BUELL DOOR MODEL: 552-1A S/N 6333

QTY.	SYMBOL	DESCRIPTION
1	MTR-1	150 HP, 1800 RPM, TEFC, motor FR# 445T 230-460/3/60, 80DBA
1	MTR-2	10 HP, 1800 RPM, TEFC, motor FR# 215T 230-460/3/60
1	MS-1	A.B. Starter 709- F0D103
1	MS-2	A.B. Starter 709- B0D103
1	PT-1	Transformer 500 VA
1	TR-1	A.B. Timer 700-NT400-A1
1		ISI Load Indicator- Converter #11483
2		Marathon Fuse Block 6F30A3
1		Marathon Fuse Block F30A1S
1	PS-1	Barksdale Pressure Switch E1H-H90
1	SOL-1	Bellows Valve #K055-1-005 115V
2	LS-1,2	Micro Switch #BAF12RN18 LH
1	PB-1	A.B. Push Button 800T-D6A
1	PB-2	A.B. Push Button 800T-B6B
1	SPB-4	A.B. Sel. PB 800T-KE2A
1	PB-5	A.B. Push Button 800T-B6D2
2	PB-3,6	A.B. Push Button 800T-A2D1
1	SOL-3	ALLEN AIR #AV-2x2-SVS-E-APR-PK
1		P.B. Panel B-30983-2
1		Electrical Panel C-49299
3	FU-1	Buss Fuse FRS-30
3	FU-2	Buss Fuse FRS-8
1	FU-3	Buss Fuse FRN-5
1		Push Button Enclosure A-48552
1		Push Button Cover A-48553

QTY.	SYMBOL	DESCRIPTION
		(Brush Option)
0	MS-3	A.B. Starter 709- T0D103
0	MTR-3	1-1/2 HP 1800 RPM, TEFC motor FR# 145T 230-460/3/60
		(No-Go Option)
0	LS-4	Micro Switch H.S19
0	CR-1	A.B. Relay 700-N200-A1
0	PB-5,6	A.B. Contact Block 800T-XD2
0	SOL-3	Bellows Valve K055-1-005-115V
		(Lift Option)
2	PB-7,8	A.B. Push Button 800T-A2A
1	MTR-4	3/4 HP 1800 RPM, TEFC motor FR# 56C 230-460/3/60
1	MS-4	A.B. Starter 705-T0D103
2	LS-5,6	Micro Switch H.S19
1		Hoffman E2PB
		(Special Belt Break Option)
1	LS-3	Micro Switch #11S19

VOLT 460/3/60

WEIGHT	
USED ON	48951
CHANGE DATE	
SCALE	
DRAWN BY	GEH
DATE	2-28-74

TIMESAVERS, INC.
MINNEAPOLIS 22, MINNESOTA

REVISIONS
MATERIAL
EXCEPT AS NOTED
TOLERANCE
FINISH

ELECTRICAL PART LIST

6333

ENGR	DATE	500 MODEL	CUSTOMER	SERIAL #	SHEET	BILL/MAT'L NO.
SWAGGERT	3/11/74	552-1A	BUELL DOOR	6333	1 OF 7	

PART NO.	DESCRIPTION	QTY	L	B	P	M	T
D-56349	DIMENSIONAL	1	X	X	X	X	X
D-48951	ELECTRICAL DIAG.	1					
C-49051-4	PNEUMATIC DIAG.	1					
E-55679	BASIC MACHINE ASSY.	1					
E-48681	MAINFRAME ASSY.	1					
D-48468	UPPER FRAME ASSY.	1					
C-49586	LOCKING DEVICE ASSY.	1					
B-49363	INDICATOR & HSG. ASSY.	1					
C-57258	COVER ASSY.	1					
C-51381-2	SOUNDPROOF ASSY.	1					
C-3900416	HYDRAULIC DIAG.						
53878	AIR MAIN ASSY.						
53881	AIR SUB-ASSY.						
53885	PUSH BUTTON ASSY						
53901	MAIN CONTROL PANEL ASSY.						

CUSTOMER: BUELL DOOR MODEL: 552-1A S/N 6333

QTY.	SYMBOL	DESCRIPTION
1	MTR-1	150 HP, 1800 RPM, TEFC, motor FR# 445T 230-460/3/60, 80DBA
1	MTR-2	10 HP, 1800 RPM, TEFC, motor FR# 215T 230-460/3/60
1	MS-1	A.B. Starter 709- F0D103
1	MS-2	A.B. Starter 709- B0D103
1	PT-1	Transformer 500 VA
1	TR-1	A.B. Timer 700-NT400-A1
1		ISI Load Indicator- Converter #11483
2		Marathon Fuse Block 6F30A3
1		Marathon Fuse Block F30A1S
1	PS-1	Barksdale Pressure Switch E1H-H90
1	SOL-1	Bellows Valve #K055-1-005 115V
2	LS-1,2	Micro Switch #BAF12RN18 LH
1	PB-1	A.B. Push Button 800T-D6A
1	PB-2	A.B. Push Button 800T-B6B
1	SPB-4	A.B. Sel. PB 800T-KE2A
1	PB-5	A.B. Push Button 800T-B6D2
2	PB-3,6	A.B. Push Button 800T-A2D1
1	SOL-3	ALLEN AIR #AV-2x2-SVS-E-APR-PK
1		P.B. Panel B-30983-2
1		Electrical Panel C-49299
3	FU-1	Buss Fuse FRS-30
3	FU-2	Buss Fuse FRS-8
1	FU-3	Buss Fuse FRN-5
1		Push Button Enclosure A-48552
1		Push Button Cover A-48553

QTY.	SYMBOL	DESCRIPTION
		(Brush Option)
0	MS-3	A.B. Starter 709- T0D103
0	MTR-3	1-1/2 HP 1800 RPM, TEFC motor FR# 145T 230-460/3/60
		(No-Go Option)
0	LS-4	Micro Switch ILS19
0	CR-1	A.B. Relay 700-N200-A1
0	PB-5,6	A.B. Contact Block 800T-XD2
0	SOL-3	Bellows Valve K055-1-005-115V
		(Lift Option)
2	PB-7,8	A.B. Push Button 800T-A2A
1	MTR-4	3/4 HP 1800 RPM, TEFC motor FR# 56C 230-460/3/60
1	MS-4	A.B. Starter 705-T0D103
2	LS-5,6	Micro Switch ILS19
1		Hoffman E2PB
		(Special Belt Break Option)
1	LS-3	Micro Switch #1LS19

VOLT 460/3/60

WEIGHT:

USED ON	48951
CHANGE DATE	
SCALE	
DRAWN BY	GEH
DATE	2-28-74

TIMESAVERS, INC.
MINNEAPOLIS 22, MINNESOTA

REVISIONS
MATERIAL
EXCEPT AS NOTED
TOLERANCE
FINISH

ELECTRICAL PART LIST

6333

CUSTOMER BUELL DOOR MODEL: 552-1A S/N 6333

QTY.	ITEM	DESCRIPTION
1	1	Power Pack 50-Gal. #D-31902-41
1	2	10 HP, 1800 RPM, FR. 215T
1	3	Vickers pump #PVB 10RSY-30-CC-10
1	4	Vickers check #DT8P1-06-65
1	5	Vickers air bleed #ABT-03-10
1	6	Parker hyd. motor #810EP1CUAA
1	7	Flow Ezy #50-T 1/2-100-RV/3
1	8	Char-Lynn #1F30-5-15
1	9	Worchester ball valve # 3/4-444YB
1	10	Christy fluid filled gauge 2000 PSI
1	11	Lovejoy coupling #L-110 c/w 1 3/8 B & 7/8B
1	12	Parker #20-16F50G5-S
1	13	Parker #16-3/4 F50G-S
1	14	Blk pipe nipple 3/4 x 6
1	15	Blk pipe nipple 3/4 x 4
1	16	Blk pipe nipple 1-1/4 x 3
1	17	Blk pipe nipple 1-1/4 x close
1	18	Blk 90° elbow 3/4
1	19	Blk reducer bushing 1/4 x 1/2
1	20	Blk reducer bushing 1-1/4 x 3/4
2	21	Imp. East. tee #25VJ-12
3	22	Imp. East. nipple #25SA-12
1	23	Imp. East. reducer #25SB-12x04
1	24	Imp. East. reducer #24SB-12x06
1	25	Imp. East. nipple #24SA-06
4	26	Imp. East. adapter #60TA-12x12
2	27	Imp. East. adapter #60UA-04x04
2	28	Imp. East. reducer #24SB-16x12
1	29	Imp. East. elbow #769FS-1/2
1	30	Imp. East. connector #768FS-3/8 x 1/2
1	31	Blk 90° reducing elbow 1-1/2 x 1-1/4
1	32	Hose assy #J4-HA12-12MB x 12 MB x 96"
1	33	Hose assy #J4-HA12-12MB x 12MB x 96"
1	34	Hose assy #R7-HA04-04MB x 04MB x 96"

QTY.	ITEM	DESCRIPTION

WEIGHT:

USED ON	C-39004-16	REVISIONS
CHANGE DATE		MATERIAL
SCALE		EXCEPT AS NOTED:
DRAWN BY	GEH	TOLERANCE
DATE	2-28-74	FINISH

TIMESAVERS, INC.
MINNEAPOLIS 22, MINNESOTA

HYDRAULIC PARTS LIST

6333

SHEET 4 OF COVER SHEET

CUSTOMER BUELL DOOR MODEL: 552-1A S/N 6333

QTY.	ITEM	DESCRIPTION
3	A	Watts regulator #364-2G
1	B	Watts mounting nut #163Y51
1	C	Watts filter #602-3MD
1	D	Watts oil removal filter #604-4
1	E	Moore regulator #41 1/8 IPS
2	F	Timesavers relay #B-23015
2	G	Weatherhead #3325X2 w/ .042 orifice
1	H	Weatherhead #11003175 w/ .089 orifice
1	I	Pneu-trol slide valve #SL-10
4	J	Gage 2" face 200 PSI
1	K	Gage 2" face 15 PSI
1	L	Bellows valve #K055-1-005 115V
1	M	Mico booster #12-021-025
2	N	Rotary joint #A-25850
1	O	Tracking cylinder #B-23395-1
1	P	Tension cylinder #D-47235
1	W	Barksdale pressure switch #E11H-1190
1	Z	Regulator mounting bracket #A-TOP-819
1		Air panel #C-55129
1	AB	ALLEN AIR #AV-2x2-SVS-E-APR-PK
		Brake On Feed Option
0	L	Bellows valve #K055-1-005 115V
		Oil Mist Option
0	U	See electrical diagram
		Air to Bearing Option
0	E	Moore regulator #41 1/8 IPS
0	K	Gage 2" face 15 PSI
0	Z	Regulator mounting bracket #A-TOP-819
		Air Loaded Infeed Option
0	A	Watts regulator #364-2G
0	R	Firestone Airide #16
0	I	Pneu-trol slide valve #SL-10
		Air Loaded Outfeed Option
0	R	Firestone Airide #16
		Air Loaded Billy Roll Option
0	A	Watts regulator #364-2G
0	R	Firestone Airide #16
		Air Loaded Shoe Option
0	A	Watts regulator #364-2G
0	S	Starz cylinder #5DW2
		Roll Friction Drive Option
0	A	Watts regulator #364-2G
0	T	Allen-Air cylinder, Type A 2" B. x 3" B. c/w #245 clevis
		Belt Direction Change Option
0	X	Barksdale valve #9021-M
		Positive Oscillation Option
0	Y	Bellows valve #P084-2015
		Bottom Head Option
0	A	Watts regulator #364-2G

USED ON	C-49051-4	REVISIONS	
CHANGE DATE		MATERIAL	
SCALE		EXCEPT AS NOTED	
DRAWN BY		TOLERANCE	
DATE		FINISH	

TIMESAVERS, INC.
MINNEAPOLIS 22, MINNESOTA

AIR PARTS LIST

6333

SHEET 3 OF COVER SHEET

TIMESAVERS, INC.

SUBJECT: Timer Installation Instructions

To insure proper operation and prevent possible damage to the unit, observe the following instructions carefully:

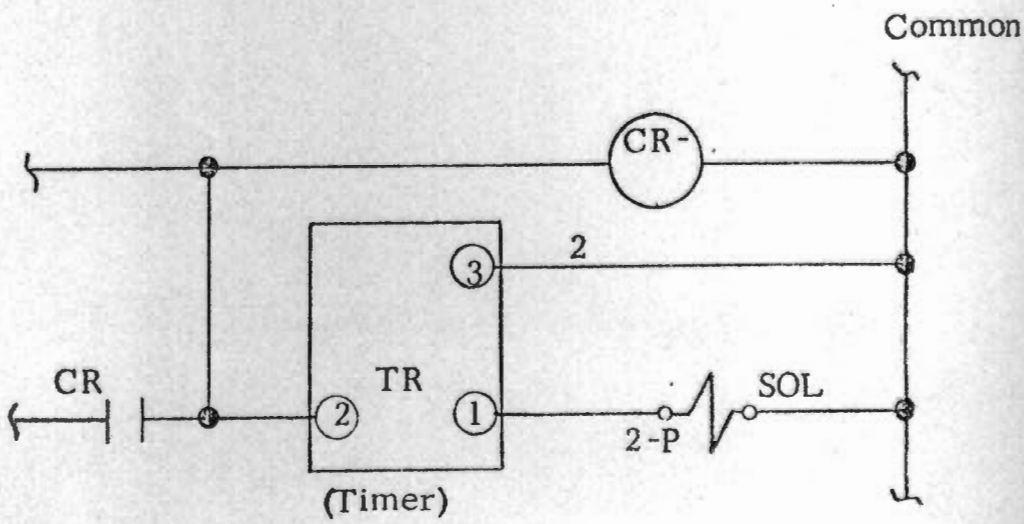
1. Locate timer on your machine's electrical diagram.

2. Identify terminal No. 1 on the timer unit. Connect this terminal to the solenoid valve shown on your schematic.

3. Connect terminal No. 2 on the timer to the relay circuit. (Note: Some modles show (2) separate relay connections to the timer; only one connection is required. Extra lead is redundant and can be ignored.)

4. Connect terminal No. 3 on the timer to the common side (wire No. 2).

5. This completes the timer installation.



TYPICAL CIRCUIT

5/10/78

TIMESAVERS, INC.

SUBJECT: Timer Installation Instructions

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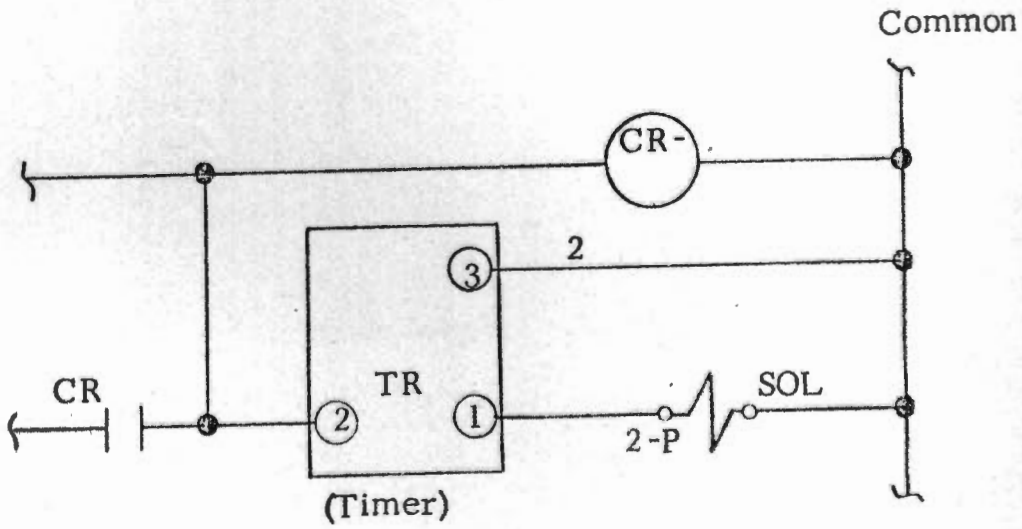

TYPICAL CIRCUIT

5/10/78

TIMESAVERS, INC.

SUBJECT: Timer Installation Instructions

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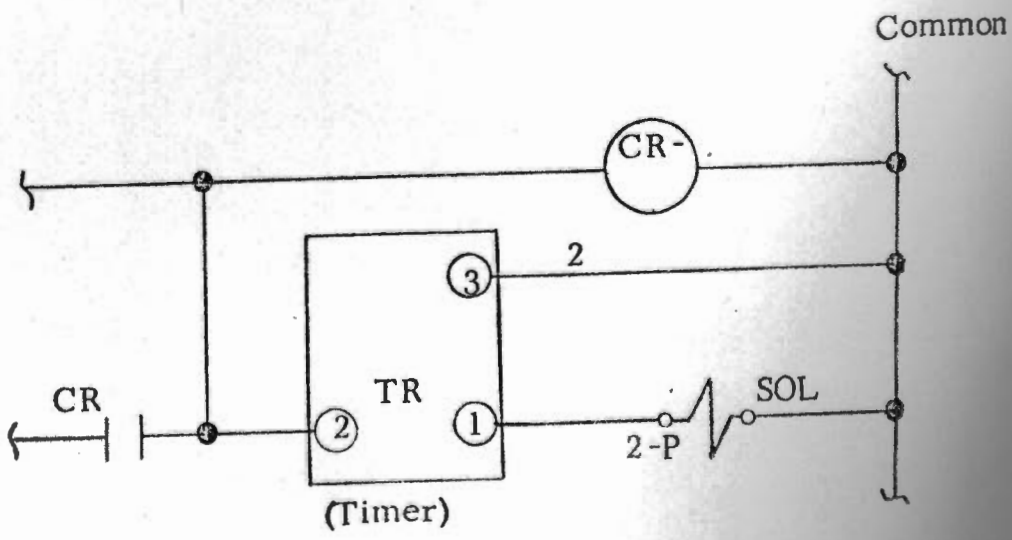

TYPICAL CIRCUIT

5/10/78

TIMESAVERS, INC.

SUBJECT: Timer Installation Instructions

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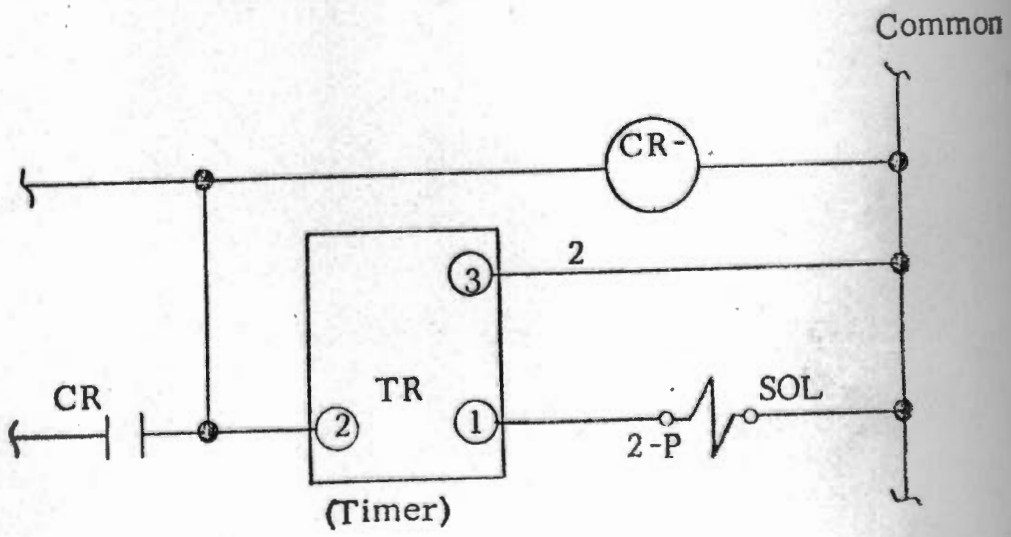
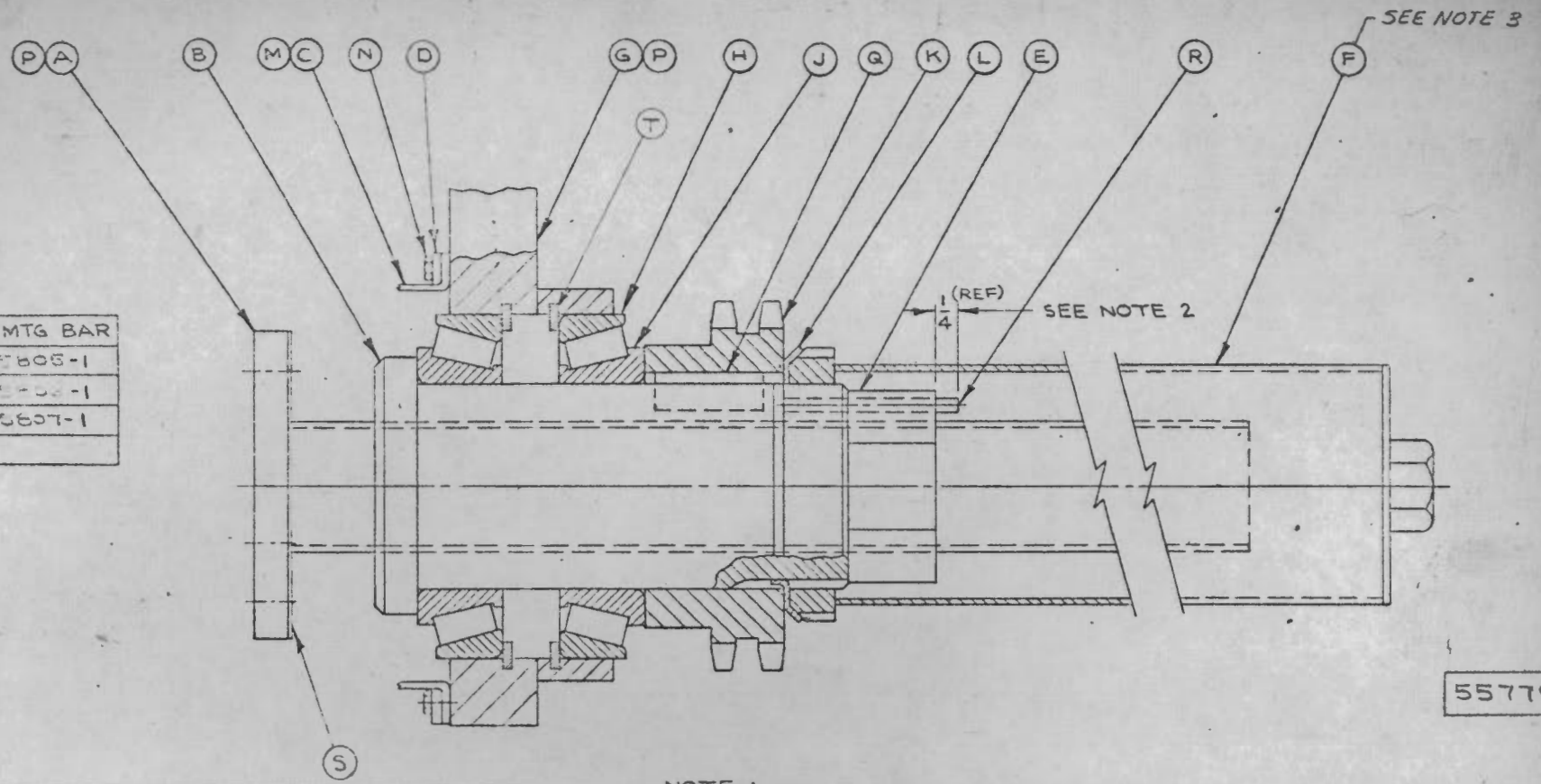


TYPICAL CIRCUIT

5/10/78

ORIG. C-52400



DASH NO.	JACK MTG BAR
-1	C-55605-1
-2	C-55606-1
-3	C-55607-1

55779

ITEM	QTY	DESCRIPTION	PART NO.
T	4	SPIROLOX RETAINING RING	RRN-393
S	2	DUST COVER	A-54926
R	2	SPRING PIN 3/16 x 2 LG	
Q	2	KEY 5/8 x 7/16 x 1 1/8 LG	
P	10	HEX HD CAP SCR 1/2-13NC x 1 1/2 LG	
N	4	HEX HD CAP SCR 1/4-20NC x 1/2 LG	
M	2	HOSE CLAMP SURE TITE	CP-56
L	2	LINK BELT LOCKWASHER	W 12
K	2	MARTIN SPROCKET 2 3/8 B. SHALLOW KW & SS	D40B25H
J	4	TIMKEN CONE	28985
H	4	TIMKEN CUP	28921
G	1	(SEE DASH NUMBER CHART)	
F	2	LOCK COVER	B-47632
E	2	ANTI-BACKLASH NUT	A-48676
D	2	BOOT CLAMP	A-47997
C	2	BOOT	C-52398
B	2	JACK DRIVER	B-47631-2
A	2	JACK SCREW	B-52399

NOTE :

1. HOLE FOR ITEM 'R' IN ITEM 'B' TO BE LOCATED AND DRILLED AT ASSY. 1/4" OF PIN MUST REMAIN EXPOSED FOR EASY REMOVAL
2. TIGHTEN LOCK COVER WITH 55 FT. LB. TORQUE
3. PACK JACK DRIVER & BRGS W/ GREASE AT ASSY
4. INTERCHANGEABLE WITH C52400 EXCEPT FOR JACK MTG. BAR & RINGS (ITEM 'T')

CLEAN & DEBURR PARTS BEFORE ASSY

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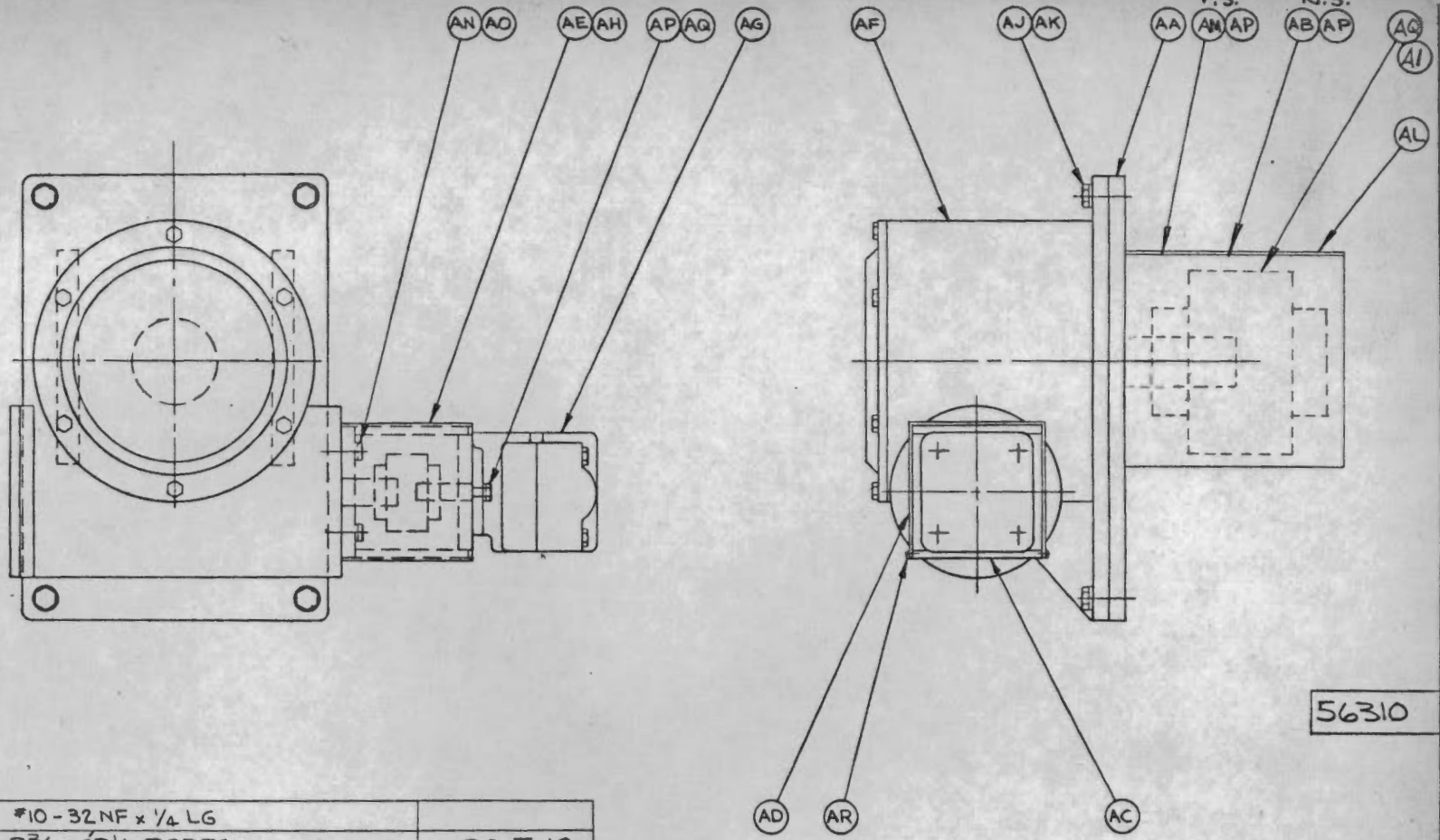
1/1
DRE
11-8-73
TIMESAVERS, INC.

JACK ASSY - 5 TONS

SEE THIS DRAWING FOR



56310

ITEM	QTY	DESCRIPTION	PART NO.
AR	2	SOC HD CAP SCR #10-32NF x 1/4 LG	
AQ	1	FALK COUPLING 2 3/16 & 2 1/4 BORES	90-T-10
AP	4	FLAT HEAD SCR 1/2-13NC x 1 1/4 LG	
AO	4	LOCKWASHER 1/2	
AN	4	HEX HD CAP SCR 1/2-13NC x 1 1/4 LG	
AM	1	REDUCER MTG BRKT	B-56323
AL	1	COVER	B-56324
AK	4	LOCKWASHER 3/4	
AJ	4	HEX HD CAP SCR 3/4-10NC x 1 1/2 LG	
AI	1	KEY 1/2 SQ x 3 LG	
AH	1	KEY 1/4 SQ x 1 1/2 LG	
AG	REF	HYDRAULIC MOTOR (SEE HYD. DIAGRAM)	
AF	1	WINSMITH REDUCER, 27:1 RATIO, ASSY 1-RD	CV-10
AE	1	FALK COUPLING, 1 1/4 & 3/4 BORES	30-T-10
AD	1	GUARD	B-50583
AC	1	HYD. MOTOR MOUNT	C-48521
AB	1	REDUCER MTG BRKT	B-56306
AA	1	REDUCER SUB PLATE	C-56305

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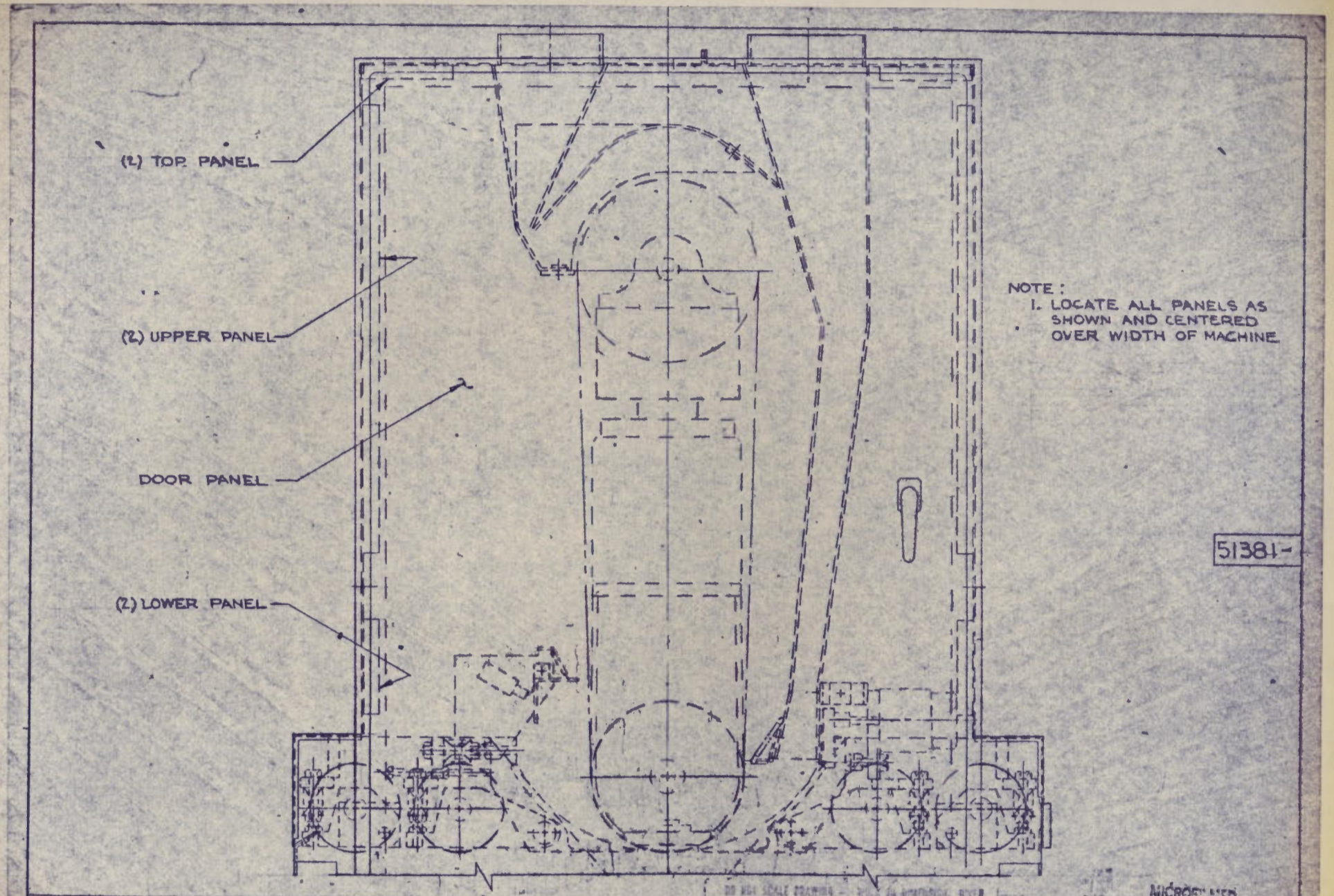
WEIGHT:		REVISIONS	
USED ON		MATERIAL	
CHANGE DATE		EXCEPT AS NOTED:	
SCALE	1/4	TOLERANCE	
DRAWN BY	CJS	FINISH	
DATE	1/9/74		

TIMESAVERS, INC.
5270 HANSON COURT
MINNEAPOLIS, MINNESOTA 55422

FEED DRIVE ASSY

56310



NOTE:
1. LOCATE ALL PANELS AS SHOWN AND CENTERED OVER WIDTH OF MACHINE

51381-

DASH NO.	MACH	DESCRIPTION
-2	-64 -52	C-51375 SOUNDPROOF KIT
-1	-40 -30	C-51374 SOUNDPROOF KIT

NOTICE

TOP HEAD
1/4
HG
10-2-72

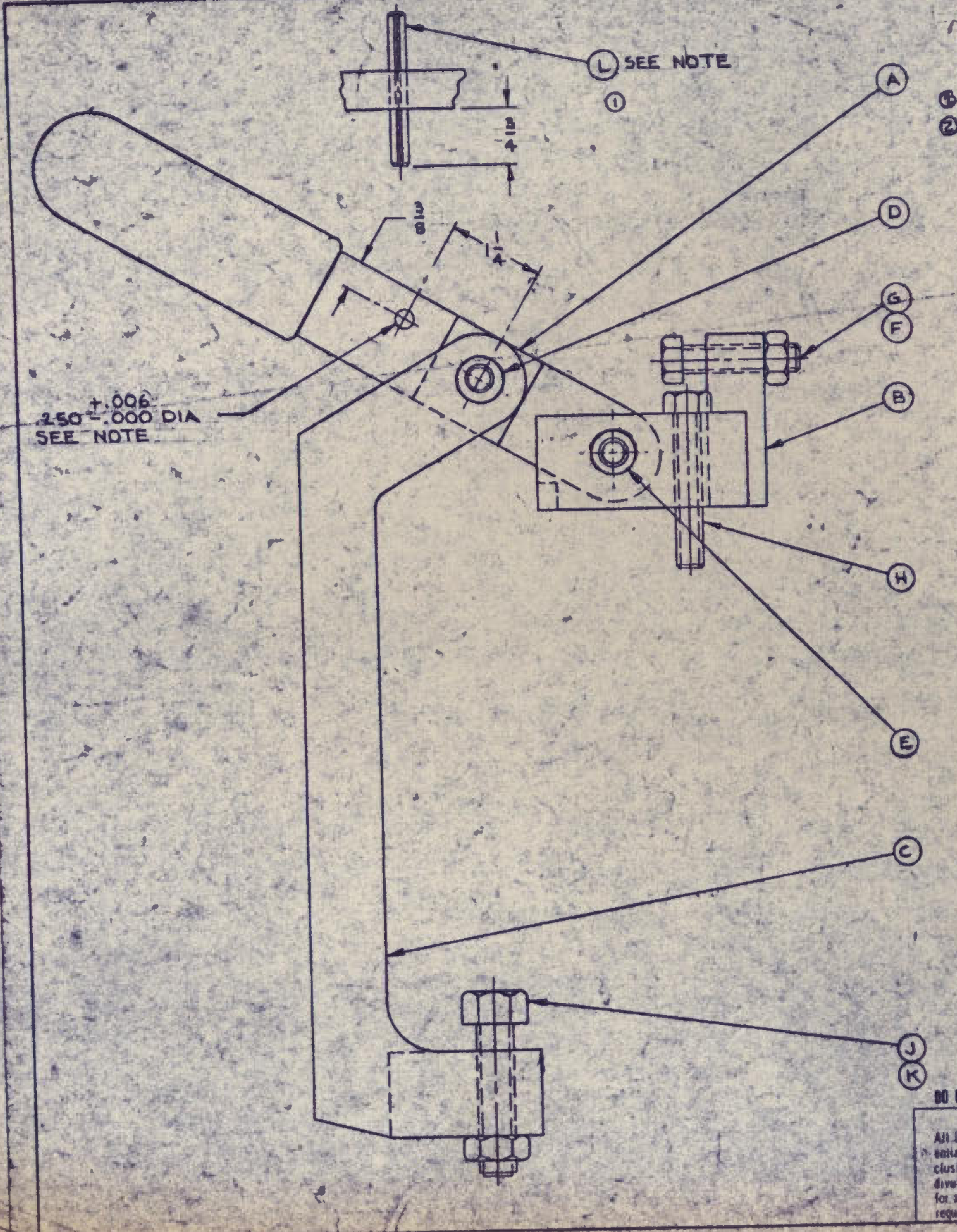
MICROFILMED

SOUNDPROOF ASSY

51381

DASH NO'S CHARTED

ITEM	QTY	DESCRIPTION	PART NO.
A	1	LEVER	A-49294
B	1	PIVOT BRACKET	A-49296
C	1	CLAMP	B-49584
① D	1	DRIV-LOC PIN, TYPE C, 2½ LG	
② E	1	DRIV-LOC PIN, TYPE C, 2 LG	
F	1	JAM NUT 3/8-16NC	
G	F	HEX HD CAP SCR 3/8-16NC x 1½ LG	
H	2	HEX HD CAP SCR 3/8-16NC x 2 LG	
J	1	HEX HD CAP SCR ½-13NC x 2 LG	
K	1	JAM NUT ½-13NC	
L	SEE NOTE	ROLL PIN ¼ DIA x 2 LG	



49586

NOTE:
PIN(I) AT ASSY AS SHOWN, FOR USE WITH BOTTOM HEAD ONLY

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B/M

WEIGHT	
USED ON	400/500
CHANGE DATE	
SCALE	1/1
DRAWN BY	HG
DATE	5-12-72

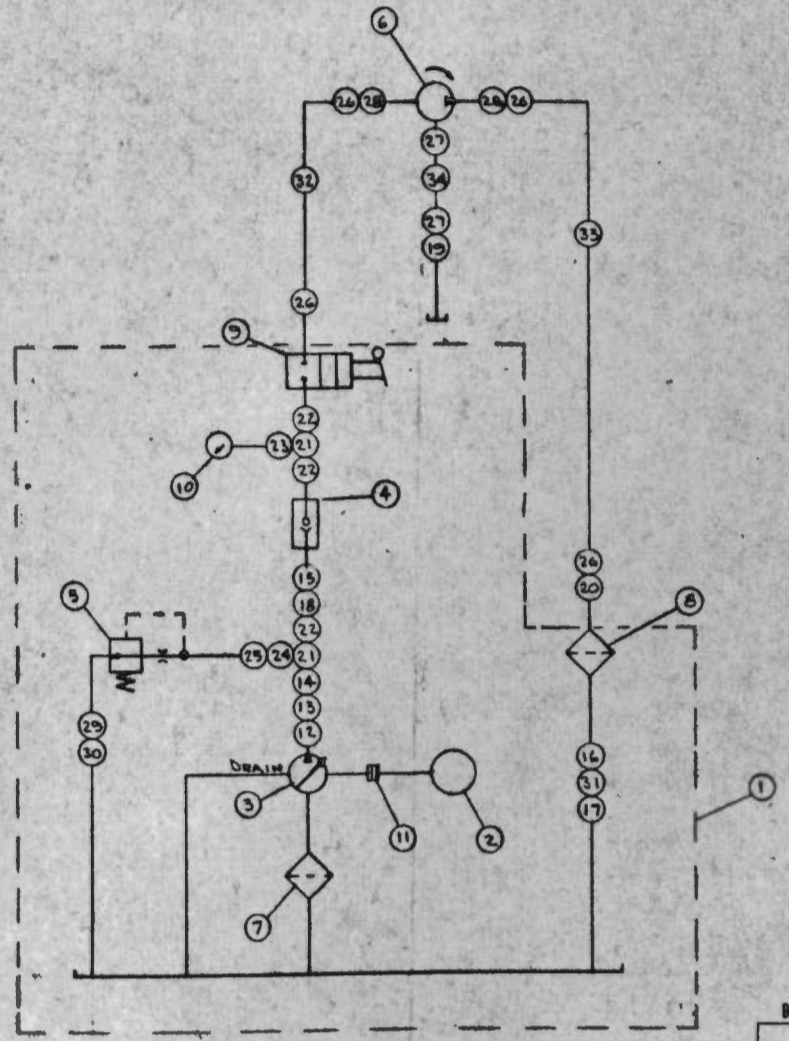
TIMESAVERS, INC.

① DRIVE-LOC ② SH. BOLT
① REDRAWN & ADDED B/M & ITEM L 7-17-72 HG

REVISIONS
MATERIAL
EXCEPT AS NOTED: TOLERANCE ± 1/16
FINISH

LOCKING DEVICE

49586



3900416

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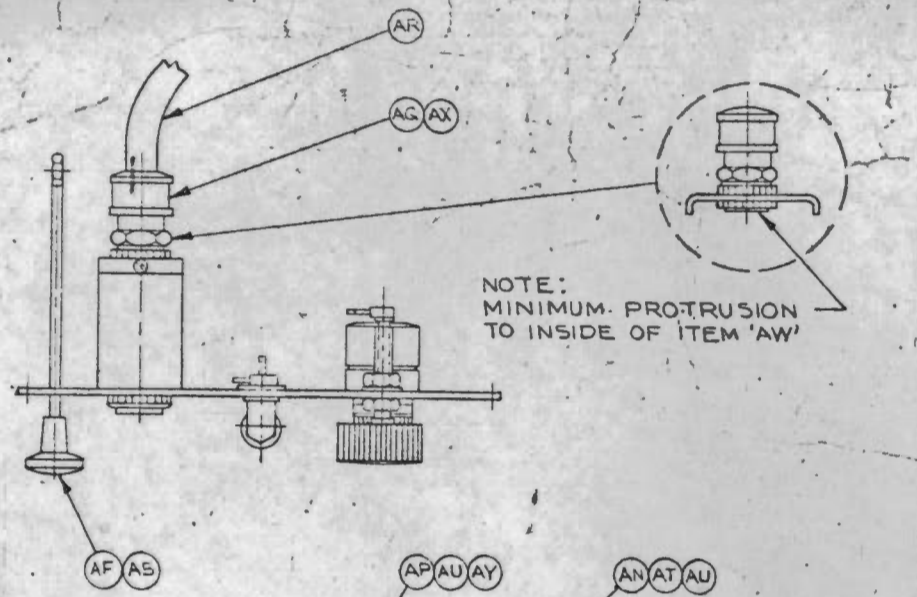
WEIGHT:		REVISIONS
USED ON		MATERIAL
CHANGE DATE		EXCEPT AS NOTED:
SCALE		TOLERANCE
DRAWN BY	C.E.H.	FINISH
DATE	5-3-73	

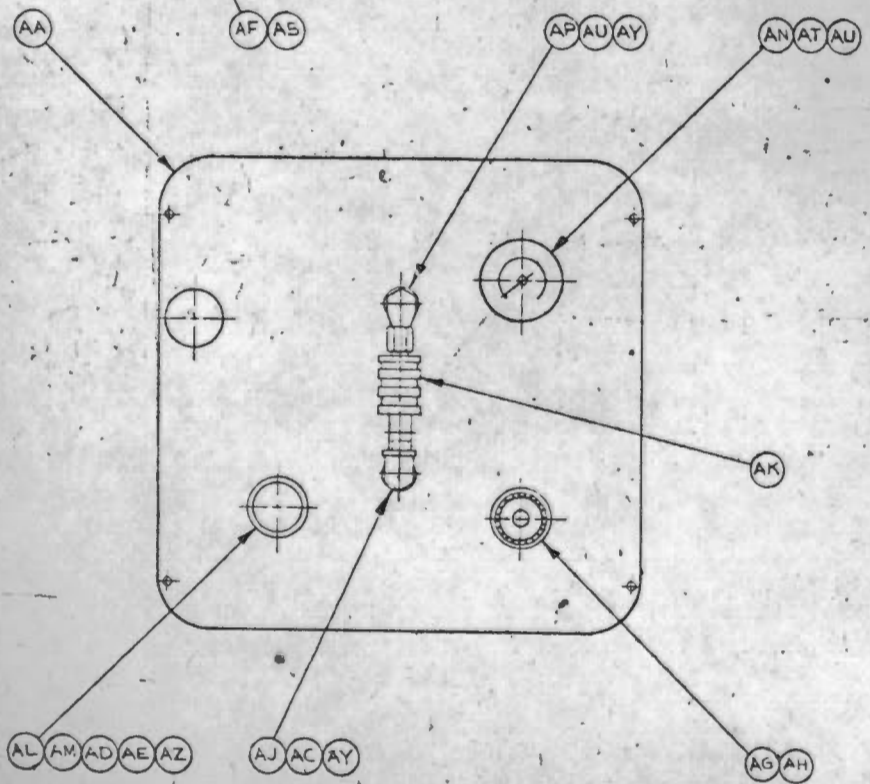
TIMESAVERS, INC.
5270 HANSON COURT
MINNEAPOLIS, MINNESOTA 55422

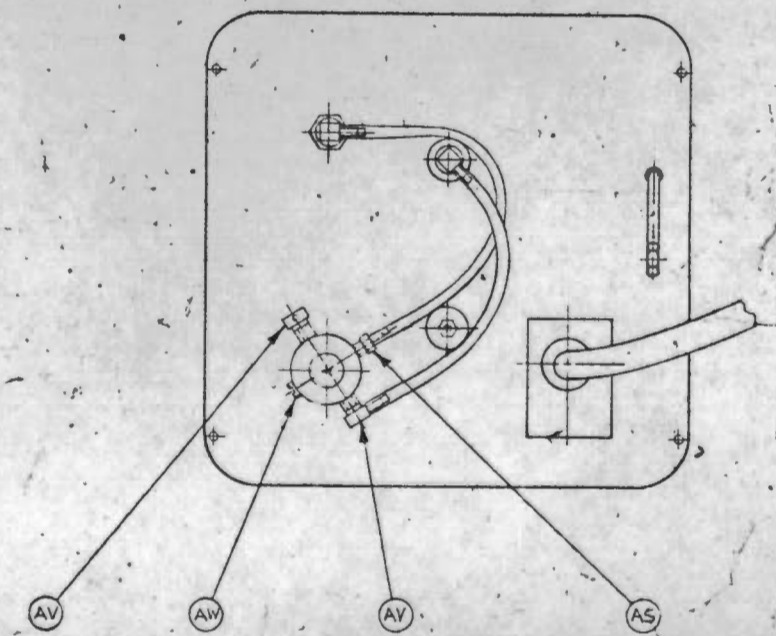
HYDRAULIC DIAGRAM

3900416



ITEM	QTY	DESCRIPTION		PART #
AA	1	COVER		A-47661-1
AB	1	KNOB EXTENSION		A-47643
AC	1	RESTRICTED FITTING		A-19789-5
AD	1	PUSH BUTTON ENCLOSURE		A-48552
AE	1	PUSH BUTTON COVER		A-48553
AF	1	REID KNOB		DK-49
AG	1	WATTS REGULATOR		364-2
AH	1	WATTS MOUNTING NUT		163Y51
AJ	1	IMPERIAL EASTMAN FITTING		100B 1/8
AK	1	PNEUTROL VALVE		SL-10
AL	1	A-B SELECTOR PUSH BUTTON (SPB-4,50R9)		800T-KE2A
AM	1	A-B NAME PLATE - DRUM "JOG-RUN"		
AN	1	WATTS GAUGE		274Z160
AP	1	IMPERIAL EASTMAN FITTING		116B 1/8
AQ	2	CROUSE HINDS		CGB 195
AR	1	TYPE SO CORD		14/4
AS	1	WEATHERHEAD FITTING	1/4 x 1/8	110-03175
AT	1	IMPERIAL EASTMAN FITTING	1/8 x 1 1/2	129 B
AU	2	WEATHERHEAD FITTING	1/4 x 1/8	110-03661
AV	2	WEATHERHEAD FITTING	1/4 x 1/4	110-03538
AW	1	BRASS PLUG 1/8"		
AX	3	LOCK NUT 1/2"		
AY	2	WASHER 3/8"		
AZ	2	SHEET METAL SCR #7		





57258

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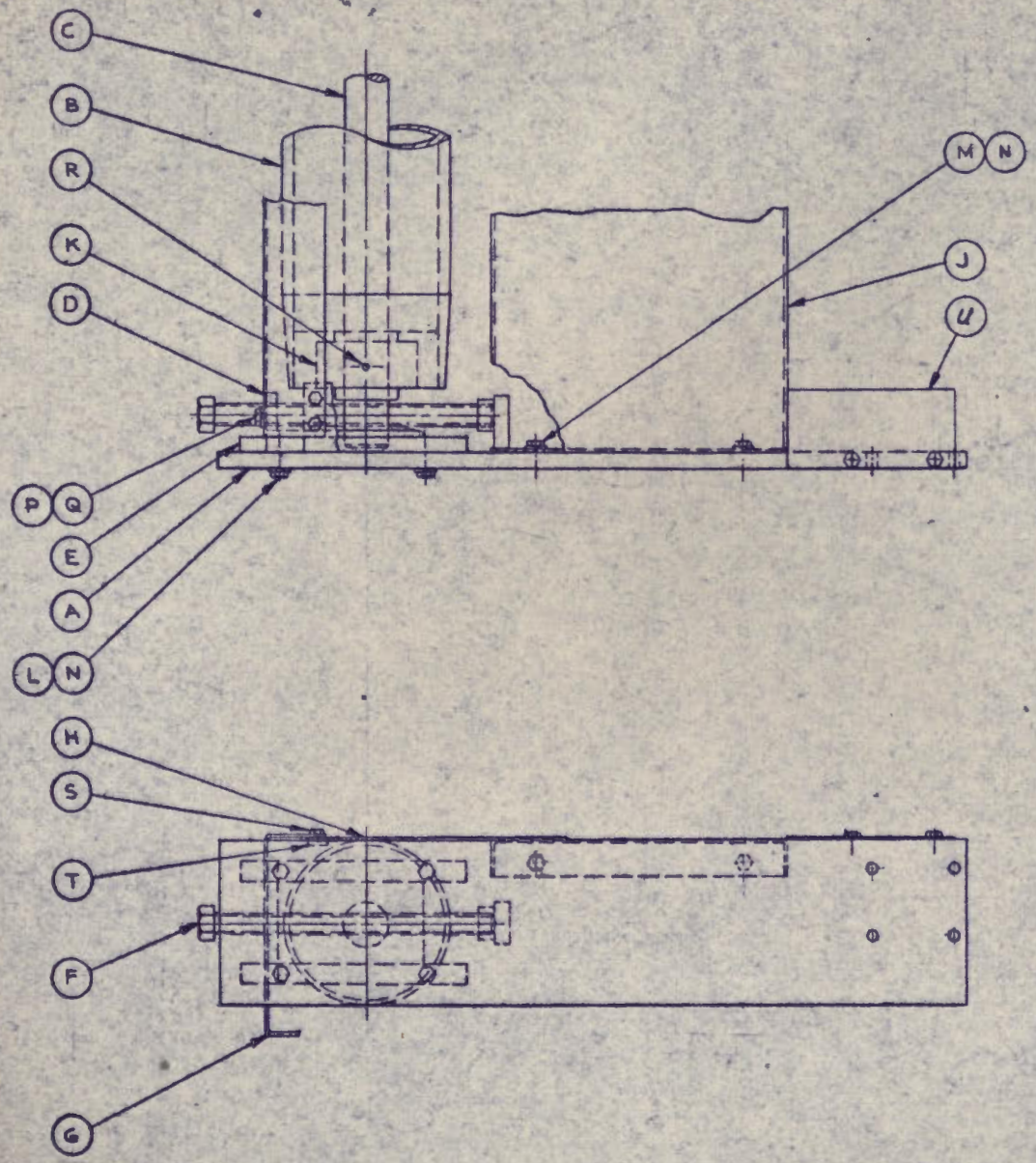
DRG. NO.	500
MAJOR DATE	
SCALE	NONE
DRAWN BY	CJS
DATE	
TIMES	



BILL OF MATERIAL - ASSEMBLY DRG. NO. C-48307

ITEM	QTY.	PART NO.	DESCRIPTION
A	2	B-48318	Side Plate - Conveyor Ext.
B	1	B-48247	Take-Up Roll
C	1	A-48311	Take-Up Shaft
D	2	A-48312	Slide
E	4	A-46591	Slide Guide
F	2	A-31123-3	Adj. Screw
G	1	B-48313	Infeed Table
H	2	A-47904	Belt Guard
J	1	C-47903	Belt Support
K	2	RC 2-3/16 B.	Pathir Bearing
L	16		Hex Hd. Screw 1/2-13NC x 1-1/2 l.g.
M	8		Hex Hd. Screw 1/2-13NC x 3/4 l.g.
N	28		Lock Washer 1/2
P	4		Hex Hd. Screw 3/8-16NC x 1/2 l.g.
Q	4		Lock Washer 3/8
R	2		Soc. Set Screw 5/16-18NC x 1-1/4 l.g.
S	4	C-31175-5618	Tinnerman Nut Retainer 5/16-18NC
T	4		Hex Hd. Screw 5/16-18NC x 1/2 l.g.
U	2	A-49200	GUARD

48307

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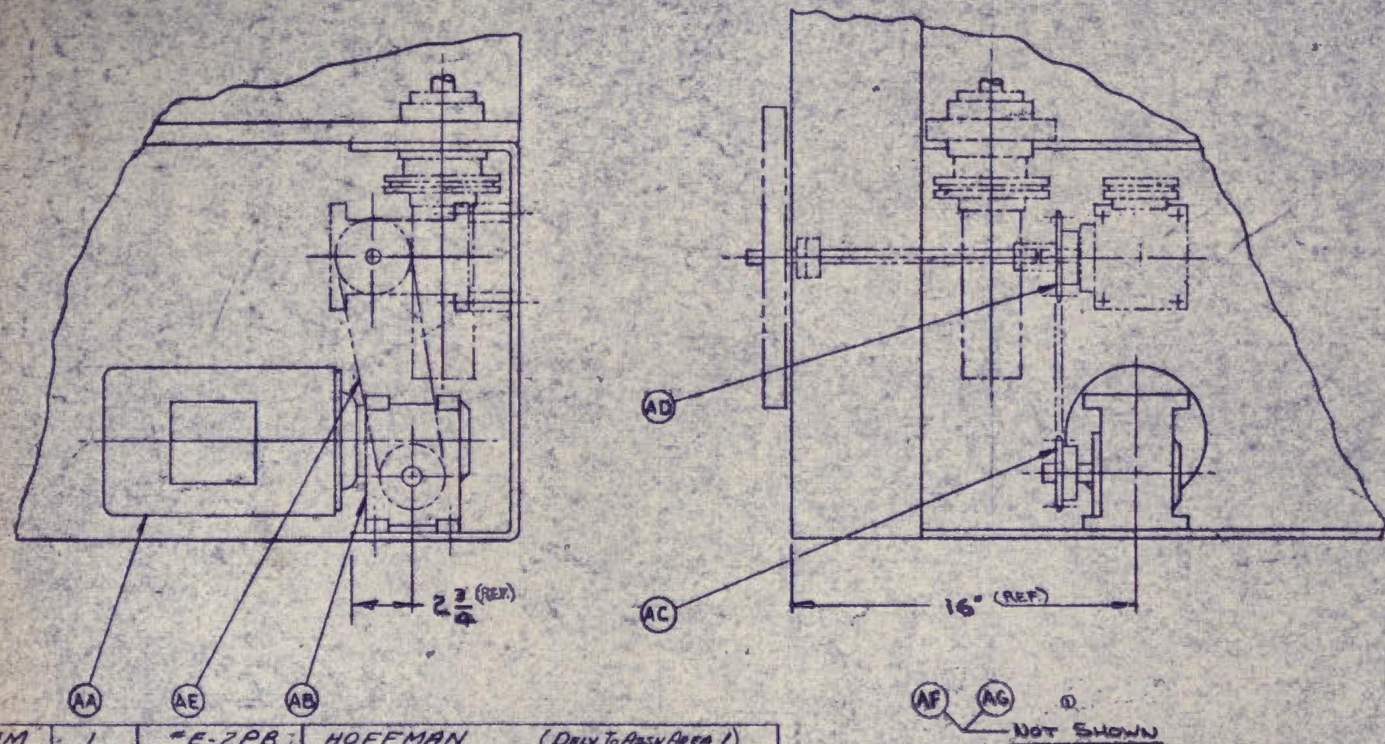
WEIGHT		
USED ON		REVISIONS
CHANGE DATE		MATERIAL
SCALE	1/4	EXCEPT AS NOTED:
DRAWN BY	HG	TOLERANCE
DATE	2-2-72	FINISH

TIMESAVERS, INC.
5075 RANSOM COURT
MINNEAPOLIS, MINNESOTA 55422

18" EXT ASSY-
8" TAKE UP ROLL

MICROFILMED



48473-

AM	1	#E-2PB	HOFFMAN (DELV. TO ASSY AREA 1)
AL	2	#1LS19	MICRO SWITCH "
AK	1	#705-TOD103	A.B. STARTER "
AJ	2	#800T-A2A	A.B. PUSH BUTTON "
AH	1	SEE TAB	
AG	1	A-51769	MICRO-SWITCH BRKT
AF	1	A-51768	TRIP ARM BRKT
AE	3 FT.		CHAIN #40, 1/2 PITCH SINGLE STRAND
AD	1	SEE TAB.	
AC	1	40B20	SPKT BROWNING, 7/8 B / STD K.W.
AB	1		WINSMITH YOGI, M175, 40:1, ASS'Y 3, (56C MOTOR 5/8 SHAFT)
AA	1		3/4 H.P., T.E.F.C., 56C FRAME, C FLANGE
ITEM	QTY	PART NO	DESCRIPTION

BILL OF MAT'L

ASSY NO.	ITEM AD	ITEM AH
48473	BOWNING SPRKT 40B25, 5/8 BORE & K.W.	———
48473-2	A-48899 MODIFIED CHAIN SPRKT	———
48473-3	BROWNING SPRKT 40B25, 5/8 BORE & K.W.	B-51938 MTG. BRKT - MOTORIZED LIFT

③ ECO 0103 AJM 3-7-73 ADDED ITEMS AJ, AK, AL, AM

② ADDED C-48473-3 11-14-72

① ADDED AF & AG JMB 11-8-72

B/M

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WEIGHT		REVISIONS	
USED ON		MATERIAL	
CHANGE DATE		EXCEPT AS NOTED	
SCALE	1/4	TOLERANCE ± 1/64	
DRAWN BY	B. Pilces	FINISH	
DATE	2-28-72		
TIMESAVERS, INC. 5270 HANSON COURT MINNEAPOLIS, MINNESOTA 55422		MOTORIZED LIFT ASSY	48473

-1, (-2 This Dwg) (-3

CONTENTS

500 Series machine features ---------- SECTION 1

- Major features
- Safety features

Assembly List ---------- SECTION 2

- List of sub-assemblies
- Sub-assembly drawings (enclosed)

Installation ---------- SECTION 3

General Operating Tips ---------- SECTION 4

- Abrasive belts
- Tracking
- Feeding

Operating Procedures ---------- SECTION 5

- Installation of abrasive belt
- Starting the machine
- Feed opening adjustment
- Feed speed adjustment
- Shoe adjustment
- Drum adjustment
- Platen head adjustment

Sanding Tips ---------- SECTION 6

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- Finishing
- Veneers and fillers
- Thin panels
- Short parts

Trouble-shooting Sanding Defects ---------- SECTION 7

- Isolating problem areas
- Trouble-shooting sanding defects (table)

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- Center bar assembly
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Air filter
Brakes
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Hydraulic powered feed drives
Spare parts list
Ordering replacement parts
Component literature

SECTION 1: 500 SERIES MACHINE FEATURES

MAJOR FEATURES:

The following photographs locate the major features of the 500 Series machine. The appearance of your machine may vary slightly depending on specific options. Refer to the assembly drawings included for the exact configuration of your machine.

SAFETY FEATURES:

The 500 Series machine is equipped with many safety features for your protection:

1. The sanding heads are quickly stopped by disc brakes when a potential hazard exists. In this event, the machine cannot be restarted until the problem is corrected.

   The following circumstances cause the machine to stop:

   Emergency or brake button pushed. (NOTE: The brakes should be used only when quick stops are required to minimize brake wear.)

   Air pressure not adequate to machine. Air switch operates when there is insufficient air pressure to track and tension belt.

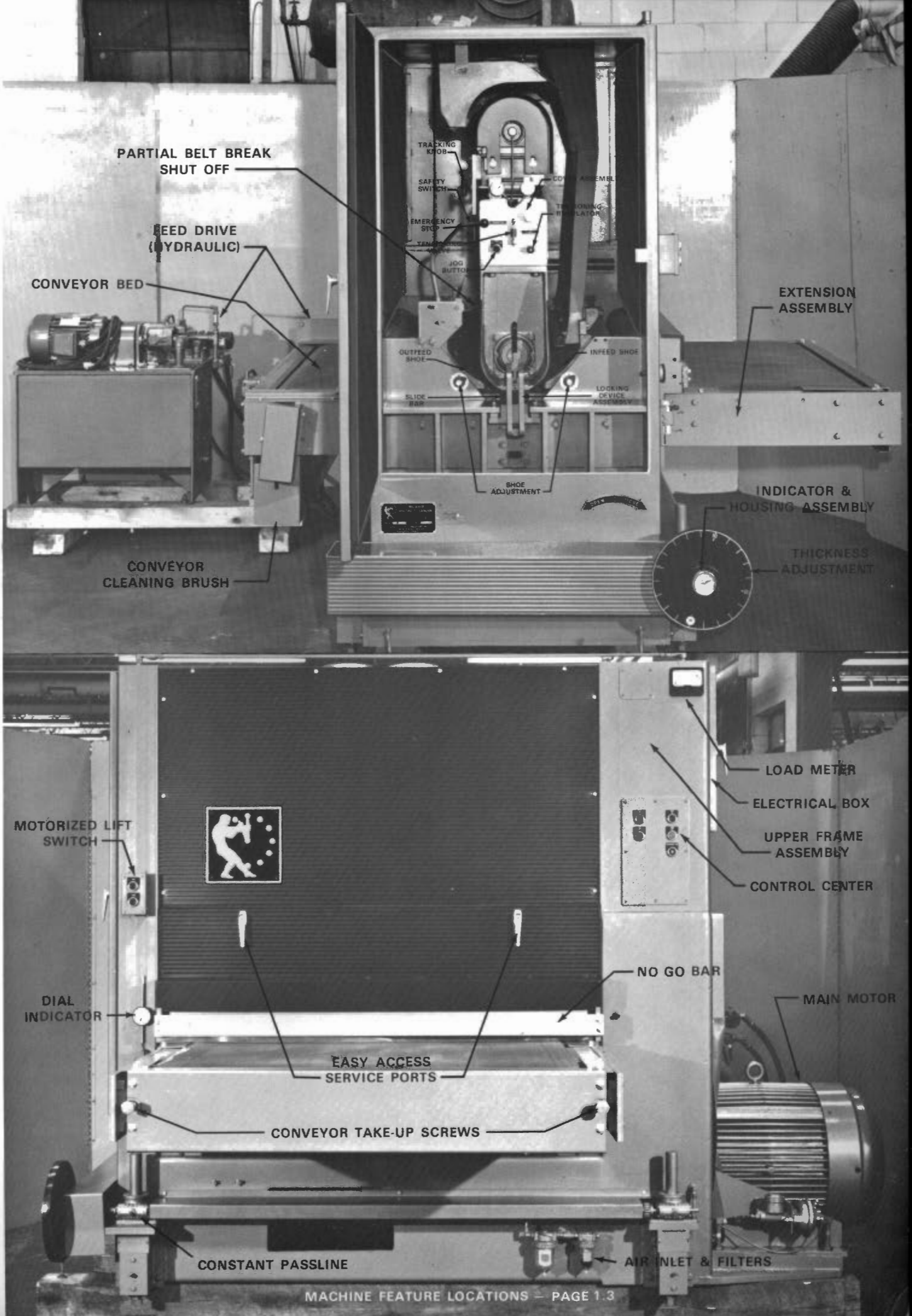
   Abrasive belt break: Tension cylinder will extend, engaging limit switch.

   Belt run-off: Abrasive belt trips limit switch when belt is not tracking.

   Partial abrasive belt break: Torn section of abrasive belt trips limit switch.

2. Guards are provided for all moving parts (belts, chains, etc.).
3. No-Go bars and feed guards are provided to protect the operator's limbs while feeding parts.

CAUTION: ALL GUARDS SHOULD BE IN PLACE AND NO-GO BARS PROPERLY ADJUSTED WHILE THE MACHINE IS OPERATING. ALWAYS DISCONNECT POWER AND LOCK MAIN DISCONNECT SWITCH OF MACHINE BEFORE DOING MAINTENANCE WORK.


PARTIAL BELT BREAK SHUT OFF
FEED DRIVE (HYDRAULIC)
CONVEYOR BED
EXTENSION ASSEMBLY
INDICATOR & HOUSING ASSEMBLY
THICKNESS ADJUSTMENT
CONVEYOR CLEANING BRUSH
LOAD METER
ELECTRICAL BOX
UPPER FRAME ASSEMBLY
CONTROL CENTER
MOTORIZED LIFT SWITCH
NO GO BAR
DIAL INDICATOR
MAIN MOTOR
EASY ACCESS SERVICE PORTS
CONVEYOR TAKE-UP SCREWS
CONSTANT PASSLINE
AIR INLET & FILTERS

SECTION 2: ASSEMBLY LIST

Your machine is specified by an assembly list, approximately six pages, which is located in the folder cover.

Refer to "500 Series Machine Features" for the general location of the assembly modules. Refer to the sub-assembly drawings located in the folder cover for the exact configuration of your machine and parts lists of sub-assemblies.

Note that air and electrical drawings are also included in the folder cover.

SECTION 3: INSTALLATION

1. After completion of this installation procedure, you will be provided a no-charge service call by your dealer or factory service engineer. To allow scheduling of this, please contact your dealer at least one week in advance of expected start-up.
2. Refer to the dimensional print of your machine in this manual for pertinent dimensions of the machine, location and size of dust collection outlets, and air and electrical attachment points. Also, refer to "500 Series Machine Features" for learning where many features of your machine are located.
3. Remove shipping skids and coverings and locate machine on an adequate foundation. A half inch thick steel plate eight inches square is recommended for placement under each support point.
4. The leveling screws are shipped inside the locked electrical box. The key for this is inside the air box. Install these screws and level machine. The feed bed may be used for leveling.
5. Wire electrical power from your disconnect to the electrical box on the machine. (NOTE: For machines with constant passline option, electrical connection must be flexible.)
6. Install dust collection system piping to the outlets provided on the machine. Note on the dimensional layout the required CFM for your machine which depends upon size of machine and options obtained. A static pressure of 6" H_2O on 500 Series Abrasive Planers and 5" H_2O on 500 Series standard machines at machine hook-up points is recommended. Note that movable dust outlets require flexible or sliding connections.

7. Attach compressed air line. (NOTE: For machines with constant passline, air connections must be flexible.) Air requirements are 7 CFM per head. Dry, clean air is important for continued correct performance of the air controls on the machine. In cases where compressed air is contaminated with water, oil, etc., dryers or permanent type filters are recommended for the supply. Compressed air is used on your machine for abrasive belt tracking, abrasive belt tensioning, controls, and (on the 500 Series Abrasive Planer) infeed shoe air loading.
8. Review the assembly drawings in this manual. These show the detailed construction of your machine.
9. Review the Recommended Spare Parts List. These are parts that we recommend you purchase. These are replacement parts that will normally be needed during the service life of your machine. By having these on hand, your machine down-time will be minimized.
10. Order and receive correct abrasive belts for your machine.

MACHINE START-UP

The service engineer will check your machine over and make any necessary adjustments. He will instruct you on the proper adjustments, operation and maintenance of your machine. Take this opportunity and have your operator and maintenance man become well acquainted with the capabilities and maintenance requirements of your machine. This will contribute to continual best operation of the machine.

SECTION 4: GENERAL OPERATING TIPS

ABRASIVE BELTS:

Abrasive belt manufacturers provide instructions for storage and handling of belts. It is important to follow these instructions for maximum belt economy. Belt life can be increased by spreading wear through feeding procedures. Vary the feeding position slightly as parts are fed to spread wear. Run wide stock first, then narrow stock so parts are fed through an evenly worn area. Avoid premature belt failure by preventing nicks or tears in belt edges. Another cause of belt failure is improper alignment of belt after installation. Make sure belts are not "cocked".

Experiment with belts to find the proper grit and backing for optimum sanding.
CAUTION: DO NOT leave abrasive belts tensioned when not in use.

TRACKING:

After the operator becomes familiar with the machine, he can jog the belt and watch it to see that the belt tracking mechanisms are operating. Failures at this point are rare but it is mentioned as a precaution particularly in new installations. If tracking problems occur, please refer to "Trouble-shooting the Tracking System".

Keep your filter on air lines in proper condition. Do not allow excess water to accumulate in the filter.

FEEDING:

Keep your feed works free of dust. Keep your machine clean with good air suction. Run belts as loose as possible without slipping.

IMPORTANT - Never allow one piece to ride on top of another.

Feed with care. Do not overlap pieces.

The following procedures are basic to the operation of a 500 Series machine. They should be studied carefully before operating the machine. The 500 Series sander is versatile and as you become familiar with your machine, you will learn the exact adjustment settings for running your materials.

INSTALLATION OF ABRASIVE BELT

1. Lower tensioning roll by operating the valve on belt loading side of abrasive head.
2. Release locking device lever and swing clamp out of the way.
3. Remove slide bar, opening area for abrasive belt to be installed over contact drum.
4. Install abrasive belt, correctly orienting arrow on inside of belt with direction of drum rotation.
5. Center abrasive belt on abrasive head.
6. Reinstall slide bar and secure locking device. Check to insure that slide bar is tight.
7. Tension abrasive belt by extending air cylinder.

STARTING THE MACHINE

(NOTE: An abrasive belt must be in place before the machine will operate.)

1. After a new abrasive belt has been installed, push the jog button and observe belt tracking. Adjust as necessary.
2. Start sanding heads by pressing start button. Start one head at a time to reduce electrical load.
3. Start optional equipment (such as brushes) and observe that they are operating correctly.
4. Start the conveyor bed.

OPERATING ADJUSTMENTS

There are several adjustments the operator may be required to make in the normal course of operation, as described below. Refer to "Sanding Tips" and "Troubleshooting Sanding Defects" to determine when these adjustments are required. Refer to "Machine Features" for location of the adjustments.

FEED OPENING

The opening of the machine is adjusted by the large handwheel at the front of the machine. (If your machine is equipped with motorized lift, opening is adjusted by the electrical buttons provided.) One revolution changes the opening .020 inches.

FEED SPEED

NOTE: Feed speed should be adjusted only while the feed motor is running.

If your machine has a mechanical feed drive, it is equipped with either a movable motor base or a "compound drive". Refer to the assembly prints for the configuration of your machine. For machines with a movable motor base, feed speed is adjusted by the handwheel on the motor base. Machines equipped with the "compound drive" are adjusted by a handwheel on the feed motor sheave.

If your machine has a hydraulic feed drive, feed speed is adjusted by loosening the lock nut on the flow control adjustment screw. Turn the screw clockwise to decrease speed and counter-clockwise to increase speed. Tighten lock nut when desired speed is obtained.

SHOE ADJUSTMENT

NOTE: Some machines are not equipped with shoes.

The infeed shoe(s) and the outfeed shoe (last head only) can be easily adjusted by the following procedure:

1. Unlock the adjustment by loosening the set screw in the face of the shoe (door side only).
2. Adjust the shoe to the proper height by turning the adjustment shaft.
3. Relock the shoe by tightening the set screw.

DRUM ADJUSTMENT

Multiple head machines and some single head machines are equipped with adjustable drums which can be adjusted by the following procedure:

1. Loosen the locking collar around the adjustment shaft.
2. Turn the shaft to raise or lower the drum. Dial gives relative location of the drum in .001 inches.
3. Retighten the locking collar.

PLATEN HEAD ADJUSTMENT

Some machines are equipped with platen heads. Platen pad pressures can be adjusted by the procedure given below. Platen pressure should be the minimum required for desired finish to prolong pad life.

1. Loosen the locking collar around the adjustment shaft.
2. Raise or lower the platen by turning the adjustment shaft.
3. Retighten the locking collar.

SECTION 6: SANDING TIPS - NON-METALS

Below are some procedures and suggestions for sanding non-metals. Note that since the 500 Series is capable of sanding a wide range of materials, some experimentation may be required before optimum results are reached on your product.

DIMENSION SANDING

The shoes should be set in the spring or air loaded position. If your machine is equipped with an air-loaded billy roll(s), the pressure should be increased and the bed adjusted accordingly (see "Set-Up Adjustment".) If it is equipped with a relieving platen(s), the metal bed strips should be installed to provide a rigid surface.

FINISHING

Generally, if it is desired that stock removal be kept to a minimum, the shoes are set in the rigid position. (NOTE: If your machine is equipped with a standard (non-relieving) bed, it may be advisable to set the shoes in the spring or air loaded position, especially if the material to be run varies in thickness. If the machine is equipped with an air loaded billy roll(s), it should be set to relieve under the finishing head(s) and the bed adjusted accordingly (see "Set-Up Adjustments"). If the machine is equipped with a relieving bed, the metal strips should be removed.

VENEERS AND FILLERS

When finishing thin veneers or fillers, the shoes must be set in the rigid position and the feed bed set to relieve; i.e., the metal strips should be removed or the billy roll set to relieve (see "Set-Up Adjustments").

THIN PANELS

Additional precaution is needed when running thin panels. Care should be taken to prevent double or overlapped feeding. Proper adjustment of No-Go bars helps prevent this.

Extremely warped thin panels may require special deflectors to prev ent stock hang-ups. (Your machine may already be equipped with these.)

SHORT PARTS

Short parts may need to be butt fed to produce optimum results. Also, some adjustment may be required to eliminate dubbing (see "Trouble-shooting Sanding Defects".)

Occasionally, it is desirable to run the abrasive belts in the same direction as the feed for extremely short parts. (Your machine may be set up to do this.) TIMESAVERS, INC. can provide information regarding this change-over.

ISOLATING PROBLEM AREAS

Generally, causes for chatter patterns occurring cyclically can be isolated by the following:

1. Run parts at different feed speeds.
2. If the pattern occurs at spacing independent of the feed speed, the problem is caused by the feed works.
3. If the pattern occurs by the formula

$$\frac{[\text{Conveyor speed (fpm)}]\ [12]}{[\text{Contact drum RPM}]} = \text{Spacing of pattern in inches}$$

the problem is caused by the contact drum.

4. If the pattern occurs by the formula

$$\frac{[\text{Conveyor speed (fpm)}]\ [12]\ [\text{Abrasive belt length (inches)}]}{[\text{Contact drum dia. (inches)}]\ [3.14]\ [\text{Contact drum RPM}]} = \text{Spacing of pattern in inches}$$

the problem is caused by the abrasive belt.

If a mark appears consistantly at a constant distance from one end of the panel, the problem usually is due to a pinch roll or shoe that is the same distance from the drum. If the mark is close to the infeed end of the panel, look for incorrectly set outfeed shoes or rolls. If on the outfeed end of the panel, look at the infeed shoes and rolls.

The following table is a guide to sanding defects, their causes and cures.

PROBLEM	CAUSE(S)	CURES
Tapered panels	Tapered contact drum	Dress drum
	Bed not level	Level bed
	Tapered stock	
	Locking device not adjusted properly	Adjust locking device
Uneven dimensioning	Jack bearings not pre-loaded properly	Tighten jacks
Dubbing (leading edge)	Infeed shoe too high	1) Lower infeed shoe 2) Butt feed short parts
Dubbing (trailing edge)	Outfeed shoe too high	1) Lower outfeed shoe 2) Butt feed short parts
Uneven sanding (finishing)	Sanding pressure too low (shoes in rigid position)	1) With air loaded billy roll increase pressure on air loaded billy roll 2) With relieving bed - close opening slightly 3) Raise infeed shoe(s) slightly
Mark across board near leading edge	Outfeed shoe too low	Adjust outfeed shoe
Long taper or "step" at leading edge	Infeed pinch roll pressure too low	1) Adjust infeed rolls down 2) Adjust spring pressure on infeed pinch rolls
Long taper or "step" at trailing edge	Outfeed pinch roll pressure too low	1) Adjust outfeed rolls down 2) Adjust spring pressure on outfeed rolls

PROBLEM	CAUSES(S)	CURES
Erratic "waviness" in finish	Stock hesitation	1) Dress conveyor belt to remove glaze 2) Feed drive belt worn - replace belt 3) Clean back side of conv. belt 4) Tighten conveyor belt 5) Material build-up on pinch rolls
Chatter	Sanding pressure too low	See "Uneven sanding"
	Machine vibration	1) Tighten bed gibs or jacks 2) Balance contact drum 3) Balance idler roll 4) Replace worn main drive belt 5) Adjust or replace contact drum bearings 6) Foundation inadequate:correct
	Uneven feed	1) Reducer to drive roll coupling loose; correct 2) Excessive gear backlash in reducer; correct 3) Covered billy roll with a flat spot; remove and dress
	Abrasive belt splice improper	Replace abrasive belt
	Contact drum out-of-round	Dress drum
Sand-throughs	Shoes not holding product properly	1) Raise drum (on multiple head machines) 2) Verify shoes in rigid mode 3) Lower shoes
	Bed not relieving properly	1) Lower pressure on air loaded billy roll 2) Remove metal strips from relieving bed 3) Open feed slightly
	Bed-drum not parallel (sand-throughs on one edge	See "Tapered Panels"

SECTION 8: SET-UP ADJUSTMENTS

The adjustments and procedures outlined below may be required when maintenance is needed.

Normally, your machine is set up as required for your product task at the factory.

Consequently, no set-up work is needed for initial operation of the machine except as outlined in "Installation".

Careful attention to detail is required when setting up a machine after maintenance work. Your machine's performance can be sharply affected by slight errors in set-up.

ADJUSTING THE MACHINE TO RUN STOCK

The following procedure should be used for initial set-up and after maintenance work is done on the machine. Note that the procedure for a single head is slightly different than a multiple head.

Single head:

1. Install abrasive belt of the proper grit.
2. Adjust shoes to their highest positions.
3. Adjust bed until a piece of material to be sanded can be loosely placed in machine. Raise bed until drag of abrasive belt occurs when rotating contact drum by hand.
4. Adjust infeed and outfeed shoe down against material.
5. Run set-up material on through machine.
6. Refer to "Sanding Tips" section to complete the set-up for specific product tasks.
7. Run sample parts.

Multiple head:

1. Install abrasive belts of the proper grits.
2. Adjust the infeed shoes and the adjustable outfeed shoes to their highest positions.
3. Adjust bed until a piece of material of uniform thickness can be loosely placed in machine. Raise bed until clearance is eliminated between the fixed outfeed shoe(s) (between heads) and the material.
4. Adjust contact drum(s) down until abrasive belt lightly drags against material. (Similarly, adjust platens, if any, against the material).
5. Set adjustable infeed shoes and outfeed shoe down against material.
6. Run set-up material on through the machine.
7. Refer to "Sanding Tips" section to complete the set-up for specific tasks.
8. Run sample parts.

The above procedures generally produce acceptable parts. Improvements can sometimes be made by experimentation with the adjustments. Use the "Trouble-shooting Sanding Defects" as a guide.

JACKS

Adjustment for height:

1. Loosen the upper boot clamp.
2. Loosen the screws at the top of the jack screws. (Remove them if needed to increase adjustment range.)
3. Turn the jack screw to achieve the desired adjustment.
4. Replace the screws in the top of the jack screws. Three are used per jack.

Drive chain adjustment:

1. Loosen screws at jack drive reducer bracket.
2. Tension chain as required; retighten screws.

Preloading jack bearings:

1. Assure that the drive chain is properly adjusted for tension.
2. Bend lock washer tang out of lock cover detent.
3. Torque lock cover to 55 ft-lbs.
4. Bend a lock washer tang into a detent to lock in place.

CONVEYOR BED

The bed requires adjustment to the following specifications after wear of rolls and after maintenance work is done on the bed.

Ordinarily, these adjustments can be made with the conveyor bed in place. However, should the need arise to remove the bed, the following procedure must be followed. (NOTE: These instructions are for a top head machine and must be modified slightly for a bottom head.)

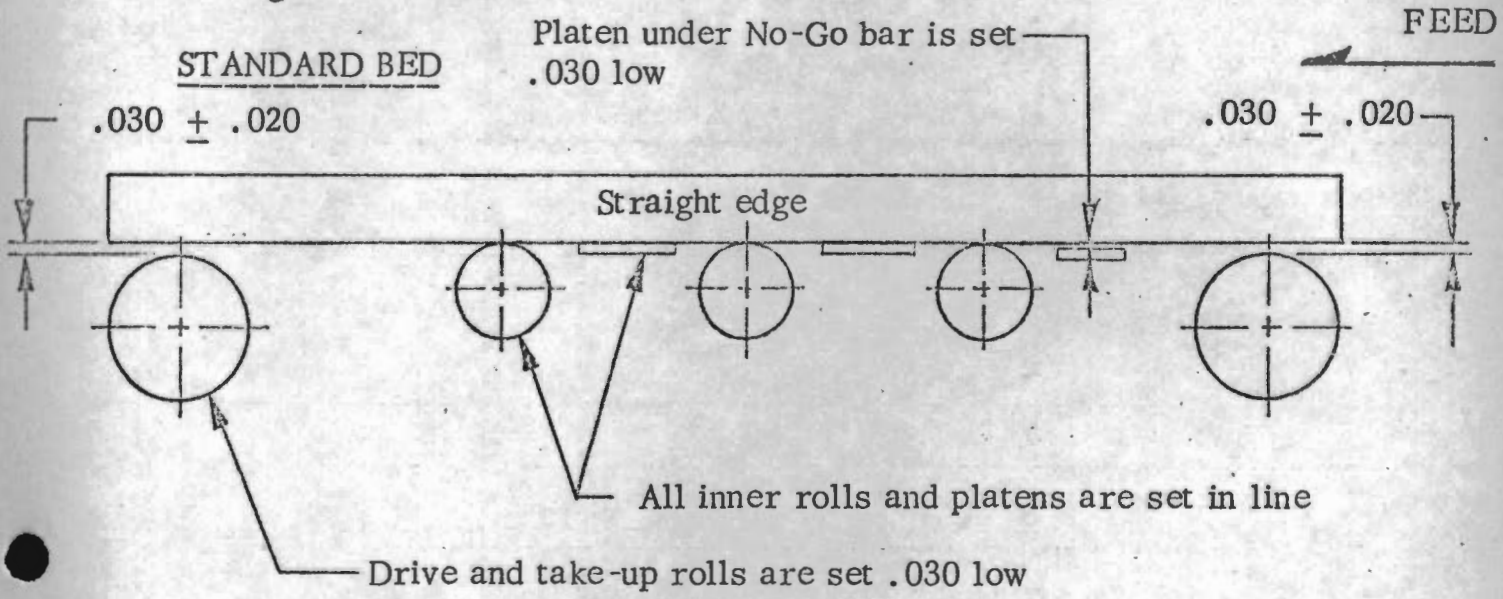
1. Remove screws from bed support plate-conveyor side plates.
2. Remove screws holding the bed slide in place. Clearance holes are provided for these screws. Adjust the bed so screws line up with the holes.
3. Open the feed as far as possible. CAUTION: FAILURE TO COMPLY WITH THE ABOVE STEP MAY RESULT IN DAMAGE TO THE JACKS.
4. Slide the bed out of the machine towards the outfeed side. It is desirable to have the assistance of a hoist or a forklift for this task.
5. Reverse the procedure to install the bed.

ADJUSTMENT OF ROLLS, PLATENS

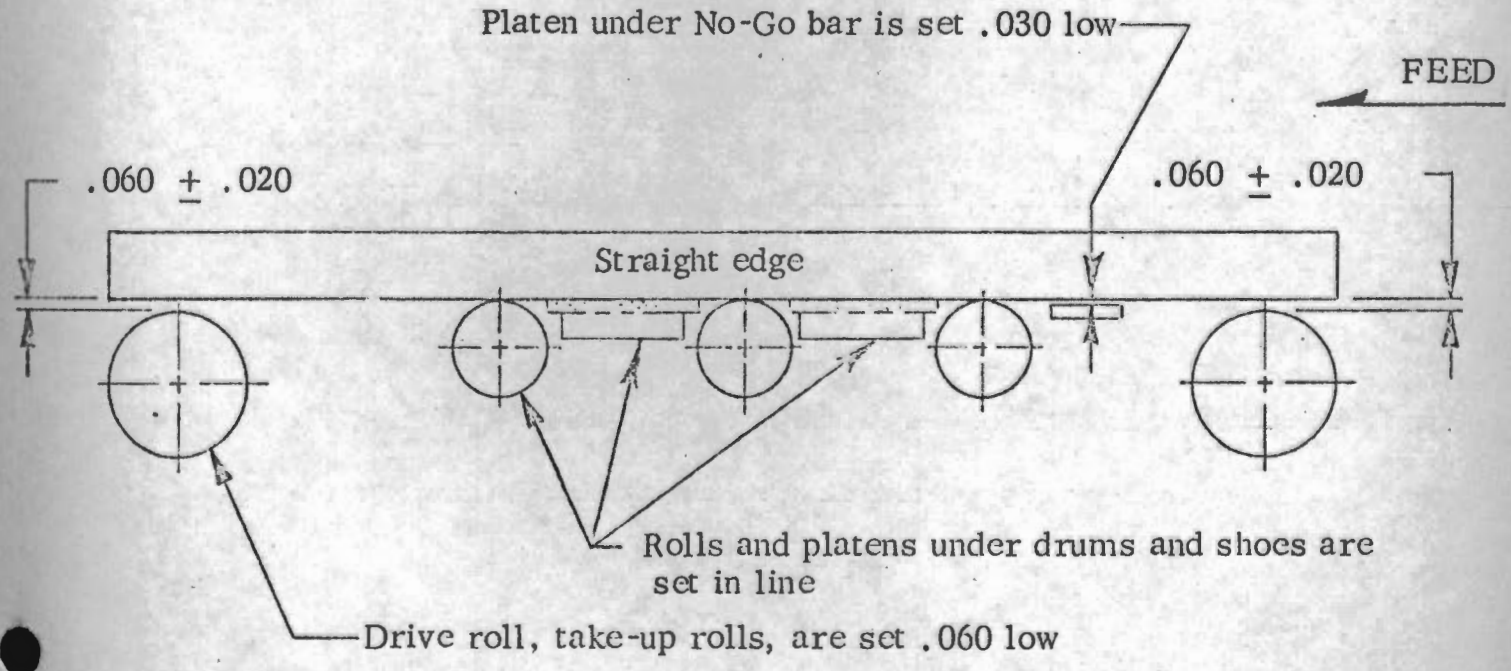
The rolls and platens on the 500 Series machine have been designed for positive location in the machine. They cannot "lose" adjustment. However, after wear of the rolls or platens, relocation can be accomplished by shimming.

These sketches are simplified to show relative location of rolls and platens in typical machines. For detailed construction of your machine, see the assembly drawings in this manual.

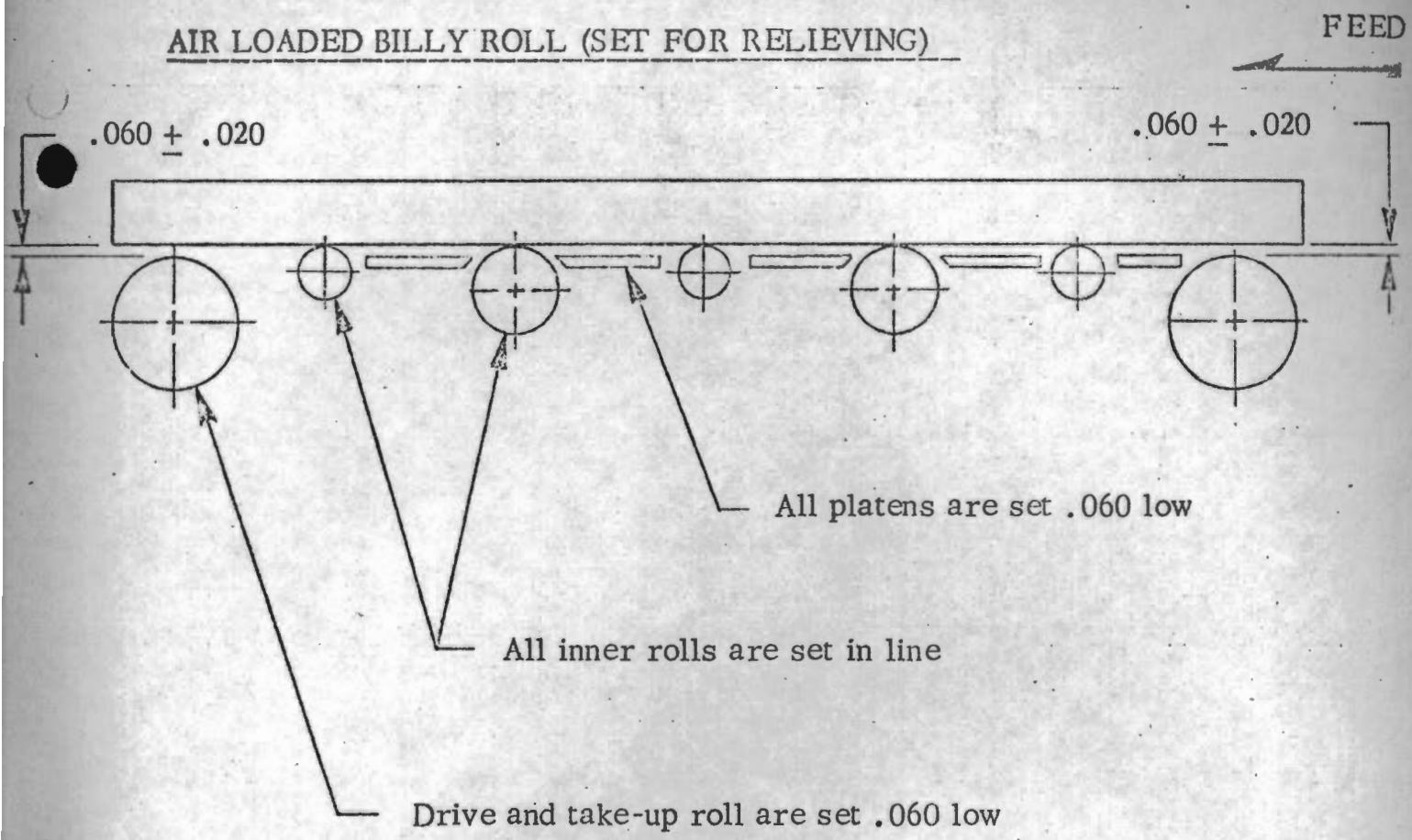
STANDARD BED



RELIEVING BED

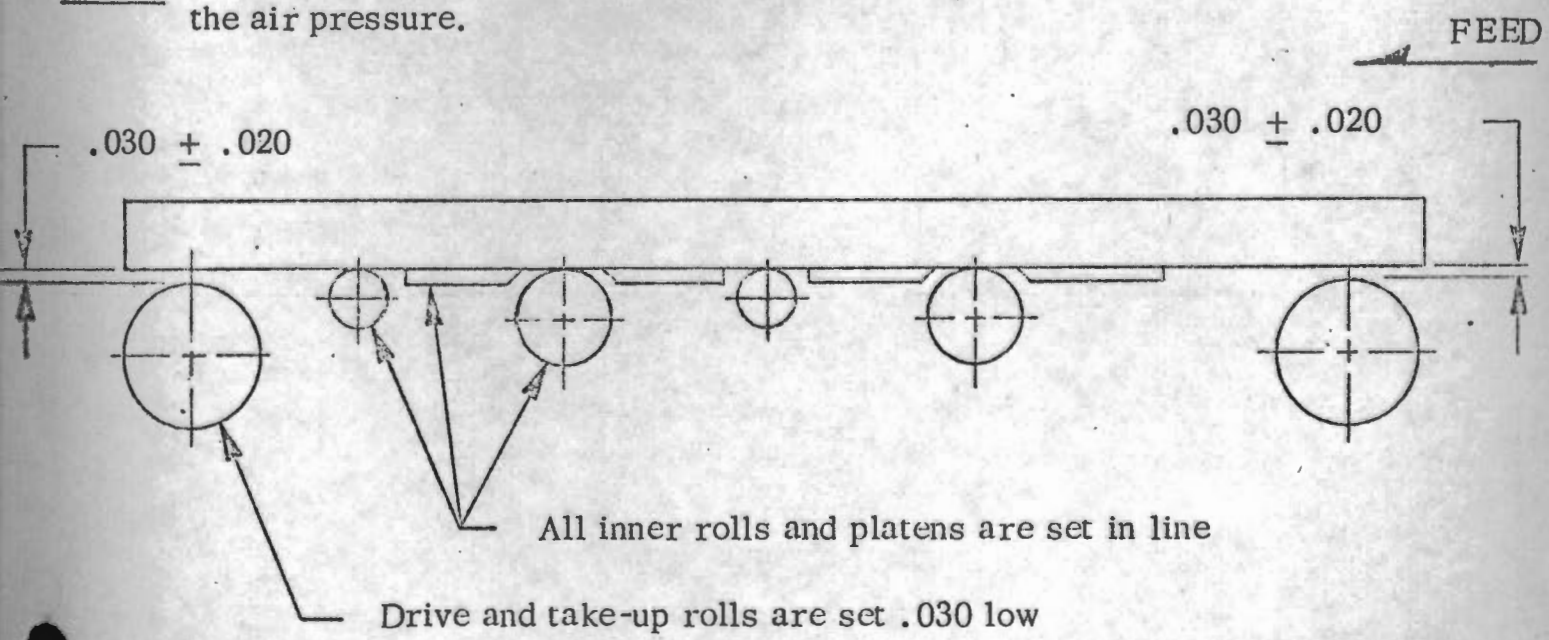


AIR LOADED BILLY ROLL (SET FOR RELIEVING)

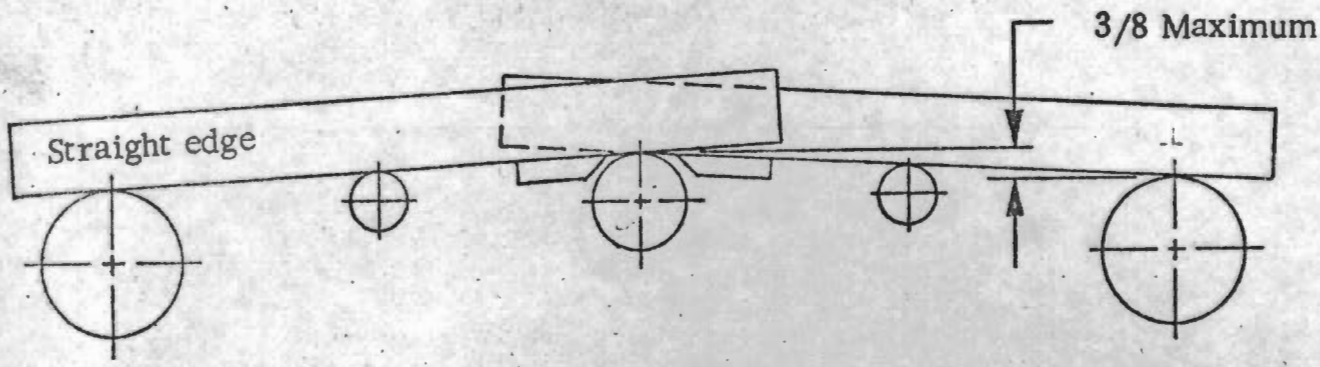


AIR LOADED BILLY ROLL (SET "FIXED" FOR DIMENSIONING).

NOTE: For multiple purpose work, adjust per "relieving" above and vary the air pressure.



BILLY ROLL FOR RUNNING THIN STOCK:



Set all rolls and platens to "crown" up to 3/8 inches at the billy roll

DRESSING THE CONVEYOR BELT

The conveyor belt needs dressing if the surface becomes glazed or if there are low spots in the belt. Using a 36 grit abrasive for urethane and a 100 grit abrasive for all conveyor belts other than urethane, lightly touch the surface of the conveyor belt with the abrasive belt while the feed is running. Remove only enough material to cut the glaze or to remove the low spots.

Track the abrasive belt over the full width of the conveyor belt for a uniform surface.

NOTE: Be sure the contact drum is not tapered and properly adjusted before dressing the conveyor belt.

CONVEYOR BELT TAKE-UP

The tension on the conveyor belt is adjusted by the screws at the ends of the take-up roll. Tighten only enough to feed stock without slipping.

The take-up screws also adjust the tracking of the conveyor belt. If the left screw is turned clockwise, the belt tracks right; counter-clockwise tracks left. If the right screw is turned clockwise, the belt tracks left; counter-clockwise tracks right.

SHOES, PINCH ROLL ADJUSTMENTS

The pinch rolls are adjusted to proper height by the following procedure:

1. Set the shoes and drums to run material as stated in "Adjusting the Machine to Run Stock". Leave the material in place.
2. Open the feed bed .040". (If your machine is equipped with covered pinch rolls, open the bed .060".)
3. Loosen the jam nut at the pinch roll pivot arm and turn the adjusting screw to adjust the rolls against the material. Retighten the jam nut.

Pinch roll pressure is adjusted by a nut equipped with a set screw at the base of the pinch roll spring. Use only enough pressure to produce proper feeding. A similar adjustment is made to adjust shoe pressure. (Note: Small adjustments of springs have large effects on feeding.)

Adjustable shoes (infeed shoes and the last outfeed shoe) have stops to prevent the shoe from contacting the drum. These are located at the inside of the shoe stop screw. These should be adjusted to allow the stop screw to be backed off three-fourths turn only. This adjustment is important to prevent damage to your machine.

Shoes between heads (multiple head machines) are adjusted by slotted brackets. Set these shoes parallel to the bed. Note that these shoes are the base line to which all other shoes, drums and pinch rolls are set, so use extreme care when adjusting these shoes.

The shoes between heads can be made fixed by replacing the shoulder bolts and springs by a 3/8-16 NC cap screw. This should be done when running thin veneers or fillers.

DRESSING CONTACT DRUM

A covered contact drum may be dressed in the machine to correct uneven wear, accidental damage, or when switching to a wider abrasive belt on dual width belt machines. Should damage occur to a steel contact drum, it is necessary to remove it from the machine and dress it on a lathe.

Use the following procedure to dress drums if you have the optional drum dresser assembly.

1. Install the drum dresser assembly under the contact drum.
2. Verify that the drum axis is parallel to the dressing bar by gauging to the drum shafts. Similarly, verify that the drum bearings are concentric by gauging to the drum shafts and rotating the drum.
3. Fasten an adhesive backed 80 grit abrasive strip to the top of the dresser slide.
4. Apply power to the contact drum, opposite the normal direction.
5. Close feed bed until the abrasive just touches the drum. Slowly slide the dresser across the face of the drum, taking a very light cut. Crowding causes distortion of the drum.
6. Slide the dresser back and forth across the face of the drum until no more material is being removed.
7. Close the feed .002" and repeat until the drum is free of defects.
8. Finish dressing with light cuts using 100 and 150 grit abrasives. This will produce a smooth face.

9. Return contact drum to normal running direction. Take a very light cut with 150 grit abrasive to break the leading edge of the land.
10. When dressing is complete, check for roundness with a dial indicator or chalk.

If no drum dresser assembly is available, the drum may be dressed by the following procedure:

1. Check the drum as described above.
2. Obtain an absolutely flat piece of closely dimensioned plywood or chipboard, two inches longer than the contact drum and at least four inches wider than the span between pinch rolls which serve as holddown rolls.
3. Set the shoes spring or air loaded and adjust to their lowest position.
4. Apply adhesive backed abrasive strip approximately 80 grit parallel to the contact drum axis.
5. Jog board into machine until abrasive strip is under drum center line.
6. Apply power to the contact drum, opposite to normal direction.
7. Crank bed toward abrasive strip until abrasive strip just starts to cut. A very light cut should be taken and a minimum of rubber removed. Crowding causes distortion of the drum.
8. After approximately one-half minute, lower feed bed and allow the drum to cool.
9. Move strip 1/4" axially each time while waiting for the abrasive to cool. This will provide uniform cut, reducing grit profile.
10. Take further cuts as necessary in .002" increments, backing off after each cut to allow abrasive to cool.

11. If abrasive is still cutting when drum is backed off for cooling, return to same position on next cut. Do not take additional .002" cut until there is no further rubber being removed.
12. Repeat above procedure using a 100 grit and 150 grit abrasive strip. The object is to make a smooth surface, restoring drum to original condition.
13. Return contact drum motors to normal running direction and take a light cut to break the leading edge of the land.
14. When dressing is completed, check surface with dial indicator or chalk. Test for parallel with billy roll or platen.

NOTE:

AFTER DRESSING, CONTACT DRUM WILL HAVE A REDUCED DIAMETER. THEREFORE, PINCH ROLLS AND SHOES MAY HAVE TO BE RESET AND/OR THE DRUM SHIMMED TO CORRECT POSITION. (SEE "SET-UP ADJUSTMENTS".)

SHIMMING THE CONTACT DRUM FOR WEAR

After the contact drum has worn, it is possible to shim the drum to provide extended life. TIMESAVERS, INC. can provide you with a shim package. The shims are installed between the support bracket and the center bar. It is recommended that the drum be shimmed in .100" increments until recovering is required. Note that the drum must be shimmed equally on both ends. Shimming the slides on the center bar an equal amount will provide ease in replacing the contact drum.

CONTACT DRUM BEARINGS

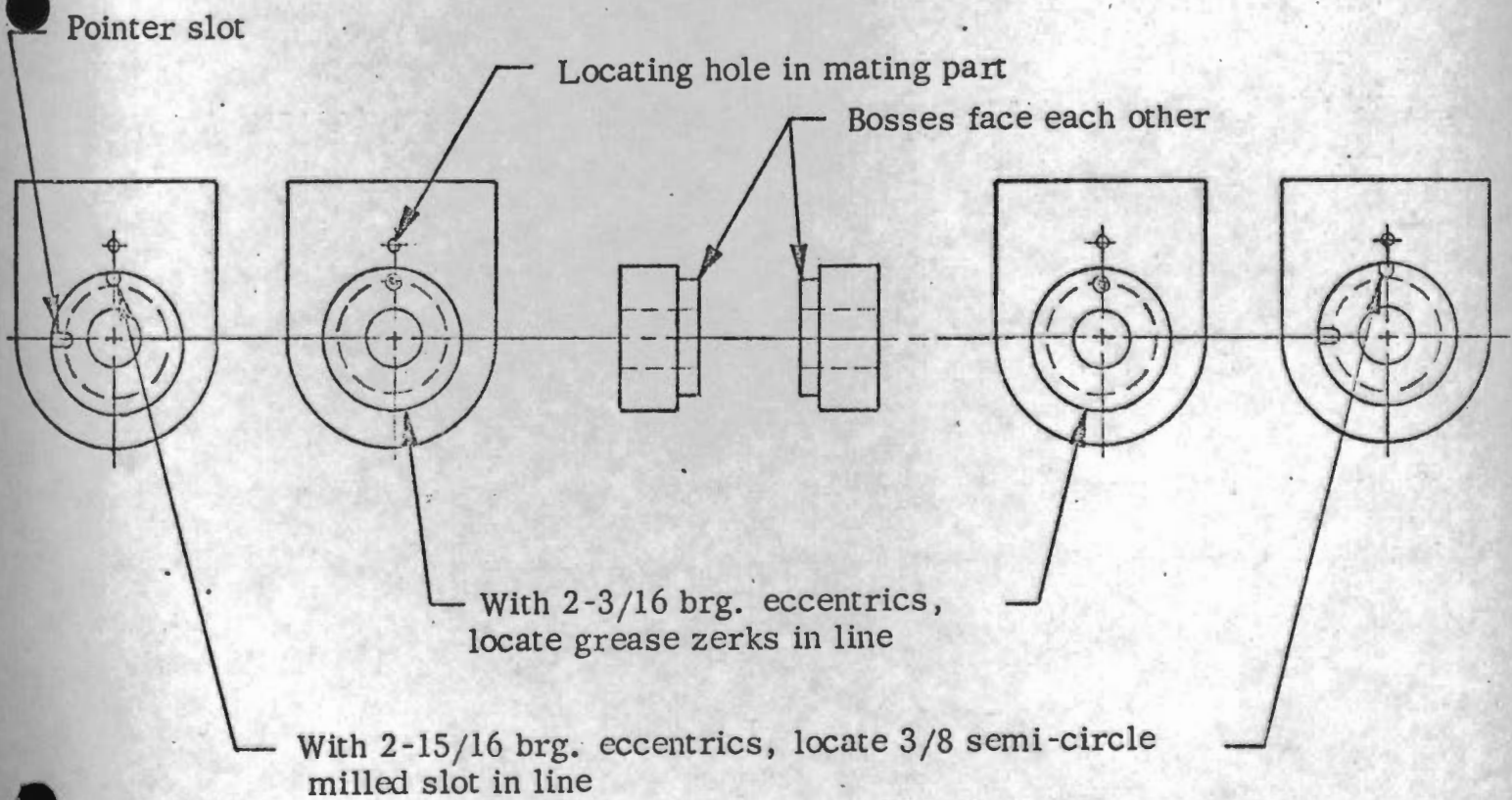
All TIMESAVERS contact drums are mounted with precision bearings. To get the benefit from these bearings, it is necessary to follow installation procedure described in Component Literature at the back of this manual.

IMPORTANT: After several days operation after installation of bearing, lock nut should be checked and, if necessary, drawn up an additional amount. This will insure the shaft is concentric to the bearing. Proper installation with periodic lubrication will make these precision bearings last indefinitely.

CONTACT DRUM ECCENTRICS

(These are not used on all machines.)

If it becomes necessary to remove contact drum bearings, the eccentrics must be reinstalled in the same position to obtain proper "throw" of the eccentrics. Refer to the sketch below for detailed instruction.



LOCKING DEVICE ASSEMBLY

Correct adjustment of the locking device assembly will assure good finish and tolerance on your product. To adjust:

1. Loosen the adjustment bolt at the bottom of the clamp and loosen for clearance.
2. Adjust the stop at the locking lever so the lever is just over center when in the closed position.
3. Adjust the bolt at bottom of the clamp so it locks the center bar in place when the locking lever is closed. The assembly should be adjusted so as to provide maximum clamping while allowing the changing of belts with relative ease.

BRUSHES

Panel cleaning and conveyor cleaning brushes are available on the 500 Series machine. These brushes should be set approximately 1/16" into the surface to be cleaned. "Mushing" the brush into the surface only decreases brush life with little or no improvement in cleaning.

Slots are provided in the brush brackets for wear. The entire assembly is moved for adjustment.

Some brushes have a "kicker bar" to assist in removing dust from the brush. These should be adjusted about 1/16" into the brush.

SUGGESTED LUBRICATION SCHEDULE

BEARINGS

Contact drum Center bar eccentrics Idler roll Conveyor drive rolls High speed shaft on speed reducer Variable speed sheave All other bearings	Grease every 300 hours
Jacks for raising or lowering sanding head	Grease once a year

Use a good grade of medium high temperature (400° F.) bearing grease.

GEAR REDUCER (OIL)

See enclosed bulletin on Suggestions for Installation and Lubrication of Speed Reducer.

CHAINS

Lubricate once a month by brushing oil on chain. A molybdenum disulfide oil is recommended.

AIR FILTER

Drain bowls weekly.
Replace oil removal filter when visual indication of oil saturation appears on the surface of the element.

TRACKING CYLINDER

Lubricate once a month by removing air lines at tracking cylinder and put 2-3 drops of #10 non-detergent oil directly into both ends of cylinder.
Caution: DO NOT over-lubricate.

TENSIONING CYLINDER: Grease fitting on top flange of air cylinder. One shot of any good grade of E.P. grease every 300 hours.

WAYS ON SLIDE ASSEMBLIES: Clean off old grease and grease every 3 or 4 months using any good grade of grease.

SHAFT COUPLINGS: Grease once a year. Refer to Component Literature for method.

AIR/HYDRAULIC CALIPER BRAKES - 500 SERIES MACHINES

Each contact drum shaft is fitted with a brake rated to absorb the energy of rotating parts. Each head has two caliper brakes. See: "Safety Devices" for conditions which activate brake.

At Installation:

1. Fill cylinder through filler port. Use a good grade of brake fluid. Bleed at port opposite line on caliper brake.
2. Check to see that brake disc is centered between brake shoes and turns freely when brake is not energized.
3. Check fluid and air lines for leakage.

If brake does not stop motor and sanding unit 4 to 5 seconds after brake is applied:

1. Air line pressure may not be adequate. Check gauge and increase pressure.
2. Hydraulic cylinder may need additional oil. Check for leaks.
3. Brake pucks may be worn. Refer to component literature for installation procedure.
4. Solenoid valve, relay, or micro switch not working. Refer to air and electrical diagrams.

PROCEDURE FOR CHECKING AIR TRACKING SYSTEM

If no setting of the tracking adjustment knob will track abrasive belt, use following list for checking air tracking system. (Refer to schematic.)

1. Abrasive belt direction may have been changed without switching lines to tracking cylinder.

2. Air pressure supply to air box not adequate.
   Pressure should be set at 60-80 PSI.

3. Relay valves not set properly.
   Set relay valves as described on previous page. If the relay valve fails to function properly, there is likely dirt in the valve seat. Disassemble valve and clean. Inspect valve for broken or damaged parts.

4. Nullmatic regulator not at right pressure.
   Regulator should be at 6 PSI for 30" to 52" belt machines and at 8 PSI for 64" machines.

5. Air not escaping from air jets on idler roll.
   A. Air holes in idler plugged.
   B. Air strainer on nullmatic regulator plugged.
   C. Restricted fittings plugged.
   D. Water or oil in air lines or components.
   E. Air lines pinched or broken.

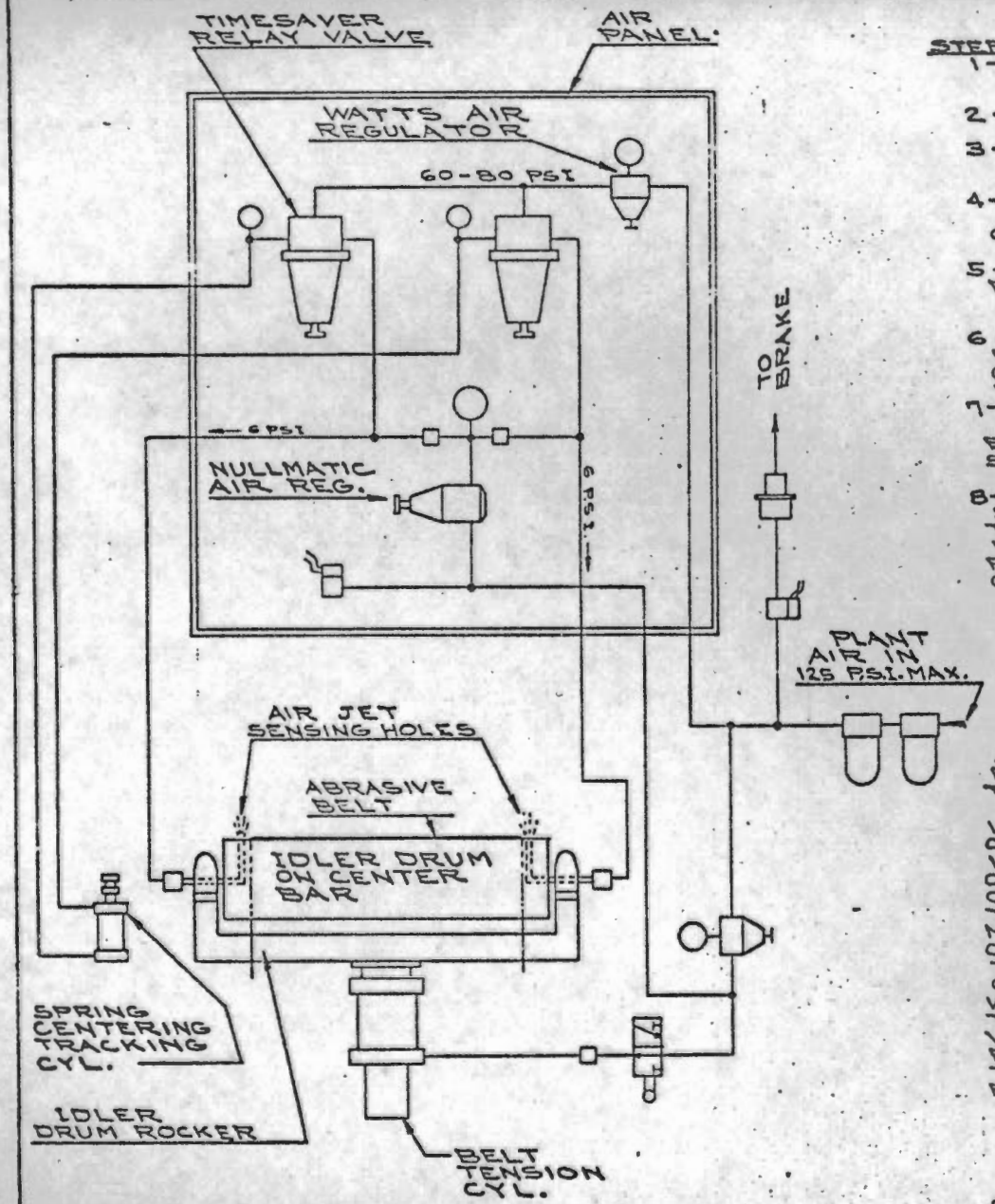
6. Air tension cylinder pressure not adequate.
   Increase pressure so air cannot easily escape between belt and idler roll.

7. Faulty rotary joint
   If air issues from hole and air relay fails to trip when you block hole with your finger, air may be blowing out of rotary joint. Disconnect air line at rotary joint and plug end of it. If relay trips and cylinder corrects, rotary joint is at fault.

8. Rocker fails to move when relay valve tripped.
   A. Air lines to tracking cylinder pinched or broken.
   B. Rocker is binding. Grease tension cylinder through fittings.
   C. Air pressure supply to air box not adequate.

9. Rocker corrects properly but fails to track.
   A. Tracking adjustment knob at the end of adjustment.
      1. Loosen bolts on adjustment cylinder bracket and move in direction to give more adjustment on tracking knob.
      2. Contact drum tapered. (This also would cause belt creasing). SEE "Dressing Contact Drum".
      3. Bearings loose on idler drum. Idler drum not parallel to contact drum.

In some of the above cases you may have a faulty part with no spares on hand. It may still be possible to continue production by compensating tracking to good side of air tracking system. If you can't track on one side of machine, adjust tracking knob to force belt to other side which is working. You will be able to operate until rest of line is down or until spares arrive.



SETTING OF TRACKING SYSTEM

STEP

1- MOUNT AN ABRASIVE BELT ONTO MACHINE AND TENSION IT.

2- PUSH THE "DRUM OFF" BUTTON TO RELEASE BRAKE.

3- TURN IDLER DRUM UNTIL BOTH AIR JET SENSING HOLES ARE UNCOVERED BY ABRASIVE BELT

4- CHECK TO SEE THAT AIR SUPPLY FROM WATTS AIR REG. TO TIMESAVER RELAY VALVES "ALL LOCATED ON AIR PANEL" IS 60 - 80 P.S.I.

5- THE NULLAMATIC AIR REG. "LOCATED ON AIR PANEL" SHOULD BE ADJUSTED TO READ 6 OR 8 P.S.I.

6- TURN ADJ. SCREW UNDER TIMESAVER RELAY VALVE COUNTER-CLOCKWISE UNTIL GAUGE READS 60 - 80 P.S.I. "ADJ ONE RELAY AT A TIME."

7- SLOWLY TURN SAME SCREW CLOCKWISE UNTIL GAUGE READS "0" P.S.I.: ADJUST SCREW BACK AND FORTH UNTILL YOU ARE SURE IT IS SET AT THE EXACT "0" P.S.I POINT

8- NOW PLACE YOUR FINGER OVER THE AIR JET SENSING HOLE. WHEN THE HOLE IS BLOCKED THE GAUGE ON THE RELAY VALVE SHOULD READ 60 - 80 P.S.I. AND THE IDLER DRUM ROCKER SHOULD MAKE THE PROPER CORRECTION.

DESCRIPTION OF OPERATION

50970

WHEN THE ABRASIVE BELT IS TRACKING PROPERLY, 6 P.S.I. AIR FROM THE NULLMATIC REG. IS FLOWING OUT THE AIR JET SENSING HOLE. THE TIMESAVER RELAY VALVE IS IN THE OFF POSITION. BLOCKING THE HIGH PRESSURE 60 - 80 P.S.I.

WHEN THE BELT TRACKS OFF TO ONE SIDE IT BLOCKS THE AIR JET SENSING HOLE CAUSING A BACK PRESSURE TO BUILD UP IN THE SENSING AIR LINE. THIS BACK PRESS CAUSES THE TIMESAVER RELAY VALVE TO OPEN, AND FEED HIGH PRESSURE 60-80 PSI TO THE TRACKING CYL. THE TRACKING CYL. MOVES THE IDLER ROCKER FOR PROPER CORRECTION UNTIL THE BELT BACKS OFF OF THE AIR JET SENSING HOLE, ALLOWING THE 6 P.S.I. AIR TO ESCAPE ONCE AGAIN. WHEN THIS AIR ESCAPES, THE SPRING IN THE TIMESAVER RELAY VALVE WILL CAUSE THE VALVE TO CLOSE, AND BLOCK THE HIGH PRESSURE, THE SPRING CENTERED TRACKING CYL. WILL RETURN THE IDLER ROCKER TO ITS NORMAL POSITION.

DO NOT SCALE DRAWING — WORK TO DIMENSIONS GIVEN

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WEIGHT:			REPRODUCED
DESIGN	400 500		REVISIONS
CHANGE DATE			DATE
SCALE			EXCEPT AS NOTED:
DRAWN	G.WILLIAMS		TOLERANCE
DATE	3-5-71		FINISH

TIMESAVERS, INC.
51 HANSEN COURT
WAYZATA, MINNESOTA 55391

BELT TRACKING

PURPOSE OF A COMPENSATING HYDRAULIC POWERED CONVEYOR FEED SYSTEM

The purpose of compensating a hydraulic powered conveyor feed system is to have the necessary power available to feed the material through the machine and yet be able to realize the safety factor necessary to keep an uncontrolled power from forcing material through a machine when the material might be oversize, double thickness, jammed up in the machine, or any resistance greater than the predetermined amount which the hydraulic system is set for. With this arrangement, the adjustable feed drive will slow down to allow the abrasive belt to remove excess stock without overloading the abrasive belt drive motor.

ADJUSTMENT OF VARIABLE VOLUME PRESSURE COMPENSATING PUMP

Before adjusting a variable volume pressure compensating pump of the type used in this system, there are several items which should be understood about the hydraulic pump.

1. A pump does not pump pressure; it pumps oil.
2. Pressure is caused by resistance to flow.
3. This variable volume pump can be adjusted to pump from 0 GPM to the rated GPM of the pump.
4. The volume (flow) is the feed speed adjustment for the conveyor motor.
5. The pressure compensating spring adjustment does not adjust pressure output of pump, but pressure at which the volume delivery of the pump changes or decreases to slow feed motors down or stall in case of jam-up.

   (The hydraulic system does not sense abrasive belt motor load in any way, only resistance to the torque required to feed the material through the machine.)

For initial start-up of the hydraulic system, the hydraulic pump should be set for "No flow" (turn flow control screw clockwise) and back off the pressure compensating spring until handknob turns freely (counter-clockwise). The purpose of this is for safety, both from damage to equipment and machine due to compensating pressure and feed speed being changed without operator's knowledge and also from lines being hooked up wrong or not hooked up at all. Now, turn off the valve in the pressure line.

After starting the hydraulic pump and checking for leaks, adjust the pressure compensating handknob in (clockwise) until operator can feel the spring compressing. Adjust flow control screw out (counter-clockwise) just far enough to get enough flow from the hydraulic pump so that the compensating pressure can be set to approximately 350 PSI on the pressure gage. With the compensator set at this pressure, open the valve in the pressure line and allow oil to flow to the hydraulic feed motor. (Check for leaks and correct rotation of feed motor.)

Adjust the flow control screw to set the desired feed speed of the conveyor unit. To set the compensating pressure, a certain amount of trial and error must be used. As the hydraulic system knows only resistance to torque required to feed the material through, care should be taken in setting the pressure at which the hydraulic pump compensates. If the product being sanded is flat with little or no stationary shoe drag, then the main resistance against the product is the abrasive belt sanding the product. If the product being sanded is not flat or has curled thick areas, etc., then the feed load does not necessarily reflect abrasive belt motor load. In this case, care should be taken to adjust compensating pressure so that the motor load does not exceed 100% when a product is sanded that has little or no stationary shoe drag.

BREAK-IN PERIOD

It is recommended that after approximately eighty(80) hours of operation, the entire hydraulic system be drained and the oil replaced with an "anti-wear" type oil as specified in the "Hydraulic Oil Recommendation" section of this manual.

The purpose of this break-in period is to flush all contamination from lines, fittings, pump, motor and all component parts. Also, hydraulic equipment has very close machining tolerances and some parts must "wear in" to mating parts.

Suggested procedure for replacing the oil in the complete hydraulic circuit is to adjust the feed speed of the unit so the rolls or conveyor belt is turning very slowly (approximately 10 FPM). This is reducing the volume output of the pump.

Turn off the electric motor driving the hydraulic pump. Drain the reservoir and refill to correct oil level. Remove return line at filter and hold line in a 5-gallon pail. Now, jog (turn on and off) electric motor driving hydraulic pump. CAUTION: DO NOT run motor, only jog, as pump will deliver several gallons per minute even at low feed speed. Run enough oil out of circuit to feel reasonably sure the entire circuit has fresh oil. Replace return line to filter, bring oil to correct level in reservoir and readjust feed speed for operation.

SUGGESTED PREVENTATIVE MAINTENANCE

1. Maintain a leak free system: Leaks are not only messy but also costly, due to cost of replacement oil, possible damage to equipment from low oil level and possible accidents.

2. Change filter elements and reservoir breather at scheduled intervals depending upon individual conditions. DO NOT blow off air breather with an air pressure hose.

3. After changing to the anti-wear type hydraulic oil, standardize on one brand available in your area. DO NOT mix different brands of hydraulic oil.

HYDRAULIC OIL RECOMMENDATION

The hydraulic oil recommended for use in this equipment must meet specifications as follows:

An "Anti-wear" type hydraulic oil

275-315 SSU @ 100^{o} F

Aniline point 215^{o} - 240^{o} F

Viscosity index 95 minimum

Pour point 0^{o} F maximum

Some major brand hydraulic oils which meet these specifications are:

Shell Oil Co.	- Shell Tellus #933 Code #65226
Texaco, Inc.	- Rando H.D.C. Code #728
Mobil Oil Co.	- DTE #26
Sinclair	- Duro AW-31
Standard Oil Co.	- Rycon Industries Oil #31
Pure Oil Co.	- Puropale RX #4197

MODEL 500 SERIES

SUGGESTED SPARE PARTS LIST

Parts listed below are expendable items which, in our experience, are advisable to have on hand to prevent unnecessary down time. All listed items are stocked except contact drums.

DESCRIPTION	ALL PRICES F.O.B. MINNEAPOLIS, MINN.
(1)	Air Relay, Part #23015
(1)	Air Rotary Joint, Part #25850
(1)	Nullmatic regulator #41 1/8 PSI
(2 Pair)	Brake Pucks
(1)	Coil for Solenoid Brake Valve
(2)	Precision Contact Drum Bearing Insert for 10-1/4" Dia. Drums: (1) 2-3/16 Dia. Bore and (1) 2-15/16 Dia. Bore
(1)	Idler Roll Pillow Block Bearing
(1)	Contact Drum
(1)	Feed Drive Belt
(1)	Conveyor Belt
(2)	Limit switch tips
(1)	Repair kit for brakes
(2)	Filters for hydraulic unit

HOW TO ORDER REPLACEMENT PARTS

If replacement parts are required, it is essential for you to provide us with the following information so that we can quickly provide you the correct parts:

Machine serial number

Model number

Sub-assembly number

Part number

Your description of part

Quantity of parts needed

The machine serial number and model number should be copied from the serial number plate on your machine.

To find part number, refer to the assembly drawings. Please note that there are several assemblies making up your machine.

COMPONENT LITERATURE

The attached literature gives essential information for components used in your machine. Familiarize yourself with the literature and refer to it for maintenance and repair of components.

TIMESAVERS, INC.
5270 Hanson Court • Minneapolis, Minnesota 55422
(612) 537-3611 • TELEX 29-0284

SERVICE POLICY

START-UPS

The Service Department of TIMESAVERS, INC. should be notified at least one week in advance of proposed start-up date in order to insure the availability of a service engineer.

All blowpipe and electrical connections should be made before the arrival of our service engineer. If a second visit is required by our serviceman due to the machine not being ready for start-up on the scheduled date, our standard charges will apply.

Where free start-up service is provided, it must be concluded on week days. All service on week-ends or holidays will be paid calls.

SERVICE CALLS

All service will be charged at the following rates, plus living and traveling expenses:

Week days. . . . . .$145.00 per day
Week-ends & Holidays . . .$195.00 per day

PARTS WARRANTY

TIMESAVERS, INC. will guarantee all of its manufactured parts to be free from defects in workmanship and material under normal use and service for a period of one year.

All purchased items, such as motors, bearings, speed reducers, etc., are guaranteed for a period of ninety (90) days or as long as original manufacturers guarantee, whichever is longer.

Any part proving defective in material or workmanship within the above described limits will be duplicated without charge, FOB factory or shipping point, to be installed at the expense of the purchaser.

The Manufacturer shall not be responsible for work done, material furnished or repairs made by others unless agreed to in writing, and reserves the right of doing or supervising any necessary repair work incident to putting equipment in proper operation under this warranty.

Effective April 15, 1974

INDEX

COMPONENT LITERATURE

SERIES 500

AIR

AIR CYLINDER #47235 (6" Bore x 3" Stroke)
AIR CYLINDER #23395-5
LIN AIR CYLINDER (Ref. 23395-5)
AIR RELAY VALVE ASSEMBLY #23015
FIRESTONE AIRIDE #16
AIR-OIL BOOSTER, Mico #12-021-025
AIR REGULATOR, WATTS
AIR REGULATOR, MOORE NULLMATIC #41 1/8"
AIR FILTER, WATTS
PNEU-TROL SLIDE VALVE #SL-10

ELECTRICAL

BELLOWS VALVES
A.B. BULLETINS
#702-717, Size 00, 0, 1, 2, 3, 4
#702-709, Size 5
#700, Control Relays
BARKSDALE PRESSURE SWITCH Form #61104 B
LOUIS ALLIS OPER. & LUBE INSTRUCTIONS
RELIANCE MOTOR

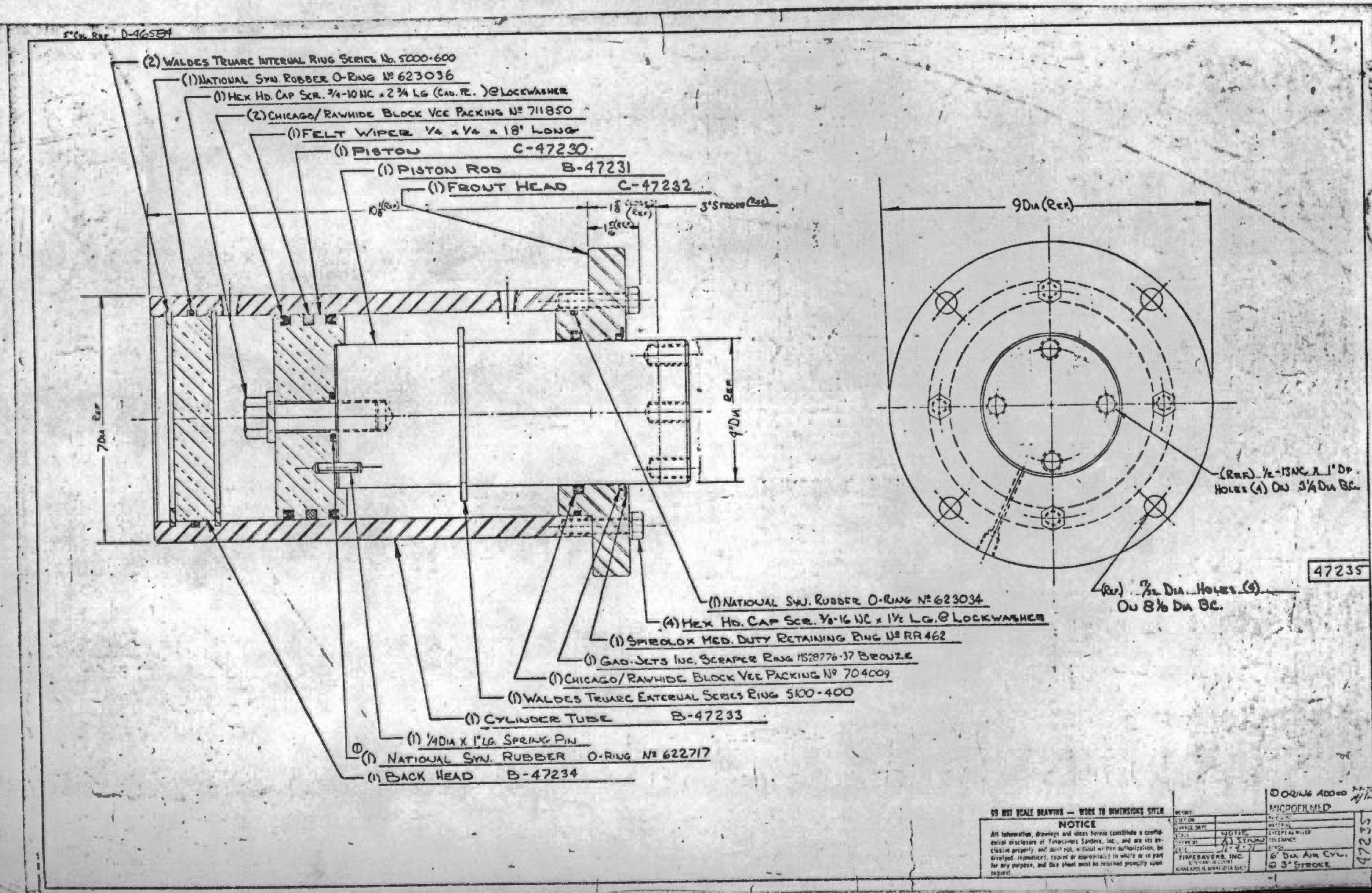
MECHANICAL

FAFNIR BEARINGS
GERBING - ROTO-CONE DRIVE, COMPOUND DRIVE
WINSMITH GEAR REDUCER - INSTALL & LUBE - CV, FCV, YOGI
LINK BELT BEARING - Ball, Pillow Block, Flange Roller
CALIPER BRAKE, MICO
STRANDBERG TACHOMETERS

HYDRAULIC

VICKERS
Variable Delivery Piston Pumps
PVB 10, PVB 15
Trouble-Shooting Guide & Maintenance Hints

PARKER HANNIFIN
Vane Type Hydraulic Motor 810, 820



5" CYL. REF. D-46584
(2) WALDES TRUARC INTERNAL RING SERIES No. 5000-600
(1) NATIONAL SYN. RUBBER O-RING Nº 623036
(1) HEX HD. CAP SCR. 3/4-10 NC x 2 3/4 LG (CAD. PL.) @ LOCKWASHER
(2) CHICAGO/RAWHIDE BLOCK VEE PACKING Nº 711850
(1) FELT WIPER 1/4 x 1/4 x 18" LONG
(1) PISTON C-47230
(1) PISTON ROD B-47231
(1) FRONT HEAD C-47232
3" STROKE (REF)
9 DIA (REF)
7 DIA REF
4" DIA REF
(REF) 1/2-13NC x 1" DP. HOLES (4) ON 3 1/4 DIA BC.
(REF) 7/32 DIA. HOLES (8) ON 8 1/2 DIA BC.
47235
(1) NATIONAL SYN. RUBBER O-RING Nº 623034
(4) HEX HD. CAP SCR. 3/8-16 NC x 1 1/2 LG. @ LOCKWASHER
(1) SPIROLOX MED. DUTY RETAINING RING Nº RR 462
(1) GAR-SETS INC. SCRAPER RING MS28776-37 BRONZE
(1) CHICAGO/RAWHIDE BLOCK VEE PACKING Nº 704009
(1) WALDES TRUARC EXTERNAL SERIES RING 5100-400
(1) CYLINDER TUBE B-47233
(1) 1/4 DIA X 1" LG. SPRING PIN
① (1) NATIONAL SYN. RUBBER O-RING Nº 622717
(1) BACK HEAD B-47234
① O-RING ADDED
MICROFILMED
DO NOT SCALE DRAWING — WORK TO DIMENSIONS GIVEN
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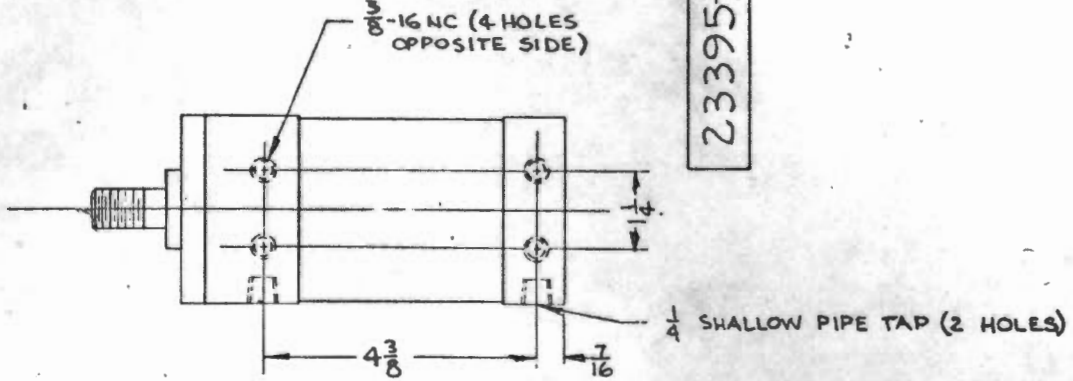
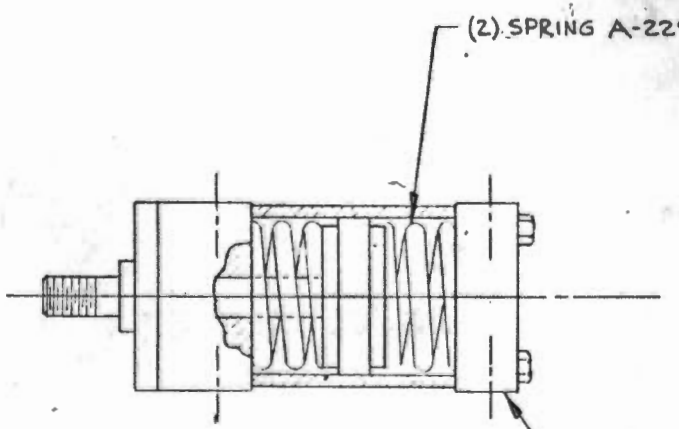
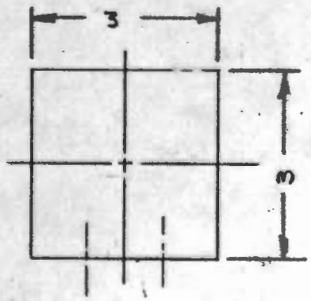
TIMESAVERS, INC.
6" DIA AIR CYL. @ 3" STROKE
47235



233955





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USED ON	STD.	REVISIONS
CHANGE DATE		MATERIAL
SCALE	1/2	EXCEPT AS NOTED:
DRAWN BY	P.H. ARMSTRONG	TOLERANCE ± 1/64
DATE	9-23-64	FINISH

TIMESAVERS, INC.
MINNEAPOLIS 22, MINNESOTA

AIR CYLINDER ASSY (2½" B x 2" S)

233955

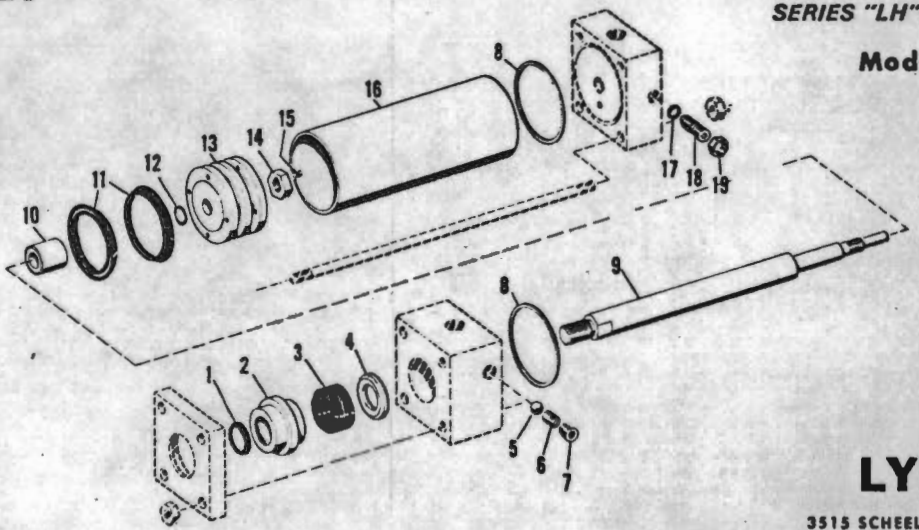
REPAIR PARTS SHEET

BASIC PARTS LIST

ITEM NO.	PART NAME	QTY. PER UNIT
1	ROD WIPER	1
2	ROD BEARING	1
3	ROD PACKING	1
4	SUPPORT RING	1
5	BALL	2
6	SPRING	2
7	PIPE PLUG	2
8A	GASKET SERIES "A" ONLY	2
8LH	HEAD TO SHELL "O" RING "LH" ONLY	2
9	PISTON ROD	1
10	CUSHION BUSHING	1
11	PISTON PACKING	2
12	PISTON "O" RING	1
13	PISTON	1
14	PISTON NUT	1
15	SET SCREW	1
16	SHELL	1
17	ADJ. SCREW "O" RING	2
18	CUSHION ADJ. SCREW	2
19	ADJ. SCREW NUT	2

SPECIFIC MODEL PARTS LIST

ITEM NO.	PART NAME
A	TIE ROD NUT
B	CAP
C	FOOT MOUNT ROD END HEAD
D	TIE ROD
E	FOOT MOUNT BLIND END HEAD
F	STANDARD ROD END HEAD
G	PIVOT MOUNT BLIND END HEAD
H	FRONT FLANGE MOUNTING PLATE
J	STANDARD BLIND END HEAD
K	REAR FLANGE MOUNTING PLATE
L	FRONT TRUNNION MOUNT ROD END HEAD
M	REAR TRUNNION MOUNT BLIND END HEAD
N	END LUG MOUNT NUT
P	CENTERLINE MOUNT ROD END HEAD
R	CENTERLINE MOUNT BLIND END HEAD



SERIES "A" SQUARE TYPE AIR CYLINDERS

SERIES "LH" LOW PRESSURE HYDRAULIC CYLS.

Models A,B,C,D,E,F,G,J,K,L

When ordering repair parts for LYNAIR SQUARE AIR CYLINDERS, furnish the following information:

SERIAL NUMBER
MODEL NUMBER
PISTON ROD DIAMETER
BORE
STROKE

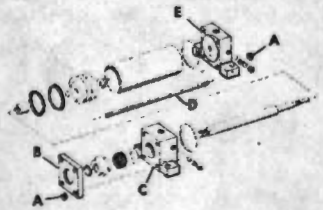
Also specify the parts you need by the item number and FULL part name.

Basic cylinder repair parts are shown in the large illustration. Repair parts suitable only to specific models are shown in the smaller illustrations. Order by letter and FULL part name.

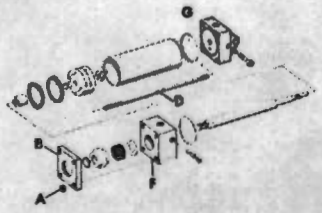
LYNAIR, INC.

3515 SCHEELE DRIVE JACKSON, MICHIGAN

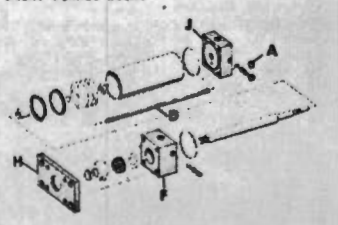
MODEL A
FOOT MOUNT



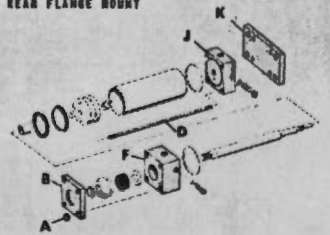
MODEL B
PIVOT MOUNT



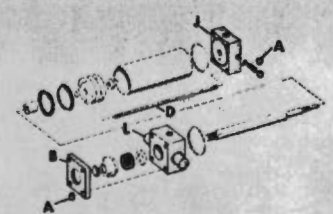
MODEL C
FRONT FLANGE MOUNT



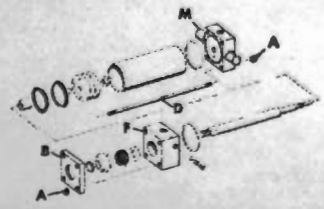
MODEL D
REAR FLANGE MOUNT



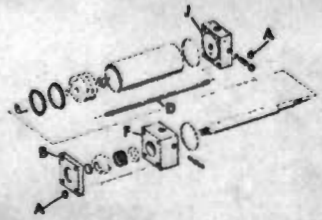
MODEL E
FRONT TRUNNION MOUNT



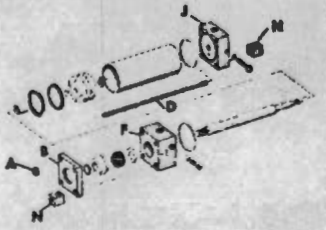
MODEL F
REAR TRUNNION MOUNT



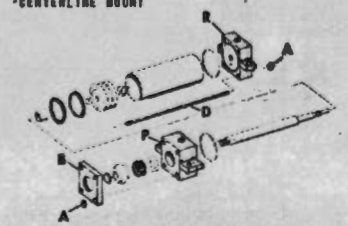
MODEL G
SIDE MOUNT



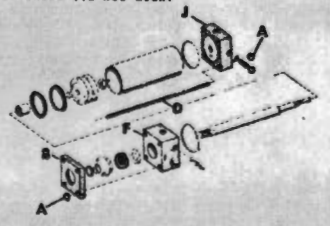
MODEL J
END LUG MOUNT



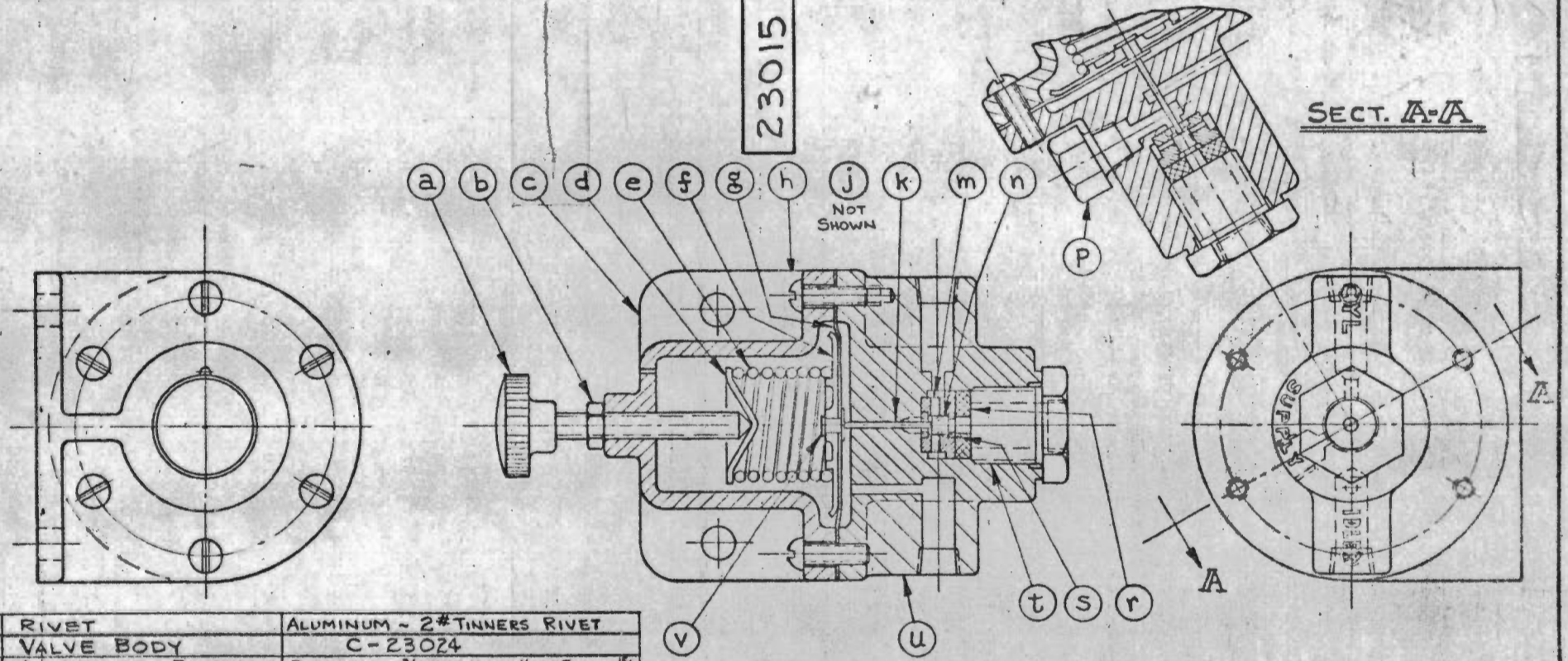
MODEL K
CENTERLINE MOUNT



MODEL L
EXTENDED TIE ROD MOUNT



23015



ITEM	QTY	NAME	PART NO.
v	1	RIVET	ALUMINUM ~ 2# TINNERS RIVET
u	1	VALVE BODY	C-23024
t	1	ADAPTER FITTING	BULKHEAD ~ 3/4-16 NC MALE x 1/4 NPT FEMALE x 15/16
s	2	QUAD RING SEAL	MINN. RUBBER QUAD RING # Q-4006
r	1	BACK-UP WASHER	A-23026
p	1	MUFFLER	AIR-MITE # 201 - 1/8 NPT
n	1	PLUG VALVE	A-26863
m	1	VALVE CARTRIDGE	A-24950
k	1	PLUNCER	A-21211
j	1	NAMEPLATE DECAL	AVERY LABEL ~ TRACKING VALVE
h	6	CAPSCREW	# 10-32 UNF x 9/16 LG. RD. HD. S.S. C.S.
g	1	DIAPHRAGM	A-21210
f	1	DIAPHRAGM CUP	A-21209
e	1	SPRING	A-23025
d	1	SPRING CUP	A-21207
c	1	BODY CAP	B-21205
b	1	JAM NUT	1/4-28 UNF HEX JAM NUT
a	1	ADJUSTING SCREW	A-21214

REF. ~
ADAPTER PLATE A-25146
OPERATION SHEET C-25096
CONVERSION KIT B-25779

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USED ON		REVISIONS
CHANGE DATE		MATERIAL
SCALE	FULL SIZE	EXCEPT AS NOTED:
DRAWN BY	P.J. ARMSTRONG	TOLERANCE
DATE	8-5-64	FINISH

TIMESAVERS, INC.
MINNEAPOLIS 22, MINNESOTA

AIR RELAY VALVE ASSEM.

23015

WATTS REGULATOR CO.
P.O. BOX 628
LAWRENCE, MASS.
01842

MINIATURE REGULATORS

TYPES 361, 363 (Non-Relieving)
TYPES 362, 364 (Relieving)

MAX. INLET: 300 PSI
TEMPERATURE RANGE: 40° - 180°F

INSTALLATION and OPERATING INSTRUCTIONS

INSTALLATION

Before installing blow out pipe line to remove scale and other foreign matter. Threads are DRYSEAL not normally requiring pipe compound, however, if desired apply sparingly and to male threads only. Install regulator in pipe line so that air will flow in direction of arrow stamped on body, install as near as possible to equipment serviced.

REDUCED PRESSURE ADJUSTMENT

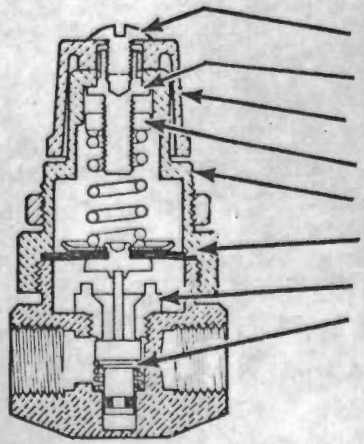
To adjust reduce pressure settings, loosen lock screw in center of knob and turn knob clockwise to increase pressure setting and counter clockwise to lower setting. With relieving-type regulators the reduced pressure follows adjustment of the screw, with non-relieving regulators adjustment for lower reduced pressure will not be obtained until the reduced pressure system is "bled-off" or until air flow starts.

MAINTENANCE - CLEANING

NOTE: To clean, it is not necessary to remove regulator from line. Refer to drawing as guide in reassembly.

If the air supply is kept clean the regulator should provide long periods of uninterrupted service. Erratic regulator operation or loss of regulation is most always due to dirt in the disc area. To clean, shut off air line pressure and disassemble the regulator. Refer to drawing as a guide to disassembly and subsequent reassembly. Clean parts with denatured alcohol and blow out body with compressed air. When reassembling make sure the seat is firmly in place and that the disc stem fits into center hole of diaphragm assembly. If diaphragm assembly is replaced make sure disc stem fits into its center hole, tighten bonnet slightly more than hand tight (to 60 inch pounds torque).

REPLACEMENT PARTS ORDER BY KIT NO.



Part Name	Kit Name	Kit No.
Lock Screw	Spring Cage and Knob Assembly Replacement Kits	CK364Y
Adjusting Screw		
Adjusting Knob		
Nut		
Spring Cage		
Diaphragm Assembly	Repair Kit Relieving	RK364Y
Seat		
Disc Assembly	Non-Relieving	RK363Y

SD41-5
Issue 6/25/73

MOORE

SERVICE INSTRUCTIONS
MODEL 41 NULLMATIC PRESSURE REGULATORS

SECTION 1 – DESCRIPTION

GENERAL INFORMATION

The Model 41 Nullmatic Pressure Regulator utilizes the Null-balance principle, which holds the output pressure constant regardless of wide changes in flow or supply pressure. Each regulator is in essence a self-contained pressure controller.

MODEL DESIGNATION

41 – 15

- 15 — Range
- Options
  - A Air Loaded
  - E Pipe-tap exhaust
  - N Nonbleed*
  - – Standard
- 41 — Basic Model Number

* For use with Model 65 square root extractors to maintain minimum output

OPERATING CHARACTERISTICS†

Maximum flow capacity: 9 scfm

Effect of change from 0.5 scfm to max. flow: –0.16 psig.

Effect of 25 psi increase in supply-dead end service: +0.24 psig.

†Data based on tests of 30 psi range regulators set at 25 psi using 100 psi supply.

PRINCIPLE OF OPERATION (See Figure 1)

A fine-turn, precision screw is used to manually load the "range spring" which sets the regulated pressure. When the adjusting knob is turned clockwise, for example, the increased spring force is exerted on the "top diaphragm assembly" which decreases the "nozzle" clearance and increases the pilot pressure. The source for pilot pressure is supply air flowing to the "pilot pressure chamber" through the "restriction screw" The increased pilot pressure forces the "exhaust diaphragm assembly" downward, closing the "exhaust port", contacting and moving the "valve plunger" and thereby opening the "supply port." This increases the "regulated output" which also feeds back to the "top diaphragm assembly." The regulator locks-up or throttles at the new output value when the feed-back force of the "top diaphragm assembly" equals the "range spring force."

On dead end service, regulators with no "N" in the model number will exhaust approximately .1 scfm out of the holes in the exhaust ring.

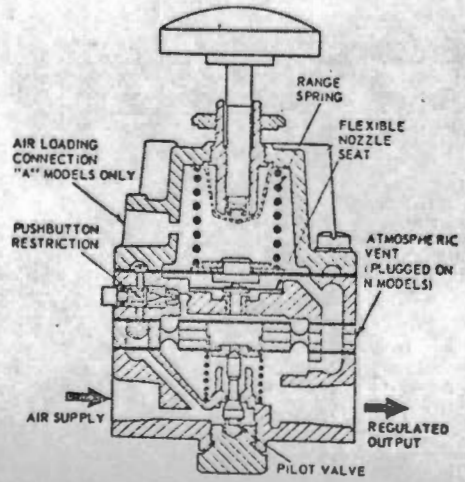
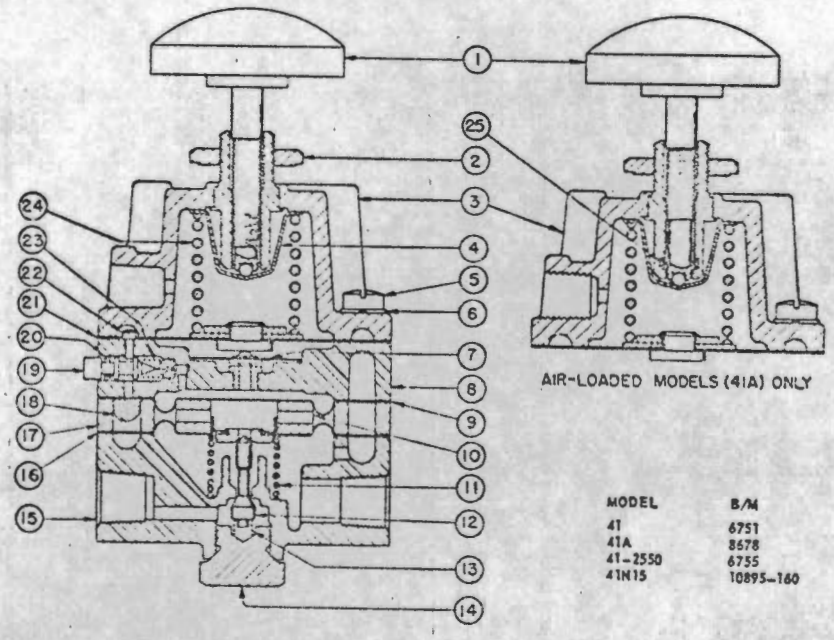


Figure 1 – Schematic

MOORE PRODUCTS CO.
SPRING HOUSE, PA.

NULLMATIC PRESSURE REGULATOR
Models 41, 41A, 41-2550 & 41N15

From Drawing No. 6731–15



AIR-LOADED MODELS (41A) ONLY

MODEL	B/M
41	6751
41A	8678
41–2550	6755
41N15	10895–160

Item No.	Part No.	Description	Req'd 41	41A	41–2550	41N15
1a	6751–6	Adjusting Screw Ass'y	1	–	1	–
1b	6754–6	Adjusting Screw Ass'y	–	1	–	–
1c	6751–26	Adjusting Screw Ass'y.	–	–	–	1
2	6750–50	Mounting Nut	1	1	1	1
3a	6751–7	Top Housing Ass'y	1	–	1	1
3b	6755–4	Top Housing Ass'y	–	1	–	–
4	6750–6	Spring Seat	1	1	1	1
5	Screw	#10-32 x 1¼ Lg. Fil. Hd. Stl.	6	6	6	6
6	Lockwasher	#10 Steel	6	6	6	6
7	6750–12	Leaf Spring Ass'y	1	1	1	1
8	6751–29	Pilot Ring Ass'y (Incl. Items 19, 20, 22 & 23)	1	1	1	1
*9	6750–17	Diaphragm	1	1	1	1
10	6750–14	Spacer	1	1	1	1
11a	6750–45	Differential Spring (All –15 Models)	1	1	–	1
11b	8678–6	Differential Spring (Except –15 Models)	1	1	1	–
*12	6750–21	Pilot Plunger	1	1	1	1
*13	6750–49	Valve Spring	1	1	1	1
14	6751–3	Retaining Nut	1	1	1	1
15	6751–2	Pilot Base	1	1	1	1
*16	6750–18	Lower Diaphragm Ass'y	1	1	1	1
17a	6750–68	Exhaust Ring (Incl. Item 18)	1	1	1	–
17b	6750–102	Diaphragm Ring Ass'y (Incl. Item 18)	–	–	–	1
18	6750–69	Screen	1	1	1	1
*19	10320–17	Cleaning Plunger	1	1	1	1
*20	2938–16	"O" Ring	1	1	1	1
*21	6750–83	Upper Diaphragm Ass'y	1	1	1	1
*22	10220–25	Plunger Stop Screw	1	1	1	1
*23	10220–10	Plunger Spring	1	1	1	1
24a	6750–39	Spring (Blue) 0–15 psi	1	1	–	1
24b	6750–40	Spring (Red) 0–30 psi	1	1	–	–
24c	6750–37	Spring (Brown) 0–50 psi	1	1	–	–
24d	6750–38	Spring (Green) 0–100 psi	1	1	–	–
24e	8678–7	Spring (Orange) 25–50 psi	1	1	1	–
*25	2938–4	"O" Ring	–	1	–	–
26	10953–73	Mounting Bracket (optional)	1	1	1	1

*Recommended On-Hand Spare Parts. Always Specify Model Number and Serial Number of Instrument When Ordering Spare Parts

Printed in U.S.A. 6/73

SECTION II – INSTALLATION

MOUNTING– Refer to figure 2 for mounting dimensions and connections. The regulator may be mounted in any position without affecting its operation.

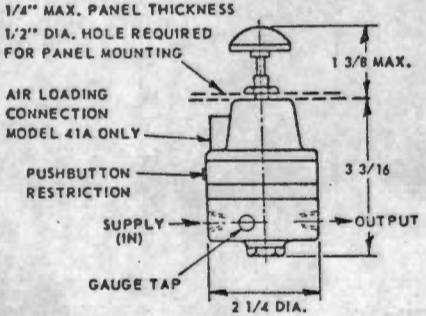


Figure 2

PIPING – All connections are 1/8 NPT. A pressure gauge can be installed in the "GAUGE" tap to indicate the regulated pressure without showing the pressure drop in downstream piping.

SUPPLY AIR – Clean, dry, oil-free air should be used for the supply. If poor quality plant air is used, a filter should be installed in the supply line close to the regulator. This will remove scale and impurities, and should virtually eliminate regulator maintenance.

Recommended and maximum supply pressures are given in the following table.

MODEL NO.	RANGE* psig	RECOMMENDED SUPPLY	MAXIMUM SUPPLY FOR BEST PERFORMANCE psig	MAXIMUM SUPPLY psig
41-15	0-15	10 psig greater than the maximum pressure to be regulated	75	150
41-30	0-30		120	150
41-50	0-50		120	150
41-100	0-100		150	350
41-2550	25-50		120	150

*The nominal minimum regulated pressure is 0 psig; but the actual minimum pressure will usually be from 0.5 to 2 psi, depending on the model and supply pressure. The nominal minimum regulated pressure for the 41-2550 is 22.5 psi.

SECTION III - MAINTENANCE

PREVENTATIVE MAINTENANCE

A clean, dry and oil-free supply air should be used. Providing an instrument air filter for the supply air system will prevent most difficulties arising from a dirty air supply. A periodic check of the filter element and regulator blow-down of the filter dripwell is recommended.

SERVICING

Lubrication - An occasional application of light grease to the adjusting screw threads and the screw-end socket will facilitate easy turning of the adjustment knob, especially in the high-pressure models.

Cleaning

If the small orifice in the restriction becomes blocked, press the cleaning plunger built into the body of the regulator. The spring loading in the assembly permits it to return to its normal position.

Valve Plunger - To clean the valve plunger and its supply and exhaust seats, it must be removed from the regulator. Turn off the supply air and remove the retaining nut on the bottom forging. The valve plunger and plunger spring will drop out when this nut is removed; be careful not to lose them. The valve plunger must be clean on both the ball and tapered-end surfaces. If necessary, use a non-abrasive solvent. The supply and exhaust seats in the regulator must also be clean. The supply seat is readily accessible; the exhaust seat can be reached by using a tobacco pipe cleaner. Here again, use non-abrasive solvents. When re-installing, see the parts list for part orientation and tighten the retaining nut secrely.

DISASSEMBLY - Before disassembling, back-off the adjustment knob to relieve spring tension. Also, make a diagonal mark across all mating parts to provide easier alignment of parts during reassembly. Refer to the parts list, remove the body screws and disassemble the regulator.

ASSEMBLY - The exhaust diaphragm assembly and exhaust ring must be positioned so that none of the holes on the bottom forging are blocked. The external holes on the exhaust ring line up under the output connection.

The center housing must be positioned to allow pilot and rebalance air to flow to the proper chambers; pilot air to the bottom cavity of the center housing and rebalance air to the top cavity. See figure 2 for orientation of the gauge connection with respect to the supply and output ports.

Position the cleaning plunger of the center casting in line with the input connection of the base casting.

Locate the upper diaphragm and top housing in any position; insert and tighten body screws.

SECTION IV – CHANGING RANGE

The range of any Model 41 Regulator may be changed by replacing the range spring, differential spring, the upper diaphragm assembly and other parts as noted in the parts list.

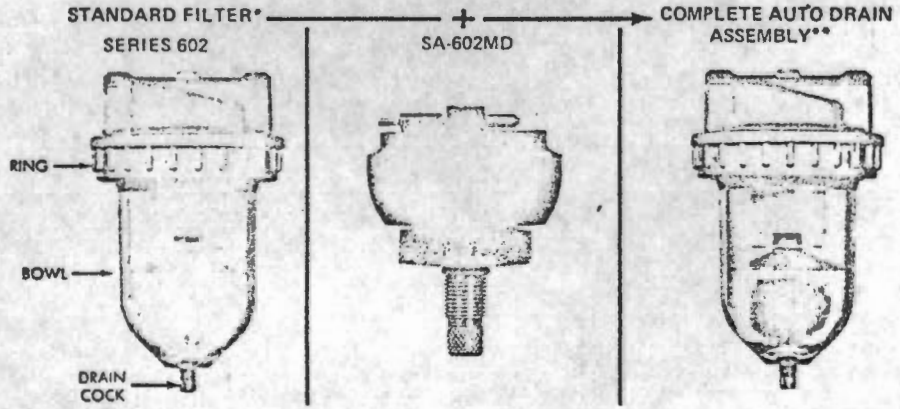
TROUBLE ANALYSIS

Symptom	Cause	Remedy
No output	No supply air	Turn on supply air.
	Clogged restriction screw.	Press cleaning plunger.
Output cannot be increased to full value.	Supply air setting too low.	Raise to recommended value.
	Valve Plunger being held open on exhaust seat by a chip (pipe dope, Teflon tape, thread shaving, pipe scale, etc) Usually detected by a heavy exhaust.	Remove valve plunger and clean its seats.

WATTS REGULATOR COMPANY - Lawrence, Massachusetts

AUTOMATIC DRAIN AIR LINE FILTERS

INSTRUCTIONS — For adapting AUTO-DRAIN Assembly to Standard Filter.



*

1/4"	602-2
3/8"	602-3
1/2"	602-4
3/4"	602-6
1"	602-8
1 1/4"	602-10
1 1/2"	602-12

1. Unscrew and remove RING, remove BOWL.
2. Unscrew (turn clockwise) DRAIN COCK and discard.
3. Thread drain cock portion of auto-drain assembly through drain cock opening in bowl and carefully screw hand tight in place.
4. Reassemble BOWL with AUTO-DRAIN ASSEMBLY to filter and tighten ring.

**

1/4"	602MD-2
3/8"	602MD-3
1/2"	602MD-4
3/4"	602MD-6
1"	602MD-8
1 1/4"	602MD-10
1 1/2"	602MD-12

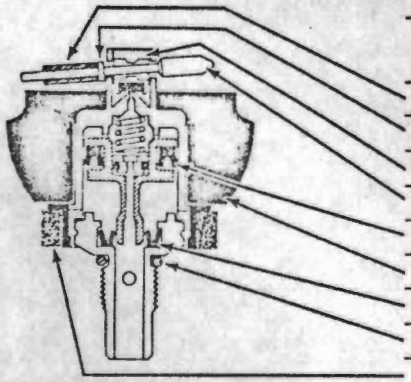
INSTALLATION – MAINTENANCE

Remove the auto-drain assembly from the filter bowl and clean or replace the polyurethane foam Filter. Disassemble the lever actuation mechanism by first sliding the rubber Sleeve off the end of the Pin, remove the Pin being careful not to lose the small Washer. Remove the Disc Assembly and the Float. Carefully breakaway the interference fit between the black plastic housing and the brass Body and remove the Piston and Spring. Clean all component parts thoroughly with soapy water or alcohol and clean or replace all seals as necessary. Insure that the small orifice in the Housing and the Piston are not clogged. Carefully re-assemble all parts positioning them as shown on the reverse side of this instruction sheet.

See other side for Replacement Parts List.

REPLACEMENT PARTS

ORDER BY KIT NUMBER



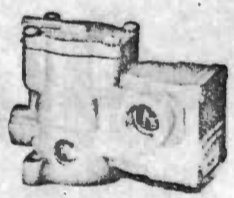
SA-602MD	
PART NAME	KIT NUMBER
SLEEVE	RK602MD
WASHER	
DISC ASSEMBLY	
PIN	
PISTON "V" SEAT	
FLOAT	
BODY "V" SEAT	
BODY "O" RING	
FILTER	

WARNING! Never use a plastic bowl filter with air supplied by a compressor lubricated with oil containing phosphate ester or chlorinated hydrocarbons. Use metal bowl type.

PRINTE

Standard Duty Pilots are designed to handle most applications up to 600 cycles per minute. Pilots are available with 1/4", 3/32", or 1/8" orifices. The largest orifice provides the highest flow and fastest response; however, the smallest orifice permits the highest operating pressure Pilots should generally be selected with the largest orifice size that will handle the operating pressure required. For operating pressures, see chart on Page B9.2.

Standard Duty Pilot Valves can be used for 2-way or 3-way normally open or normally closed service. They are designed for use with air, vacuum or inert gas. Pilots may be ordered for "Direct Pipe Ported" or "Manifold Mounting." All ports are tapped 1/4" NPTF. Coils are available for most AC or DC voltages. Specify voltage and hertz when ordering.



ENGINEERING DATA:

Service: Air, Inert Gas, Vacuum.
Cycle Speed: Maximum 600 Cycles per Minute.
Current Consumption @ 115/60: .34 amp. Inrush; .24 amp. Holding.

PORT IDENTIFICATION:

FUNCTION		PRESSURE SERVICE			VACUUM SERVICE		
		Port 1	Port 2	Port 3	Port 1	Port 2	Port 3
3-WAY	Normally Closed	Inlet	Cylinder	Exhaust	Pump	Device	Open
	Normally Open	Exhaust	Cylinder	Inlet	Open	Device	Pump
2-WAY	Normally Closed	Outlet	Inlet	Plugged	Pump	Device	Plugged
	Normally Open	Plugged	Outlet	Inlet	Plugged	Device	Pump

Use pipe plug H074-07 for 2-way service.

HOW TO ORDER:

Select Valve Model Number and add Solenoid Voltage and Hertz. For example, K055-4005 115V/60 Hz. When specifying Sub-base type, list Sub-base or Modular Manifold separately.

VALVE DESCRIPTION	ORIFICE SIZE	Cv	STANDARD SERVICE		SPECIAL SERVICE "Continuously Energized"		VACUUM SERVICE	
			WITH JUNCTION BOX	WITHOUT JUNCTION BOX	WITH JUNCTION BOX	WITHOUT JUNCTION BOX	WITH JUNCTION BOX	WITHOUT JUNCTION BOX
N.C. DIRECT PIPE PORTED	1/4 3/32 1/8	.12 .21 .22	K055-4005 K055-4019 K055-4041	K055-1005 K055-1019 K055-1041	K075-4019	K075-1019	K055-4007 K055-4023 K055-4043	K055-1007 K055-1023 K055-1043
N.O. DIRECT PIPE PORTED	1/4 3/32 1/8	.10 .18 .21	K055-4007 K055-4023 K055-4043	K055-1007 K055-1023 K055-1043	K075-4023	K075-1023	K055-4005 K055-4019 K055-4041	K055-1005 K055-1019 K055-1041
N.C. SUB-BASE MOUNTING	1/4 3/32 1/8	.11 .15 .15	K065-4005 K065-4019 K065-4041	K065-1005 K065-1019 K065-1041	K085-4019	K085-1019	K065-4007 K065-4023 K065-4043	K065-1007 K065-1023 K065-1043
N.O. SUB-BASE MOUNTING	1/4 3/32 1/8	.11 .15 .19	K065-4007 K065-4023 K065-4043	K065-1007 K065-1023 K065-1043	K085-4023	K085-1023	K065-4005 K065-4019 K065-4041	K065-1005 K065-1019 K065-1041

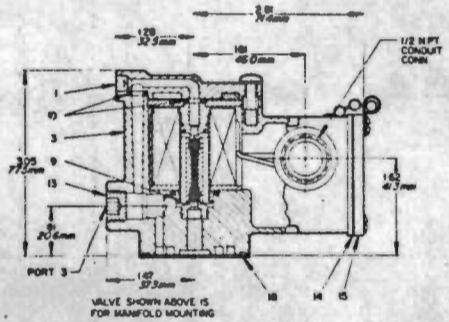
INSTALLATION KITS:

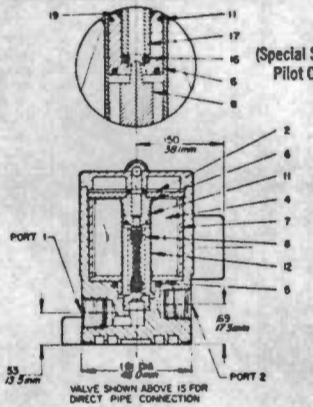
2-STATION KIT—K122-001
3-STATION KIT—K122-002
4-STATION KIT—K122-003
5-STATION KIT—K122-004
Kits Include Seals and Tie Rods

K142-075
MANIFOLD

K022-098
SUB-BASE

DIMENSIONAL DATA / PARTS LIST



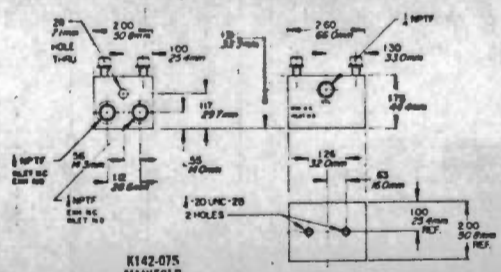


PARTS LIST • PARTS INCLUDED IN SEAL KIT K352-166

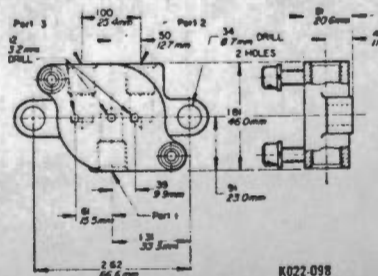
KEY	PART NUMBER		PART NAME
1	K062-012		Cover Assembly
2	K323-005		Washer
3	Manifold Mounted		
	With Junction Box	Without Junction Box	
	K112-025	K112-031	Body Assembly (5/16" Orifice)
	K112-026	K112-032	Body Assembly (3/32" Orifice)
	K112-027	K112-033	Body Assembly (1/4" Orifice)
	Direct Pipe Ported		
	With Junction Box	Without Junction Box	
	K112-028	K112-034	Body Assembly (5/16" Orifice)
	K112-029	K112-035	Body Assembly (3/32" Orifice)
	K112-030	K112-036	Body Assembly (1/8" Orifice)
*4	K593-025		Coil 115V 60Hz
	K593-035		Coil 230V 60Hz
	K593-041		Coil 460V 60Hz
	K593-003		Coil 6V DC
	K593-010		Coil 12V DC
	K593-014		Coil 24V DC
	K593-041		Coil 115V DC
	K593-036		Coil 230V DC

KEY	PART NUMBER	PART NAME
5	•H142-13	Seal
6	K423-005	Top Seat (5/16" Orifice)
	K423-006	Top Seat (3/32" Orifice)
	K423-004	Top Seat (1/4" Orifice)
	K423-010	Top Seat (Special Service Pilot)
7	K443-009	Split Sleeve
8	•K343-002	Plunger—Standard Service
	K343-001	Plunger—Special Service
9	K373-001	Spring N.O. Valve
	K373-002	Spring N.C. Valve
10	•H142-01	Seal
11	•H249-69	O-Ring
12	K272-004	Sleeve Assembly
13	H074-07	Pipe Plug
14	•K183-047	Cover Gasket
15	K062-004	Junction Box Cover Assembly
16	•H134-73	O-Ring
17	K213-005	Insert
18	•K183-001	Gasket
19	•H134-13	O-Ring

*NOTE: Coil leads are 19" long. For other voltages, see Page B9.17.



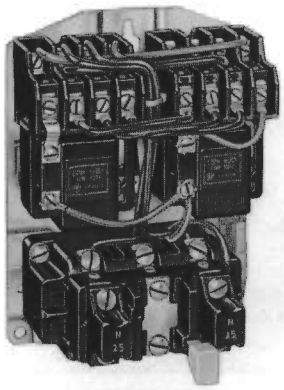
K142-075
MANIFOLD



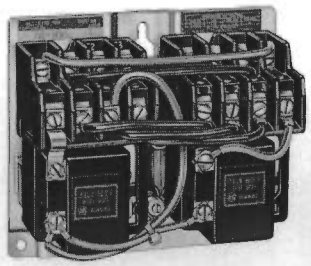
K022-098
SUB-BASE

Full Voltage Reversing Starters
Size 00 • Series K and L Construction

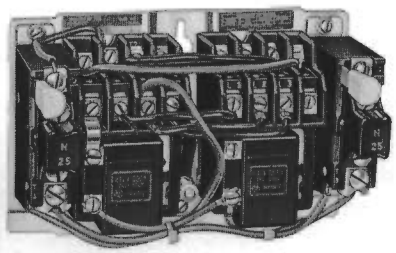
BULLETIN 705
RENEWAL PARTS LIST



With Block Type Overload Relay
(Known as Bulletin 705X in open type construction)



Without Overload Relays



With Side Mounted Overload Relays

Bulletin 705, 3 Phase Starters

OPERATION — These Bulletin 705 starters are used for full voltage starting and reversing of polyphase squirrel cage motors, primary winding of slip-ring motors and also several types of single phase motors.

Bulletin 705 starters consist essentially of a "Forward" and a "Reverse" contactor mounted to a common base. These contactors are mechanically interlocked to insure against both contactors closing at the same time. Starters are available with various types of overload protection or without overload protection.

Both 2 wire and 3 wire control devices may be employed as control means.

SERIES IDENTIFICATION — Parts and part assemblies listed on the back page of this renewal parts list are for use on starters of both the Series K and Series L construction. **IMPORTANT** — To replace a mounting plate or mechanical interlock assembly on either a Series K or a Series L starter, consult the factory. When consulting the factory always identify the starter by catalog number, series identification letter and complete nameplate data.

MAINTENANCE — These starters are constructed to be virtually trouble-free. Periodic inspection of the movable and stationary contacts is the only maintenance suggested.

Mechanical interlock assemblies are factory set. Attempts to tighten or adjust the mechanical interlock assembly could result in the loss of positive interlocking. The Series L starters have capped adjustment screws to discourage tightening or attempts at adjustment.

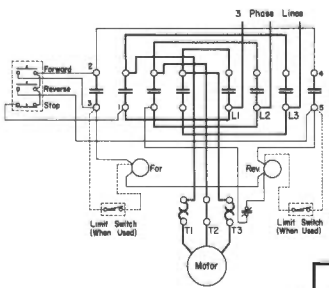
REPAIRS — Starters disassemble as depicted in the illustrations on the back page. Additional attention should be given the contact block screws. These are specially insulated hex head machine screws used to insure proper electrical clearance and should not be substituted.

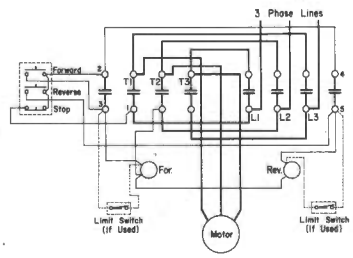
ENGINEERING DATA —

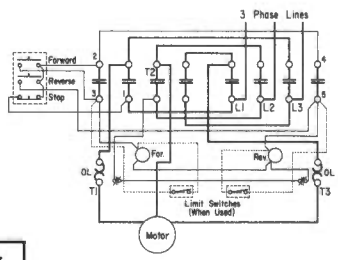
600 VOLTS MAXIMUM			
[1] Continuous Ampere Rating	Maximum Horsepower Rating		
	Volts	3 Phase	Single Phase
9	120	Separate Control	⅓
	208	1½	1
	240	1½	—
	480	2	—
	600	2	—

[1] Full load current must not exceed "Continuous Ampere Rating."

TYPICAL WIRING DIAGRAMS —

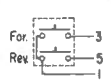




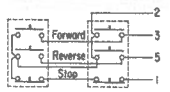


3 Phase Starters, 3 Wire Control Connections

Block Type Overload Relay | Without Overload Relays | Side Mounted Overload Relays

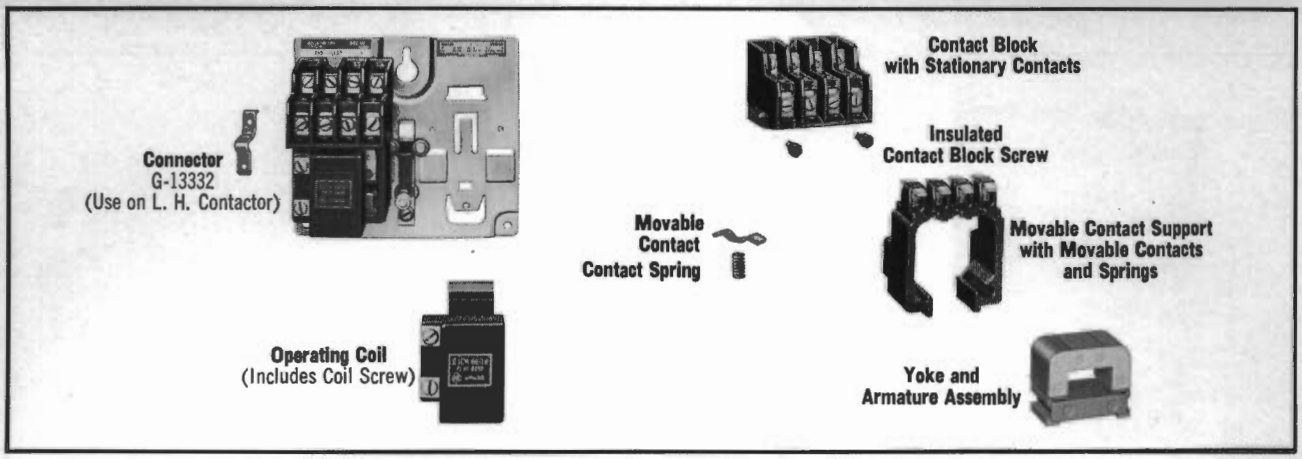


2 Wire Control Connections

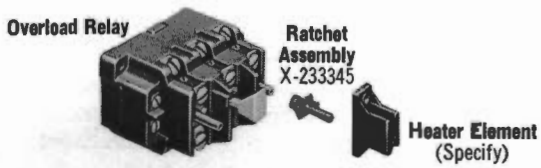


2 Station, 3 Wire Control Connections

Renewal Parts List 705-716 — October, 1968
Supersedes Parts List 705-716 Dated February, 1966

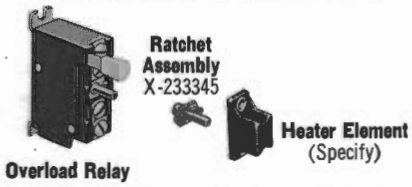


Block Type Overload Relay



(Bulletin 815, Manual Reset Type Illustrated)

Side Mounted Overload Relay



(Bulletin 815, Manual Reset Type Illustrated)

Description of Part	Three Phase	Single Phase	
		3 Lead Repulsion-Induction or Split Phase (Cap. Start-Ind. Run) Type Motor	4 Lead Repulsion-Induction or Split Phase (Cap. Start-Ind. Run) Type Motor
	Part No.	Part No.	Part No.
Contact Block with Stationary Contacts	X-241076	X-241077	X-241076
★Movable Contact Support with Movable Contacts & Springs	X-241534	X-241535	X-241534
Movable Contact Support	F-20964	F-20964	F-20964
Set of Movable Contacts & Springs	Z-21103	Z-21102	Z-21103
Movable Contact	X-240327		
Contact Spring	B-31029		
★Yoke & Armature Assembly	Z-31857		
Yoke Assembly	X-240334		
Armature Assembly	X-240335		
Insulated Contact Block Screw	M-7243		

Operating Coils				
Volts	Cycles	Coil Number	Coil Current	
			Inrush	Sealed
120	60	69A86	.5	.121
110	50		.40	.116
110	60	69A01	.545	.132
208	60	69A113	.29	.070
240	60	69A83	.25	.06
220	50		.20	.058
220	60	69A06	.27	.066
480	60	69A288	.125	.030
440	50		.10	.029
440	60	69A11	.136	.033
380	50		.10	.031
600	60	69A81	.072	.020
550	50		.070	.022
550	60	69A16	.109	.026

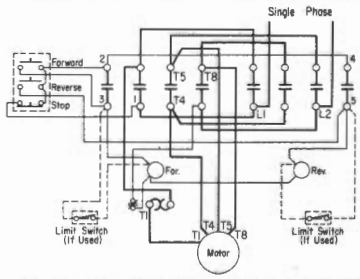
OVERLOAD RELAYS	
Description of Relay	Catalog No.
[1] **Single Pole** — Manual Reset — Side Mounted	815-BOV4
[1] **Single Pole** — Automatic Reset — Side Mounted	816-BOV4
★[2] **Single Pole** — Manual Reset — Third Overload Relay Kit	1415-N50
★[2] **Single Pole** — Automatic Reset — Third Overload Relay Kit	1416-N50
Two Pole — Manual Reset — Block Type	815-BOV15
Three Pole — Manual Reset — Block Type	815-BOV16
Two Pole — Automatic Reset — Block Type	816-BOV15
Three Pole — Automatic Reset — Block Type	816-BOV16

[1] Single phase starters employ a single pole overload relay mounted horizontally at the bottom of the starter.

[2] For use on open type starters — not "field" adaptable to enclosed type starters.

★ Added or changed since previous issue.

Typical Wiring Diagram — Single Phase Starter



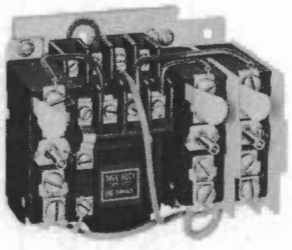
(4 Lead Repulsion-Induction Type Motor)

ORDERING INFORMATION — Your order cannot be entered unless the following information is given: Part number, description of part, the catalog number and series letter of switch. This renewal parts list applies also to the above switches when used on control apparatus listed under other Bulletin numbers.

FULL VOLTAGE STARTERS

OPERATION — These AC Full Voltage Starters are designed for starting of polyphase squirrel cage motors and the primary control of slip-ring motors. They can also be used for self-starting single phase motors. See the Engineering Data for specific starter ratings.

The rapid consistent action of these starters makes them particularly suitable for high speed automatic operations.



Bulletin 709, 3 Phase

Size 00
Series K & L Construction

Starters may be operated by remote control with push buttons, float switches, thermostats, pressure switches, snap switches, limit switches, or any other form of two or three wire pilot device.

Starters are furnished as standard with three side mounted manual reset overload relays.

REPAIRS — Starters disassemble as depicted in the illustration below. Additional attention should be given the contact block screws. These are specially insulated hex head machine screws used to provide proper electrical clearance and should not be substituted.

ENGINEERING DATA —

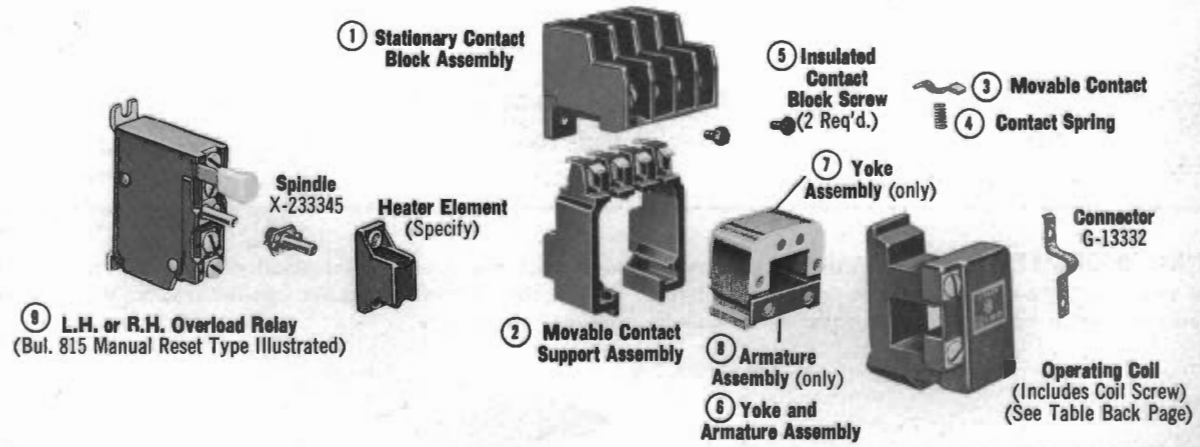
600 VOLTS MAXIMUM • 60 Hz			
[1] Continuous Ampere Rating	Maximum Horsepower Rating		
	Volts	3 Phase	Single Phase
9	115	—	⅓
	200	1½	—
	230	1½	1
	460	2	—
	575	2	—

[1] Full load current must not exceed "Continuous Ampere Rating."

MAINTENANCE — Construction of these starters is such that when properly applied, very little maintenance is normally required. Check points which should be considered are as follows:

Contact Inspection — Periodic inspection of the contacts is necessary to insure that the contact surfaces are in satisfactory operating condition. If the contacts become severely burned, pitted or worn, they should be replaced. Never attempt to file or "dress" contacts during their service life.

Operating Environment — Starters should always be maintained in reasonably contamination free condition in order to assure dependable operation. Choice of the proper NEMA enclosure type for the application is very important in this respect.



Item	Description of Part	3 Phase Part No.	Single Phase Part No.
1	Stationary Contact Block Assembly (includes contacts)	X-241076	X-241077
2	Movable Contact Support Assembly (includes contacts and springs)	X-241534	X-241535
	Movable Contact Support (only)	F-20964	F-20964
3-4	Set of Movable Contacts and Springs	Z-21103	Z-21102
3	Movable Contact	X-240327	
4	Contact Spring	B-31029	

Item	Description of Part	3 Phase / Single Phase Part No.
5	Insulated Contact Block Screw	M-7243
6	Yoke and Armature Assembly	Z-31857
7	Yoke Assembly (only)	X-240334
8	Armature Assembly (only)	X-240335
9	[1] L.H. or R.H. Overload Relay — Manual Reset	815-BOV4
	L.H. or R.H. Overload Relay — Automatic Reset	816-BOV4
	[2] Third Overload Relay Kit — Manual Reset	1415-N50
	[3] Third Overload Relay Kit — Automatic Reset	1416-N50

NOTE — Third overload relay kits are not "field" adaptable to enclosed type "Series K" construction starters.

[1] Manual reset overload relays are furnished with spindles.

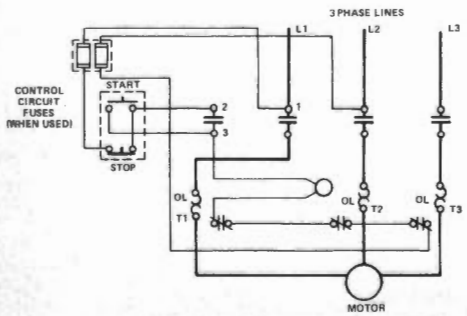
[2] Furnished as third overload relay (T3) on all standard starters.

[3] Furnished as third overload relay (T3) on all starters utilizing Bulletin 816 overload relays.

Renewal Parts List 709-723 — May, 1974
Supersedes Parts List 709-723 Dated August, 1968

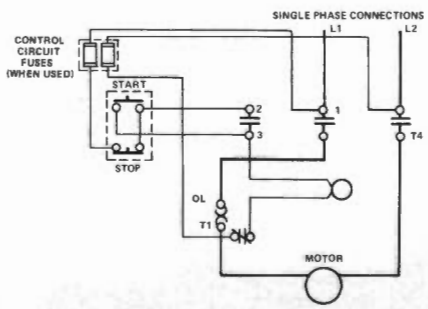
OPERATING COILS						
Volts	Hz	Coil Number	★Coil Current		★Volt-Amperes	
			Inrush	Sealed	Inrush	Sealed
120	60	69A86	.440	.123	60	15
110	50		.435	.132	44	13
110	60	69A01	.480	.135	60	15
208	60	69A113	.264	.075	60	15
240	60	69A83	.220	.062	60	15
220	50		.218	.066	44	13
220	60	69A06	.240	.067	60	15
480	60	69A288	.110	.031	60	15
440	50		.109	.033	44	13
440	60	69A11	.120	.034	60	15
380	50		.116	.033	38	12
600	60	69A81	.088	.025	51	14
550	50		.087	.026	46	14
550	60	69A16	.096	.027	60	15

TYPICAL WIRING DIAGRAMS — (See Applicable Codes and Laws)



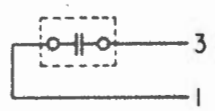
3 Phase Starter

3 Wire Control Connections

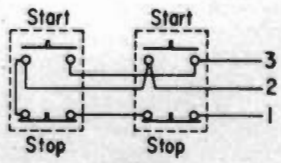


Single Phase Starter

3 Wire Control Connections



2 Wire Control

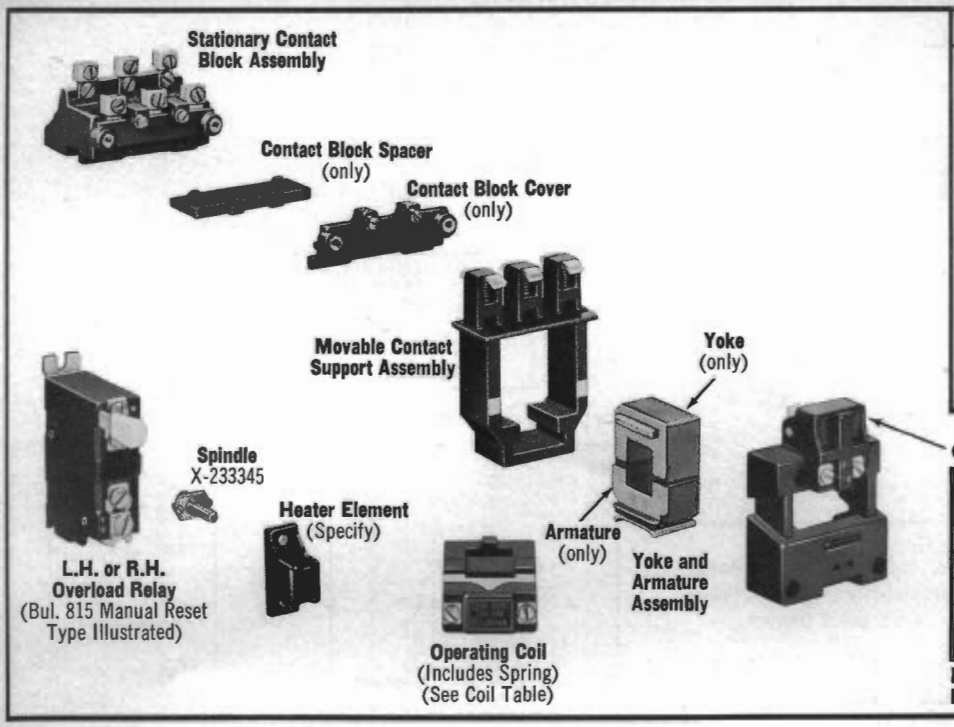


2 Station, 3 Wire Control

ORDERING INFORMATION — Your order cannot be entered unless the following information is given: Part number, description of part, the catalog number and series letter of starter. This renewal parts list applies also to these starters when used on control apparatus listed under other bulletin numbers.

★Added or changed since previous issue.

ALLEN-BRADLEY
Industrial Control Division
Milwaukee, Wisconsin 53204



INDIVIDUAL CONTACTS

▲Rear Stationary Contact Assembly Z-23421

▲Front Stationary Contact Assembly Z-23420

Movable Contact▲ X-225936

Movable Contact Spring▲ B-28636

★Single Pole Contact Set Z-34037 (▲One each included in single pole contact set)

Interlock Contact	Part No.
None	Z-21130
NO	Z-21128
NC	Z-21127
NO-NC	Z-21129
Single Phase	Z-21126

NO — Normally Open
NC — Normally Closed

Description of Part	Single Phase 2 Pole Part Number	3 Phase 3 Pole Part Number	2 Phase, 4 Wire 4 Pole Part Number
Stationary Contact Block Assembly (includes contacts, spacer and cover)	X-371898	X-355639	X-355640
Stationary Contact Block Assembly (less contacts)	X-355643	X-355643	X-355644
★Contact Block Spacer (only)	F-20559	F-20559	F-20225
★Contact Block Cover (only)	X-232227	X-232227	X-232228
Movable Contact Support Assembly (includes contacts and springs)	X-266217	X-232693	X-232694
Movable Contact Support Assembly (less contacts and springs)	F-20562	F-20562	F-20226
Yoke and Armature Assembly 60-50 Hz (includes retainers and spring)	Z-31849	Z-31849	Z-31849
Yoke and Armature Assembly 25 Hz (includes retainers and spring)	—	Z-31853	—
★Yoke (only) 60-50 Hz	X-225619	X-225619	X-225619
★Yoke (only) 25 Hz	—	X-268681	—
★Armature (only) 60-50-25 Hz	X-225620	X-225620	X-225620
Set of Front and Rear Stationary Contacts	Z-23362	Z-23363	Z-23364
Set of Movable Contacts and Springs	Z-21104	Z-21105	Z-21106
Set of Front and Rear Stationary Contacts, Movable Contacts and Springs	[1] X-247277	[1] X-247278	[1] X-247279
[2] L.H. or R.H. Overload Relay — Manual Reset	815-BOV4	815-BOV4	815-BOV4
L.H. or R.H. Overload Relay — Automatic Reset	816-BOV4	816-BOV4	816-BOV4
[2] Third Overload Relay Kit — Manual Reset	1415-N50	1415-N50	1415-N50
Third Overload Relay Kit — Automatic Reset	1416-N50	1416-N50	1416-N50

[1] Also available in quantities of Single Pole Sets. Refer to top of page.
[2] Manual reset overload relays are furnished with spindles.

OPERATING COILS

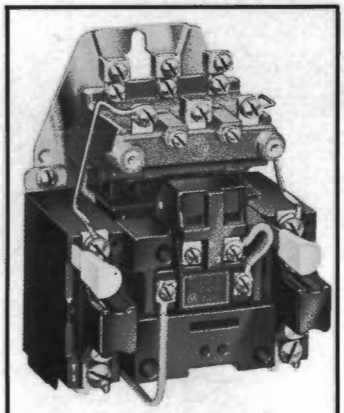
Volts	Hz	Coil Number	★Coil Current Inrush	★Coil Current Sealed	★Volt-Amperes Inrush	★Volt-Amperes Sealed	Volts	Hz	Coil Number	★Coil Current Inrush	★Coil Current Sealed	★Volt-Amperes Inrush	★Volt-Amperes Sealed
120	60	70A86	.90	.159	110	20	440	50	70A288	.21	.049	80	22
110	50		.84	.195	93	22	440	60	70A11	.24	.044	110	20
110	60	70A01	.98	.173	110	20	380	50		.21	.045	80	17
95	50		.84	.180	80	17	440	25	70A15	.12	.041	52	18
110	25	70A05	.47	.164	52	18	600	60	70A81	.18	.032	110	20
208	60	70A113	.52	.092	110	20	550	50		.17	.039	93	22
240	60	70A83	.45	.080	110	20	550	60	70A16	.20	.035	110	20
220	50		.42	.098	93	22	550	25	70A20	.10	.033	52	18
220	60	70A06	.49	.087	110	20	110/220	60	[3] 70A806	.98-.49	.173-.087	110	20
220	25	70A10	.24	.082	52	18	110/220	50	[3] 70A562	.84-.42	.195-.098	93	22
480	60	70A288	.23	.040	110	20	120/240	60		.90-.45	.159-.080	110	20

[3] For Single Phase Starters.

★Added or changed since previous issue.

Full Voltage Starters
Size 0 • Series K Construction

OPERATION — These AC Full Voltage Starters are designed for starting of polyphase squirrel cage motors and the primary control of slip-ring motors. They can also be used for self-starting single phase motors. See the Engineering Data for specific starter ratings.



Bulletin 709
3 Phase Starter

The rapid consistent action of these starters makes them particularly suitable for high speed automatic operations.

Starters may be operated by remote control with push buttons, float switches, thermostats, pressure switches, snap switches, limit switches, or any other form of two or three wire pilot device.

ENGINEERING DATA —

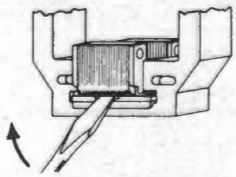
600 VOLTS MAXIMUM • 60 Hz			
[1] Continuous Ampere Rating	Maximum Horsepower Rating		
	Volts	3 Phase	Single Phase
18	120	Separate Control	1
	208	3	—
	240	3	2
	480	5	—
	600	5	—

[1] Full load current must not exceed "Continuous Ampere Rating."

MAINTENANCE — These starters are constructed to be virtually trouble-free. Periodic inspection of the movable and stationary contacts is the only maintenance required.

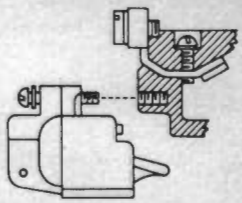
REPAIRS—Starters disassemble as depicted in the illustrations on Page 2 of this Parts List. Additional consideration should be given to the following techniques.

REMOVING MAGNET ARMATURE — To remove the magnet armature from the movable contact support, insert screwdriver into slot as illustrated and lift screwdriver in the direction shown. At the same time push the magnet armature out. It may be necessary to wiggle the armature before it can be removed because of the pressure applied by the retainer spring.



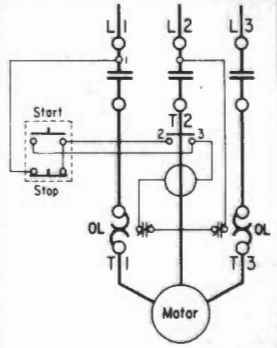
REPLACING OPERATING COIL — To replace the operating coil, first insert the magnet yoke into the operating coil as shown. After this has been done, insert both the operating coil and the magnet yoke as a unit into the coil cover. When replacing the coil cover into the switch unit, be sure the operating lever of the interlock contact rests on top of the movable contact support.

BULLETIN 1495 AUXILIARY CONTACTS — To provide extra pilot circuit contacts, one or two Bulletin 1495 auxiliary contacts can be attached to the front of the contact block.

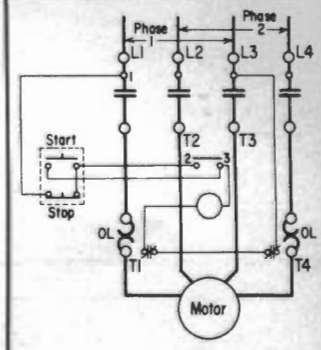


Description of Contact	Catalog No.
Normally Open	1495-F1
Normally Closed (Early Break)	1495-G0
Normally Closed (Late Break)	1495-H0

TYPICAL WIRING DIAGRAMS —

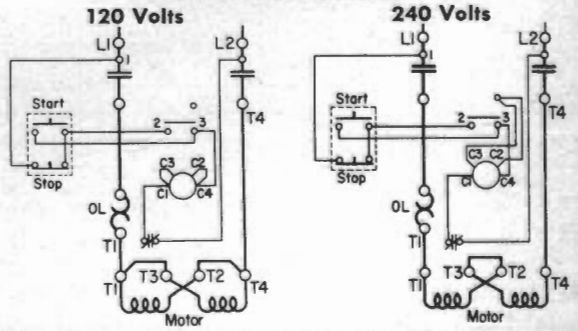


3 Phase Starter
3 Wire Control Connections



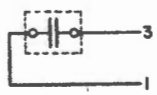
2 Phase, 4 Wire Starter
3 Wire Control Connections

Single Phase Starter
3 Wire Control Connections

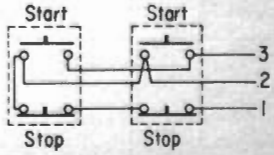


NOTE: When changing the starter from 120 Volt operation to 240 Volt operation or vice versa, the heater element may require changing unless the motor current remains the same.

2 Wire Control



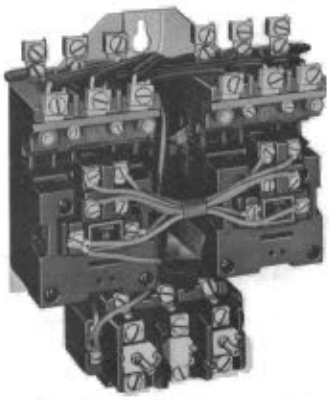
2 Station, 3 Wire Control



ORDERING INFORMATION — Your order cannot be entered unless the following information is given: Part number, description of part, the catalog number and series letter of starter. This renewal parts list applies also to these starters when used on control apparatus listed under other Bulletin numbers.

Renewal Parts List 709-710 — October, 1970
Supersedes Parts List 709-724 Dated October, 1967

FULL VOLTAGE REVERSING STARTERS



Size 1 with Block Type Overload Relays

Size 1 • Series K and L Construction

OPERATION — These Bulletin 705 starters are used for applications such as full voltage starting and reversing of polyphase squirrel cage motors and controlling the primary windings of slip-ring motors.

Bulletin 705 starters consist essentially of a "Forward" and a "Reverse" contactor mounted to a common base. These contactors are electrically and mechanically interlocked to guard against both contactors closing at the same time. A single block having three overload relays is provided on all enclosed starters. Open type starters are supplied with either a single block having three overload relays mounted below the contactors or three relays mounted at the sides of the contactors.

Either 2 wire or 3 wire control devices may be used as control means.

ENGINEERING DATA —

600 VOLTS MAXIMUM • 60 Hz			
[1] Continuous Ampere Rating	Maximum Horsepower Rating		
	Volts	3 Phase	Single Phase
27	115	—	2
	200	7½	—
	230	7½	3
	460	10	—
	575	10	—

[1] Full load current must not exceed "Continuous Ampere Rating."

MAINTENANCE — Construction of these starters is such that when properly applied, very little maintenance is normally required. Check points which should be considered are as follows:

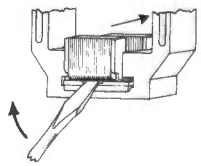
Contact Inspection — Periodic inspection of the movable and stationary contacts is necessary to insure that the contact surfaces are in satisfactory operating condition. If the contacts become severely burned, pitted or worn, they should be replaced. Never attempt to file or "dress" contacts during their service life.

Mechanical Interlock Inspection — The purpose of the mechanical interlock is to prevent against simultaneous "pick up" of both contactors. Although the interlock is factory adjusted, it should be rechecked periodically during the service life of the starter. Refer to ADJUSTMENT CHECK procedure on page 3.

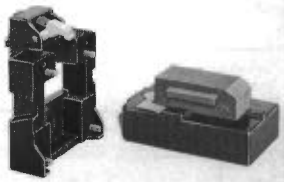
Operating Environment — Starters should always be maintained in reasonably contamination free condition in order to assure dependable operation. Choice of the proper NEMA enclosure type for the application is very important in this respect.

REPAIRS — Starters can be disassembled as depicted in the illustrations on Page 2 of this Parts List. Additional consideration should be given to the following techniques.

Removing Magnet Armature — To remove the magnet armature from the movable contact support, insert screwdriver into slot as illustrated and lift screwdriver in the direction shown. At the same time push the magnet armature out. It may be necessary to wiggle the armature before it can be removed because of the pressure applied by the retainer spring.



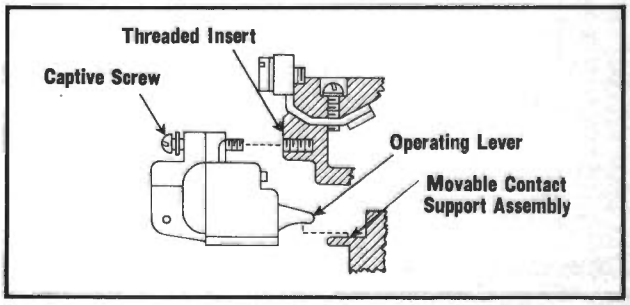
Replacing Operating Coil — To replace the operating coil, first insert the magnet yoke into the operating coil as shown. After this has been done, insert both the operating coil and the magnet yoke as a unit into the coil cover. When replacing the coil cover into the switch unit, be sure the operating lever of the interlock contact rests on top of the movable contact support, and the yoke retainer is in place.

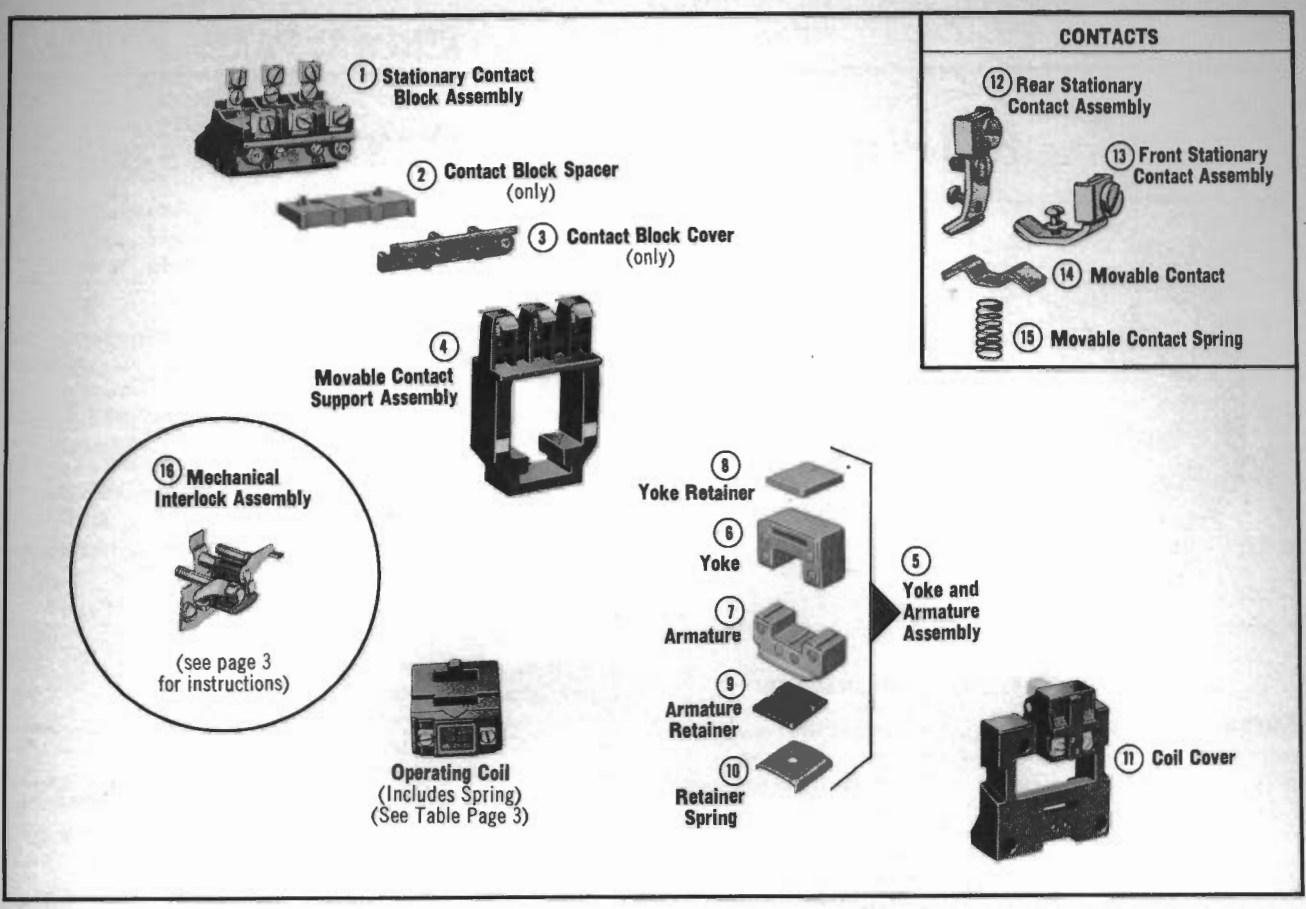


BULLETIN 1495 AUXILIARY CONTACTS — These auxiliary contacts are designed to operate on the upward motion of the movable contact support assembly. The auxiliary contacts are furnished with a captive screw. The captive screw is used to engage either of the two inserts imbedded in each of the contact block front covers. Refer to illustration below.

IMPORTANT — The auxiliary contact operating lever **must** rest on top of the movable contact support assembly.

Refer to listings in Handy Catalog for replacement catalog numbers.

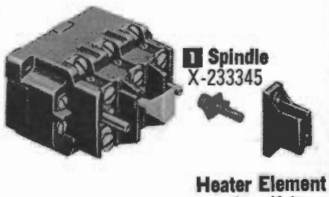




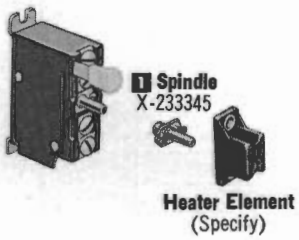
Item	Description of Part	Single Phase 3 Lead Repulsion-Induction or Split Phase (Cap. Start-Ind. Run) Type Motors	3 PHASE Single Phase 4 Lead Repulsion-Induction or Split Phase (Cap. Start-Ind. Run) Type Motors	2 PHASE, 4 WIRE Single Phase 4 Lead Split Phase (Cap. Start-Ind. Run) (Break all lines) Type Motor
		2 Pole	3 Pole	4 Pole
		Part Number	Part Number	Part Number
1	Stationary Contact Block Assembly (includes contacts, spacer and cover)	X-355027	X-355028	X-355029
	Stationary Contact Block Assembly (less contacts)	X-355023	X-355024	X-355025
2	Contact Block Spacer (only)	F-20587	F-20597	F-20175
3	Contact Block Cover (only)	F-20586	X-232230	X-232231
4	Movable Contact Support Assembly (includes contacts and springs)	X-232696	X-232697	X-232698
	Movable Contact Support Assembly (less contacts and springs)	F-20588	F-20598	F-20167
5	Yoke and Armature Assembly 60-50 Hz (includes retainers and spring)	Z-31837	Z-31837	Z-31837
	Yoke and Armature Assembly 25 Hz (includes retainers and spring)	Z-31839	Z-31839	Z-31839
6	Yoke 60-50 Hz	X-225320	X-225320	X-225320
	Yoke 25 Hz	X-270384	X-270384	X-270384
7	Armature 60-50-25 Hz	X-225321	X-225321	X-225321
8	Yoke Retainer	F-20179	F-20179	F-20179
9	Armature Retainer	F-20178	F-20178	F-20178
10	Retainer Spring	B-28603	B-28603	B-28603
11	Coil Cover — With Normally Open-Normally Closed Interlock Contact	Z-21134	Z-21134	Z-21134
12	Rear Stationary Contact Assembly	Z-23423	Z-23423	Z-23423
13	Front Stationary Contact Assembly	Z-23422	Z-23422	Z-23422
14	Movable Contact	X-225866	X-225866	X-225866
15	Movable Contact Spring	B-28595	B-28595	B-28595
12-15	Set of Front and Rear Stationary Contacts	Z-23366	Z-23367	Z-23368
	Set of Movable Contacts and Springs	Z-21108	Z-21109	Z-21110
	Set of Front and Rear Stationary Contacts, Movable Contacts and Springs	X-247281	X-247282	X-247283
	Single Pole Contact Set (includes one (1) Front and Rear Stationary Contacts, Movable Contact and Contact Spring)	Z-34038	Z-34038	Z-34038
16	Mechanical Interlock Assembly	Z-19264	Z-19264	Z-19264

Overload Relays

Block Type Overload



Side Mounted Type Overload



(Bulletin 815, manual reset types illustrated)

Description of Relay	Catalog No.
Block Type — Two Pole — Manual Reset	815-BOV15
2 Block Type — Three Pole — Manual Reset	815-BOV16
Block Type — Two Pole — Automatic Reset	816-BOV15
Block Type — Three Pole — Automatic Reset	816-BOV16
Side Mounted — Single Pole — Manual Reset	3 815-BOV4
	4 1415-N50
Side Mounted — Single Pole — Automatic Reset	3 816-BOV4
	4 1416-N50

2 Furnished as standard on latest construction.

3 Single phase starters employ a single pole overload relay mounted horizontally at the bottom of the starter.

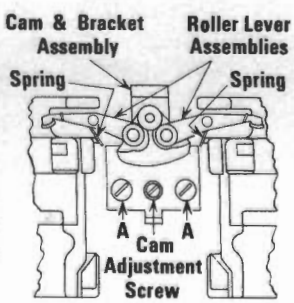
4 For use as third overload relay (T3) on open type starters—not "field" adaptable to enclosed type starters.

1 The manual reset overload relays listed in the table are furnished with spindles.

OPERATING COILS						
Volts	Hz	Coil Number	★Coil Current		★Volt-Amperes	
			Inrush	Sealed	Inrush	Sealed
120	60	71A86	1.46	.182	175	22
110	50		1.41	.218	155	24
110	60	71A01	1.52	.185	167	21
95	50		1.38	.197	131	19
110	25	71A05	.640	.227	71	25
208	60	71A113	.805	.098	167	21
240	60	71A83	.730	.091	175	22
220	50		.705	.109	155	24
220	60	71A06	.760	.093	167	21
220	25	71A10	.320	.114	71	26
480	60	71A288	.365	.046	175	22
440	50		.353	.054	155	24
440	60	71A11	.380	.046	167	21
380	50		.346	.049	131	19
440	25	71A15	.160	.057	71	26
600	60	71A81	.280	.034	168	21
550	50		.270	.041	149	23
550	60	71A16	.304	.037	167	21
550	25	71A20	.130	.046	72	26

REPLACING MECHANICAL INTERLOCK —

1. Remove the motor starter from the enclosure or panel.
2. Remove both contact block front covers.
3. Remove both coil covers, coils and magnet yokes.
4. Remove both movable contact support assemblies.
5. Remove both roller lever assemblies, (See illustration). Use a small hammer and punch to "tap-out" these assemblies from back of the mounting plate. In the event that the "retaining ring" which holds the shaft to the bronze bushing should break, the bushing must be driven out separately.



6. Remove the cam and bracket assembly (See illustration) which is secured by screws "A". Insert the replacement cam and bracket assembly securing loosely with screws "A" and associated flat washers.
7. Place springs onto roller assemblies.

IMPORTANT: Be sure the springs are in their proper position before attempting to insert roller lever assemblies.

8. Insert replacement roller lever assemblies and tap or press into position until they bottom out within the steel bushing.

IMPORTANT: Use care to avoid catching the roller lever assemblies on the edge of the center cam.

9. Replace both movable contact support assemblies, coils, magnet yokes and coil covers. Be sure all auxiliary contact and mechanical interlock operating levers rest **on top** of the movable contact support and the yoke retainer is in place. Incorrect position of these levers will cause improper operation and equipment damage.
10. Replace both contact block front covers.

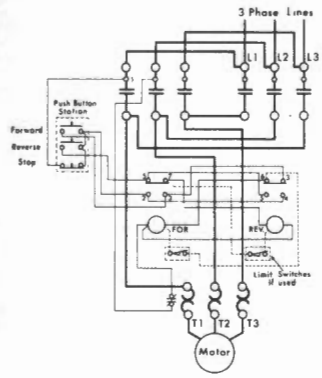
ADJUSTING THE MECHANICAL INTERLOCK — With screws "A" loosened and the starter in the vertical position, hold the left hand contactor in the fully closed position by pressing upward on the bottom of the movable contact support. Turn the cam adjustment screw (see illustration) to a point where the right hand contactor has a very slight movement (1/64" to 1/32") when alternately pressed upward and released so gravity returns the movable contact support to the full opened (down) position. Repeat this procedure holding the right hand contactor in the fully closed position and check the movement of the left hand contactor's movable contact support. Tighten screws "A" securely (10-20 inch-pounds of torque). Operate the starter manually a few times to check against binding of the interlock mechanism. If binding occurs, the adjustment may have to be loosened very slightly and rechecked.

ADJUSTMENT CHECK — As a final adjustment check, with power removed from the line terminals and with the motor disconnected from the starter, connect a flash light test lamp to the L1 terminal and L3 terminal. Operate the starter manually by pushing the movable contact support of both contactors up against the interlock at the same time. There should be no circuit through these contacts in any position of the movable contact supports, i.e., the test lamp should not light. If the starter fails to pass the test, refer back to "Adjusting the Mechanical Interlock."

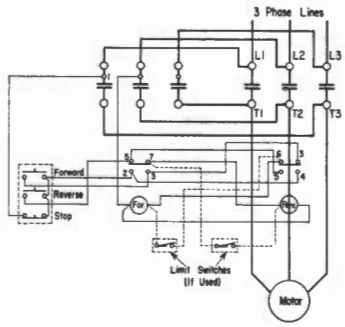
★ Added or changed since previous issue.

TYPICAL WIRING DIAGRAMS — (See applicable codes and laws)

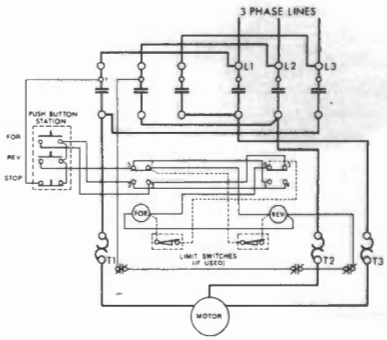
3 Phase Starters, 3 Wire Control Connections



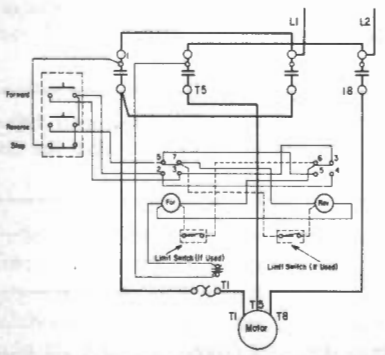
3 Pole Block Type Overload Relay



Without Overload Relays

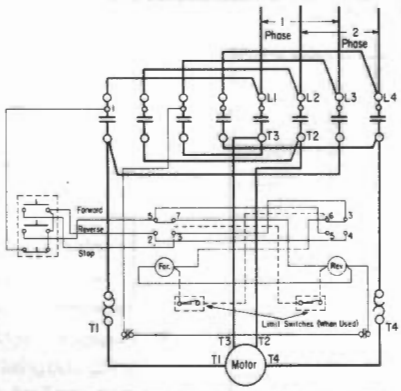


3 Side Mounted Overload Relays



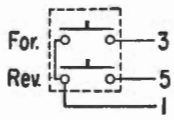
Single Phase Starter

(3 Wire Control Connections)

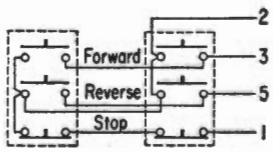


2 Phase, 4 Wire Starter

(3 Wire Control Connections)



2 Wire Control Connections

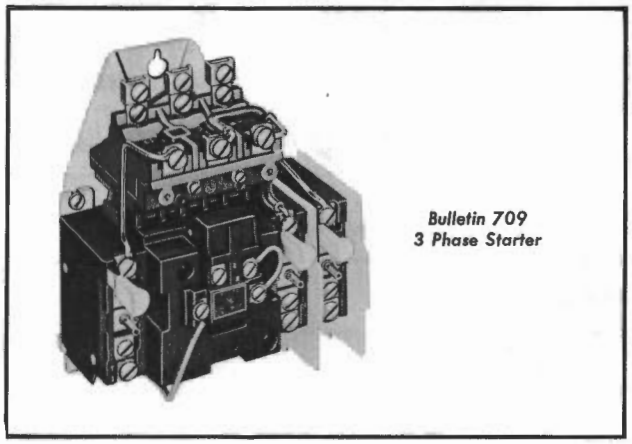


2 Station, 3 Wire Control Connections

ORDERING INFORMATION — Your order cannot be entered unless the following information is given: Part number, description of part, catalog number and series letter of starter. This renewal parts list applies also to these starters when used on control apparatus listed under other Bulletin numbers.

Allen-Bradley
Industrial Control Division
Milwaukee, Wisconsin 53204

FULL VOLTAGE STARTERS



Bulletin 709
3 Phase Starter

Size 1 • Series K and L Construction

OPERATION — These AC Full Voltage Starters are designed for starting of polyphase squirrel cage motors and the primary control of slip-ring motors. They can also be used for self-starting single phase motors. See the Engineering Data for specific starter ratings.

The rapid consistent action of these starters makes them particularly suitable for high speed automatic operations.

Starters may be operated by remote control with push buttons, float switches, thermostats, pressure switches, snap switches, limit switches, or any other form of two or three wire pilot device.

Starters are equipped as standard with three side mounted manual reset overload relays.

ENGINEERING DATA —

600 VOLTS MAXIMUM • 60 Hz			
[1] Continuous Ampere Rating	Maximum Horsepower Rating		
	Volts	3 Phase	Single Phase
27	115	—	2
	200	7½	—
	230	7½	3
	460	10	—
	575	10	—

[1] Full load current must not exceed "Continuous Ampere Rating."

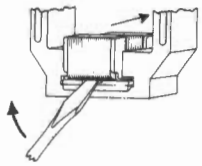
MAINTENANCE — Construction of these starters is such that when properly applied, very little maintenance is normally required. Check points which should be considered are as follows:

Contact Inspection — Periodic inspection of the movable and stationary contacts is necessary to insure that the contact surfaces are in satisfactory operating condition. If the contacts become severely burned, pitted or worn, they should be replaced. Never attempt to file or "dress" contacts during their service life.

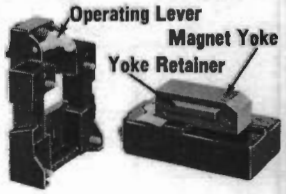
Operating Environment — Starters should always be maintained in reasonably contamination free condition for dependable operation. Choice of the proper NEMA enclosure type for the application is very important in this respect.

REPAIRS — Starters can be disassembled as depicted in the illustrations on Page 2 of this Parts List. Additional consideration should be given to the following techniques.

Removing Magnet Armature — To remove the magnet armature from the movable contact support, insert screwdriver into slot as illustrated and lift screwdriver in the direction shown. At the same time push the magnet armature out. It may be necessary to wiggle the armature before it can be removed because of the pressure applied by the retainer spring.



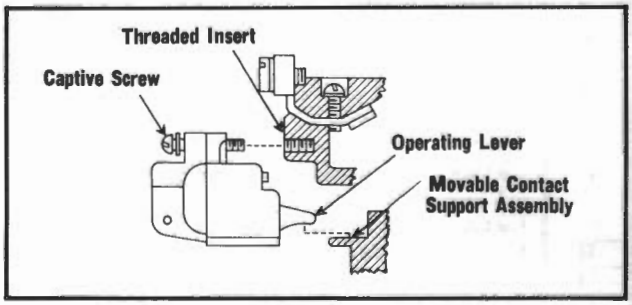
Replacing Operating Coil — To replace the operating coil, first insert the magnet yoke into the operating coil as shown. After this has been done, insert both the operating coil and the magnet yoke as a unit into the coil cover. When replacing the coil cover into the switch unit, be sure the operating lever of the interlock contact rests on top of the movable contact support, and the yoke retainer is in place.



BULLETIN 1495 AUXILIARY CONTACTS — These auxiliary contacts are designed to operate on the upward motion of the movable contact support assembly. The auxiliary contacts are furnished with a captive screw. The captive screw is used to engage either of the two inserts imbedded in the contact block front cover. Refer to illustration below.

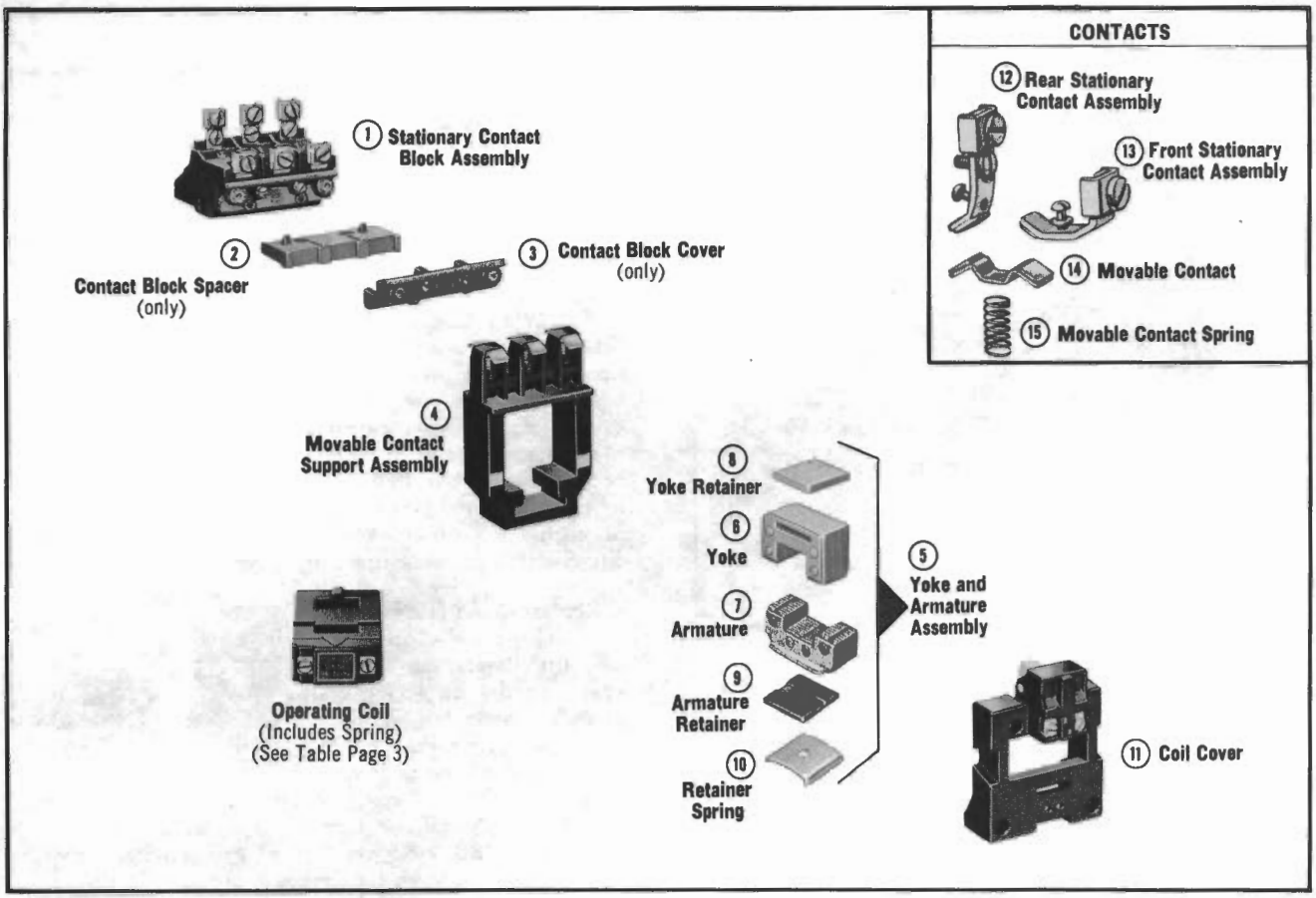
IMPORTANT — The auxiliary contact operating lever **must** rest on top of the movable contact support assembly.

Refer to listings in Handy Catalog for replacement catalog numbers.



ORDERING INFORMATION — Your order cannot be entered unless the following information is given: Part number, description of part, catalog number and series letter of starter. This renewal parts list applies also to these starters when used on control apparatus listed under other bulletin numbers.

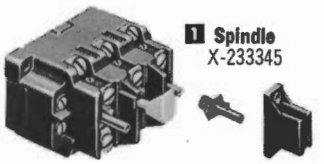
Renewal Parts List 709-711 — August, 1973
Supersedes Parts List 709-711 Dated September, 1970



Item	Description of Part	SINGLE PHASE 2 Pole Part Number	3 PHASE 3 Pole Part Number	2 PHASE, 4 WIRE 4 Pole Part Number
1	Stationary Contact Block Assembly (includes contacts, spacer and cover)	X-355027	X-355028	X-355029
	Stationary Contact Block Assembly (less contacts)	X-355023	X-355024	X-355025
2	Contact Block Spacer (only)	F-20587	F-20597	F-20175
3	Contact Block Cover (only)	F-20586	X-232230	X-232231
4	Movable Contact Support Assembly (includes contacts and springs)	X-232696	X-232697	X-232698
	Movable Contact Support Assembly (less contacts and springs)	F-20588	F-20598	F-20167
5	Yoke and Armature Assembly 60-50 Hz (includes retainers and spring)	Z-31837	Z-31837	Z-31837
	Yoke and Armature Assembly 25 Hz (includes retainers and spring)	Z-31839	Z-31839	Z-31839
6	Yoke 60-50 Hz	X-225320	X-225320	X-225320
	Yoke 25 Hz	X-270384	X-270384	X-270384
7	Armature 60-50-25 Hz	X-225321	X-225321	X-225321
8	Yoke Retainer	F-20179	F-20179	F-20179
9	Armature Retainer	F-20178	F-20178	F-20178
10	Retainer Spring	B-28603	B-28603	B-28603
11	Coil Cover — Single Phase	Z-21131	—	—
	Coil Cover — With Normally Closed Interlock Contact	—	Z-21132	Z-21132
	Coil Cover — With Normally Open Interlock Contact	—	Z-21133	Z-21133
	Coil Cover — With Normally Open-Normally Closed Interlock Contact	—	Z-21134	Z-21134
	Coil Cover — Without Interlock Contact	—	Z-21135	Z-21135
12	Rear Stationary Contact Assembly	Z-23423	Z-23423	Z-23423
13	Front Stationary Contact Assembly	Z-23422	Z-23422	Z-23422
14	Movable Contact	X-225866	X-225866	X-225866
15	Movable Contact Spring	B-28595	B-28595	B-28595
12-15	Set of Front and Rear Stationary Contacts	Z-23366	Z-23367	Z-23368
	Set of Movable Contacts and Springs	Z-21108	Z-21109	Z-21110
	Set of Front and Rear Stationary Contacts, Movable Contacts and Springs	X-247281	X-247282	X-247283
	Single Pole Contact Set (includes one (1) Front and Rear Stationary Contacts, Movable Contact and Contact Spring)	Z-34038	Z-34038	Z-34038

Overload Relays

Block Type Overload



Side Mounted Type Overload

(Bulletin 815, Manual Reset Type Illustrated)

Description of Relay	Catalog No.
Block Type — Two Pole — Manual Reset	815-BOV15
Block Type — Three Pole — Manual Reset	815-BOV16
Block Type — Two Pole — Automatic Reset	816-BOV15
Block Type — Three Pole — Automatic Reset	816-BOV16
Side Mounted — Single Pole — Manual Reset	815-BOV4
	2 1415-N50
Side Mounted — Single Pole — Automatic Reset	816-BOV4
	3 1416-N50

1 The manual reset overload relays in the table above are furnished with spindles.

2 Furnished as third overload relay (T3) on all standard starters.

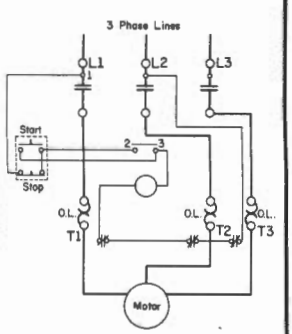
3 Furnished as third overload relay (T3) on starters utilizing Bulletin 816 overload relays.

OPERATING COILS

Coil Volts	Hz	Coil Number	Coil Current		Volt-Amperes		Coil Volts	Hz	Coil Number	Coil Current		Volt-Amperes	
			Inrush	Sealed	Inrush	Sealed				Inrush	Sealed	Inrush	Sealed
120	60	71A86	1.46	.182	175	22	440	50	71A288	.353	.054	155	24
110	50		1.41	.218	155	24	440	60	71A11	.380	.046	167	21
110	60	71A01	1.52	.185	167	21	380	50		.346	.049	131	19
95	50		1.38	.197	131	19	440	25	71A15	.160	.057	71	26
110	25	71A05	.640	.227	71	25	600	60	71A81	.280	.034	168	21
208	60	71A113	.805	.098	167	21	550	50		.270	.041	149	23
240	60	71A83	.730	.091	175	22	550	60	71A16	.304	.037	167	21
220	50		.705	.109	155	24	550	25	71A20	.130	.046	72	26
220	60	71A06	.760	.093	167	21	110/220	60	4 71A806	1.52-.76	.178-.089	175	22
220	25	71A10	.320	.114	71	26	110/220	50	4 71A562	1.41-.70	.218-.109	155	24
480	60	71A288	.365	.046	175	22	120/240	60		1.46-.73	.182-.091	175	22

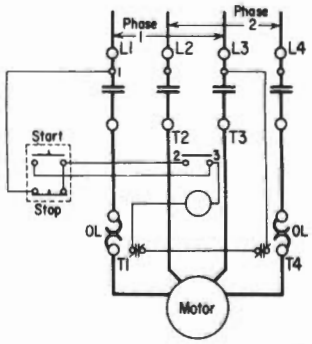
4 For single phase starters.

TYPICAL WIRING DIAGRAMS —(See Applicable Codes and Laws)



3 Phase Starter

3 Wire Control Connections

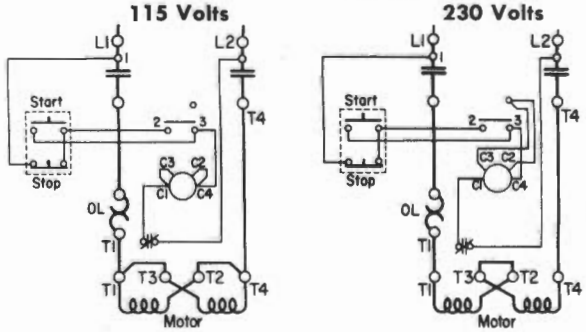


2 Phase, 4 Wire Starter

3 Wire Control Connections

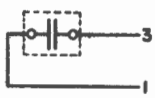
Single Phase Starter

3 Wire Control Connections

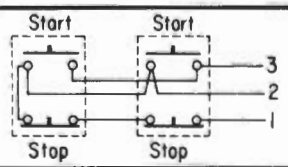


NOTE: When changing the starter from 115 Volt operation to 230 Volt operation or vice versa, the heater element may require changing unless the motor current remains the same.

2 Wire Control

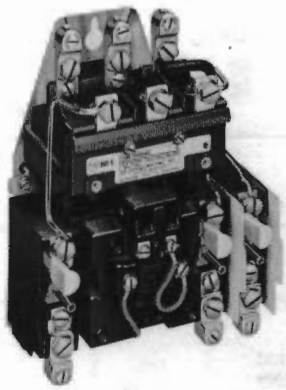


2 Station, 3 Wire Control



ALLEN-BRADLEY
Industrial Control Division
Milwaukee, Wisconsin 53204

FULL VOLTAGE STARTERS • Size 2 • Series K and L Construction



Bulletin 709
3 Phase Starter

OPERATION — These AC Full Voltage Starters are designed for starting of polyphase squirrel cage motors and the primary control of slip-ring motors. They can also be used for self-starting single phase motors. See the Engineering Data for specific starter ratings.

The rapid consistent action of these starters makes them particularly suitable for high speed automatic operations.

Starters may be operated by remote control with push buttons, float switches, thermostats, pressure switches, snap switches, limit switches, or any other form of two or three wire pilot device.

Starters are equipped as standard with three side mounted manual reset overload relays.

ENGINEERING DATA —

600 VOLTS MAXIMUM • 60 Hz			
[1] Continuous Ampere Rating	Maximum Horsepower Rating		
	Volts	3 Phase	Single Phase
45	115	—	3
	200	10	—
	230	15	7½
	460	25	—
	575	25	—

[1] Full load current must not exceed "Continuous Ampere Rating."

MAINTENANCE — Construction of these starters is such that when properly applied, very little maintenance is normally required. Check points which should be considered are as follows:

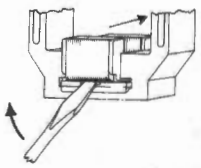
Contact Inspection — Periodic inspection of the movable and stationary contacts is necessary to insure that the contact surfaces are in satisfactory operating condition. If the contacts become severely burned, pitted or worn, they should be replaced. Never attempt to file or "dress" contacts during their service life.

Operating Environment — Starters should always be maintained in reasonably contamination free condition for dependable operation. Choice of the proper NEMA enclosure type for the application is very important in this respect.

Renewal Parts List 709-712 — May, 1974
Supersedes Parts List 709-712 Dated July, 1969

REPAIRS — Starters can be disassembled as depicted in the illustrations on Page 2 of this Parts List. Additional consideration should be given to the following techniques.

Removing Magnet Armature — To remove the magnet armature from the movable contact support, insert screwdriver into slot as illustrated and lift screwdriver in the direction shown. At the same time push the magnet armature out. It may be necessary to wiggle the armature before it can be removed because of the pressure applied by the retainer spring.

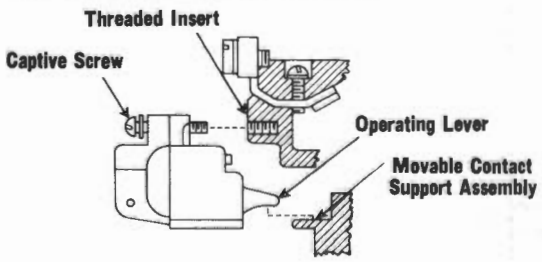


Replacing Operating Coil — To replace the operating coil, first insert the magnet yoke into the operating coil as shown. After this has been done, insert both the operating coil and the magnet yoke as a unit into the coil cover. When replacing the coil cover into the switch unit, be sure the operating lever of the interlock contact rests on top of the movable contact support, and the yoke retainer is in place.

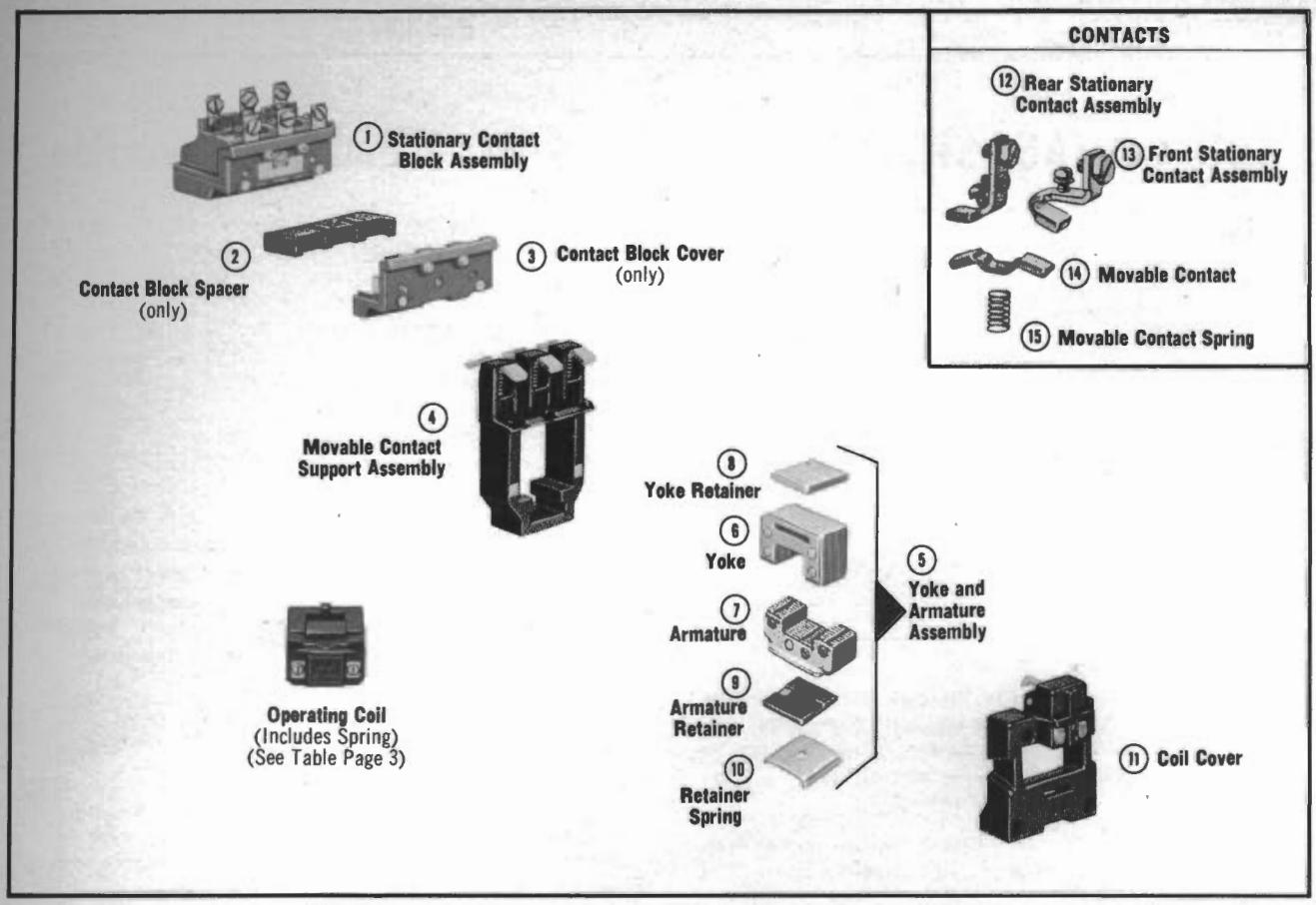
BULLETIN 1495 AUXILIARY CONTACTS — These auxiliary contacts are designed to operate on the upward motion of the movable contact support assembly. The auxiliary contacts are furnished with a captive screw. The captive screw is used to engage either of the two inserts imbedded in the contact block front cover. Refer to illustration below.

IMPORTANT — The auxiliary contact operating lever **must** rest on top of the movable contact support assembly.

Refer to listings in Handy Catalog for replacement catalog numbers.



ORDERING INFORMATION — Your order cannot be entered unless the following information is given: Part number, description of part, catalog number and series letter of starter. This renewal parts list applies also to these starters when used on control apparatus listed under other bulletin numbers.



Item	Description of Part	SINGLE PHASE 2 Pole Part Number	3 PHASE 3 Pole Part Number	2 PHASE, 4 WIRE 4 Pole Part Number
1	Stationary Contact Block Assembly (includes contacts, spacer and cover)	X-355646	X-355647	X-355648
	Stationary Contact Block Assembly (less contacts)	X-355650	X-355651	X-355652
2	Contact Block Spacer (only)	F-20626	F-20310	F-20694
3	Contact Block Cover (only)	X-232802	X-232803	X-232804
4	Movable Contact Support Assembly (includes contacts and springs)	X-232700	X-232701	X-232702
	Movable Contact Support Assembly (less contacts and springs)	F-20625	F-20323	F-20693
5	Yoke and Armature Assembly 60-50 Hz (includes retainers and spring)	Z-31837	Z-31837	Z-31837
	Yoke and Armature Assembly 25 Hz (includes retainers and spring)	Z-31839	Z-31839	Z-31839
6	Yoke 60-50 Hz	X-225320	X-225320	X-225320
	Yoke 25 Hz	X-270384	X-270384	X-270384
7	Armature 60-50-25 Hz	X-225321	X-225321	X-225321
8	Yoke Retainer	F-20179	F-20179	F-20179
9	Armature Retainer	F-20178	F-20178	F-20178
10	Retainer Spring	B-28603	B-28603	B-28603
11	Coil Cover — Single Phase	Z-21131	—	—
	Coil Cover — With Normally Closed Interlock Contact	—	Z-21132	Z-21132
	Coil Cover — With Normally Open Interlock Contact	—	Z-21133	Z-21133
	Coil Cover — With Normally Open-Normally Closed Interlock Contact	—	Z-21134	Z-21134
	Coil Cover — Without Interlock Contact	—	Z-21135	Z-21135
12	Rear Stationary Contact Assembly	Z-23425	Z-23425	Z-23425
13	Front Stationary Contact Assembly	Z-23424	Z-23424	Z-23424
14	Movable Contact	X-226979	X-226979	X-226979
15	Movable Contact Spring	B-28874	B-28874	B-28874
12-15	Set of Front and Rear Stationary Contacts	Z-23370	Z-23371	Z-23372
	Set of Movable Contacts and Springs	Z-21112	Z-21113	Z-21114
	Set of Front and Rear Stationary Contacts, Movable Contacts and Springs	X-247285	X-247286	X-247287
	Single Pole Contact Set (includes one (1) Front and Rear Stationary Contacts, Movable Contact and Contact Spring)	Z-34039	Z-34039	Z-34039

[1] Overload Relays

Block Type Overload

Side Mounted Type Overload

(Bulletin 815, Manual Reset Type Illustrated)

Description of Relay	Catalog No.
Block Type — Two Pole — Manual Reset	815-COV15
Block Type — Three Pole — Manual Reset	815-COV16
Block Type — Two Pole — Automatic Reset	816-COV15
Block Type — Three Pole — Automatic Reset	816-COV16
Side Mounted — Single Pole — Manual Reset	815-COV4 [2] 1415-N52
Side Mounted — Single Pole — Automatic Reset	816-COV4 [3] 1416-N52

[1] **Note** — All replacement overload relays are furnished with lugs. Manual reset overload relays are furnished with spindles.

[2] Furnished as third overload relay (T3) on all standard starters.

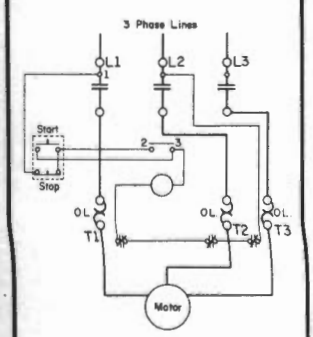
[3] Furnished as third overload relay (T3) on starters utilizing Bulletin 816 overload relays.

OPERATING COILS

Coil Volts	Hz	Coil Number	Coil Current		Volt-Amperes		Coil Volts	Hz	Coil Number	Coil Current		Volt-Amperes	
			Inrush	Sealed	Inrush	Sealed				Inrush	Sealed	Inrush	Sealed
120	60	72A86	1.97	.252	240	31	440	50	72A288	.460	.080	205	35
110	50		1.84	.318	205	35	440	60	72A11	.537	.069	240	31
110	60	72A01	2.15	.275	240	31	380	50		.473	.077	180	30
95	50		1.89	.308	180	30	440	25	72A15	.200	.059	88	26
110	25	72A05	.790	.237	88	26	600	60	72A81	.394	.050	240	31
208	60	72A113	1.13	.144	235	30	550	50		.368	.064	205	35
240	60	72A83	.985	.126	240	31	550	60	72A16	.430	.055	240	31
220	50		.920	.159	205	35	550	25	72A20	.160	.047	88	26
220	60	72A06	1.07	.138	240	31	120/240	60	[4] 72A562	1.97/.985	.252/.196	240	31
220	25	72A10	.400	.118	88	26	110/220	50		1.84/.920	.318/.159	205	35
480	60	72A288	.493	.063	240	31							

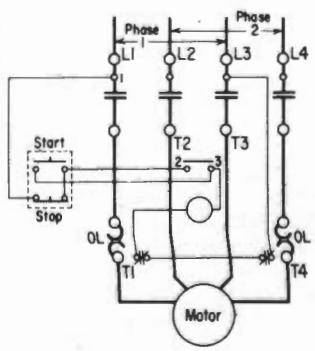
[4] For single phase starters.

TYPICAL WIRING DIAGRAMS —(See Applicable Codes and Laws)



3 Phase Starter

3 Wire Control Connections

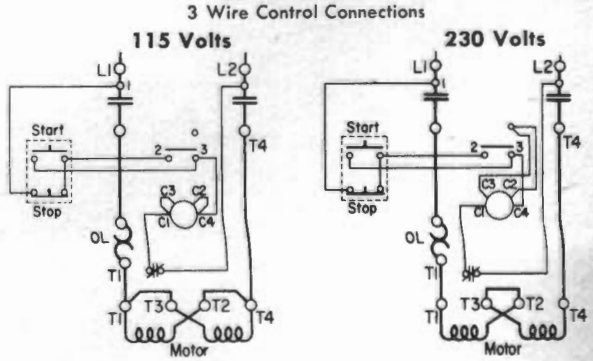


2 Phase, 4 Wire Starter

3 Wire Control Connections

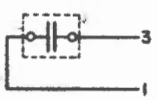
Single Phase Starter

3 Wire Control Connections

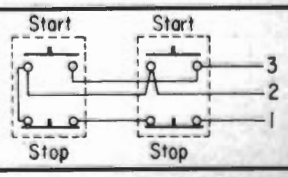


NOTE: When changing the starter from 115 Volt operation to 230 Volt operation or vice versa, the heater element may require changing unless the motor current remains the same.

2 Wire Control

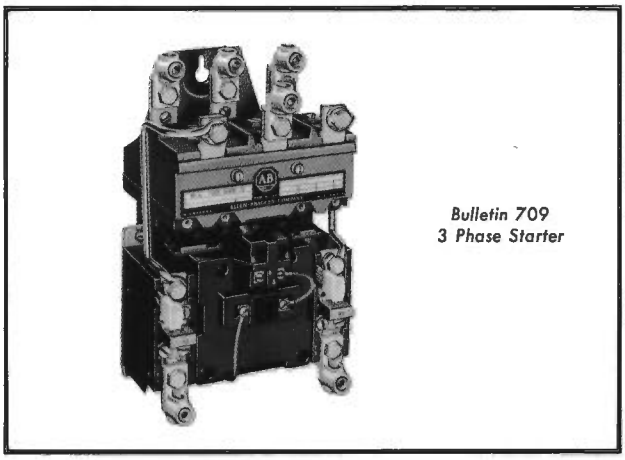


2 Station, 3 Wire Control



ALLEN-BRADLEY
Industrial Control Division
Milwaukee, Wisconsin 53204

Full Voltage Starters
Size 3 • Series K Construction



Bulletin 709
3 Phase Starter

OPERATION — These AC Full Voltage Starters are designed for starting of polyphase squirrel cage motors and the primary control of slip-ring motors. They can also be used for self-starting single phase motors. See the Engineering Data for specific starter ratings.

The rapid consistent action of these starters makes them particularly suitable for high speed automatic operations.

Starters may be operated by remote control with push buttons, float switches, thermostats, pressure switches, snap switches, limit switches, or any other form of two or three wire pilot device.

ENGINEERING DATA —

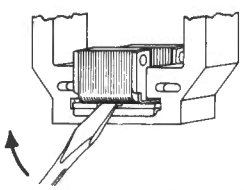
600 VOLTS MAXIMUM • 60 Hz			
[1] Continuous Ampere Rating	Maximum Horsepower Rating		
	Volts	3 Phase	Single Phase
90	120	Separate Control	—
	208	30	15
	240	30	15
	480	50	—
	600	50	—

[1] Full load current must not exceed "Continuous Ampere Rating."

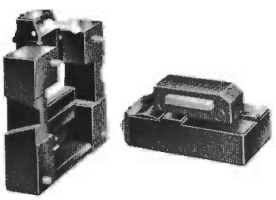
MAINTENANCE — These starters are constructed to be virtually trouble-free. Periodic inspection of the movable and stationary contacts is the only maintenance required.

REPAIRS — Starters can be disassembled as depicted in the illustrations on Page 2 of this Parts List. Additional consideration should be given to the following techniques.

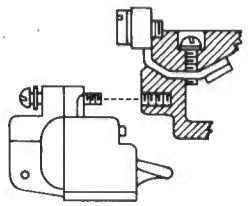
REMOVING MAGNET ARMATURE — To remove the magnet armature from the movable contact support, insert screwdriver into slot as illustrated and lift screwdriver in the direction shown. At the same time push the magnet armature out. It may be necessary to wiggle the armature before it can be removed because of the pressure applied by the retainer spring.



REPLACING OPERATING COIL — To replace the operating coil, first insert the magnet yoke into the operating coil as shown. After this has been done, insert both the operating coil and the magnet yoke as a unit into the coil cover. When replacing the coil cover into the switch unit, be sure the operating lever of the interlock contact rests on top of the movable contact support.

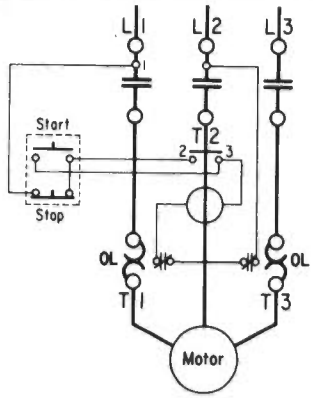


BULLETIN 1495 AUXILIARY CONTACTS — To provide extra pilot circuit contacts, up to four extra Bulletin 1495 auxiliary contacts can be attached to the front of the contact block.

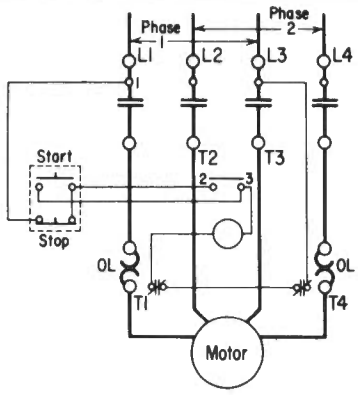


Description of Contact	Catalog No.
Normally Open	1495-F1
Normally Closed (Early Break)	1495-G3
Normally Closed (Late Break)	1495-H0

TYPICAL WIRING DIAGRAMS —

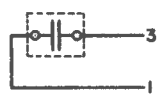


3 Phase Starter
3 Wire Control Connections

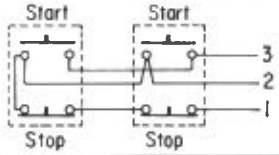


2 Phase, 4 Wire Starter
3 Wire Control Connections

2 Wire Control

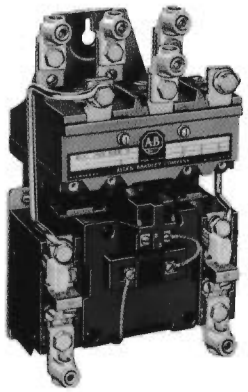


2 Station, 3 Wire Control



Renewal Parts List 709-713—July, 1969
Supersedes Parts List 709-713 Dated November, 1967

Full Voltage Starters
Size 3 • Series K Construction



Bulletin 709
3 Phase Starter

OPERATION — These AC Full Voltage Starters are designed for starting of polyphase squirrel cage motors and the primary control of slip-ring motors. They can also be used for self-starting single phase motors. See the Engineering Data for specific starter ratings.

The rapid consistent action of these starters makes them particularly suitable for high speed automatic operations.

Starters may be operated by remote control with push buttons, float switches, thermostats, pressure switches, snap switches, limit switches, or any other form of two or three wire pilot device.

ENGINEERING DATA —

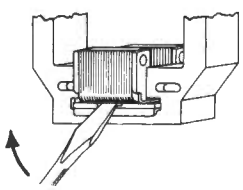
600 VOLTS MAXIMUM • 60 Hz			
[1] Continuous Ampere Rating	Maximum Horsepower Rating		
	Volts	3 Phase	Single Phase
90	120	Separate Control	—
	208	30	15
	240	30	15
	480	50	—
	600	50	—

[1] Full load current must not exceed "Continuous Ampere Rating."

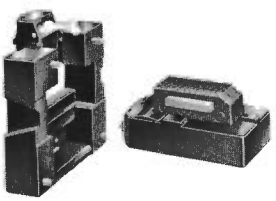
MAINTENANCE — These starters are constructed to be virtually trouble-free. Periodic inspection of the movable and stationary contacts is the only maintenance required.

REPAIRS — Starters can be disassembled as depicted in the illustrations on Page 2 of this Parts List. Additional consideration should be given to the following techniques.

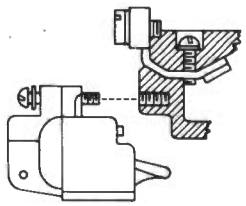
REMOVING MAGNET ARMATURE — To remove the magnet armature from the movable contact support, insert screwdriver into slot as illustrated and lift screwdriver in the direction shown. At the same time push the magnet armature out. It may be necessary to wiggle the armature before it can be removed because of the pressure applied by the retainer spring.



REPLACING OPERATING COIL — To replace the operating coil, first insert the magnet yoke into the operating coil as shown. After this has been done, insert both the operating coil and the magnet yoke as a unit into the coil cover. When replacing the coil cover into the switch unit, be sure the operating lever of the interlock contact rests on top of the movable contact support.

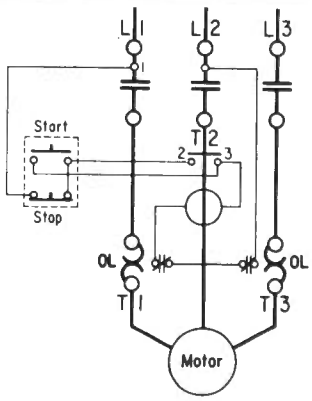


BULLETIN 1495 AUXILIARY CONTACTS — To provide extra pilot circuit contacts, up to four extra Bulletin 1495 auxiliary contacts can be attached to the front of the contact block.



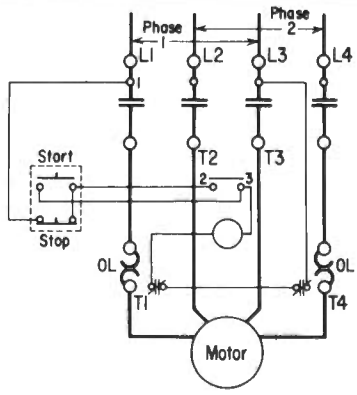
Description of Contact	Catalog No.
Normally Open	1495-F1
Normally Closed (Early Break)	1495-G3
Normally Closed (Late Break)	1495-H0

TYPICAL WIRING DIAGRAMS —



3 Phase Starter

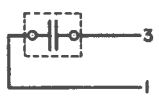
3 Wire Control Connections



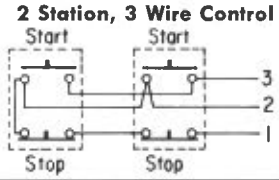
2 Phase, 4 Wire Starter

3 Wire Control Connections

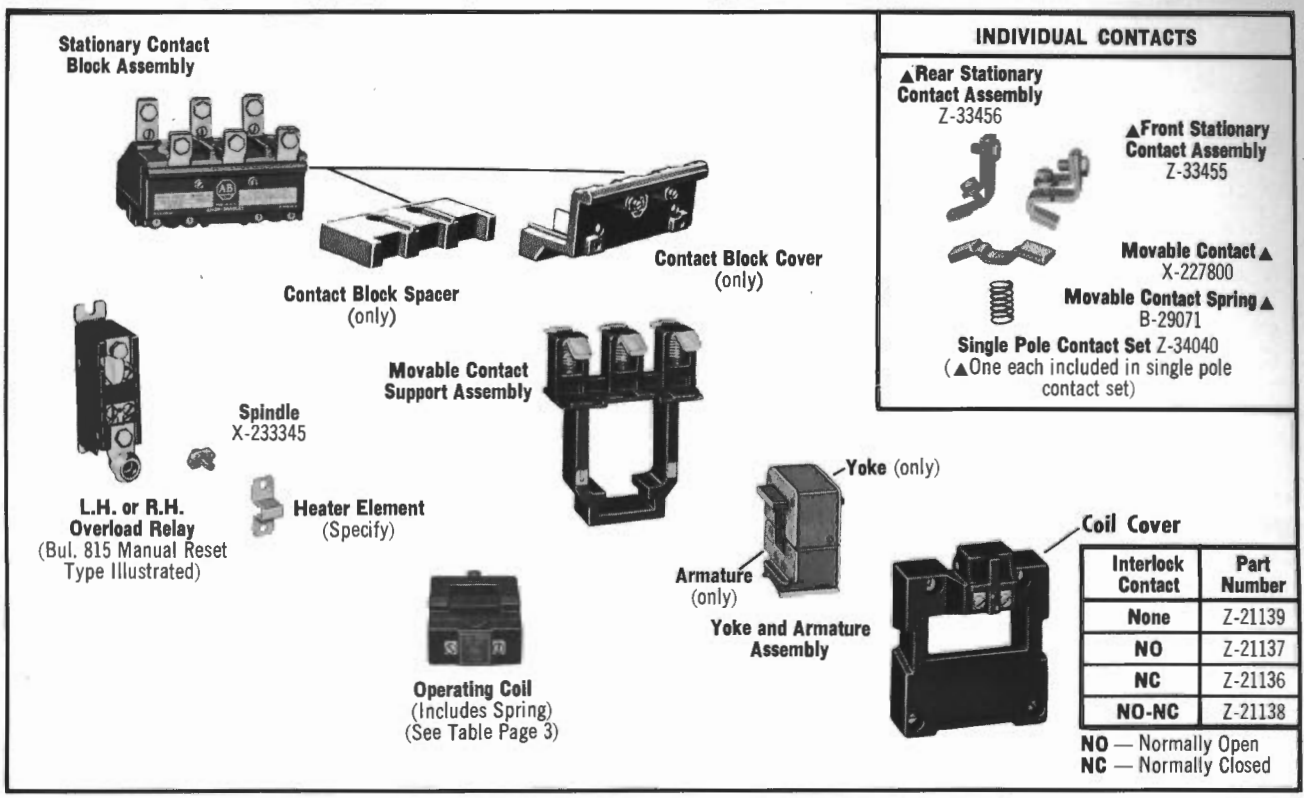
2 Wire Control



2 Station, 3 Wire Control



Renewal Parts List 709-713—July, 1969
Supersedes Parts List 709-713 Dated November, 1967



INDIVIDUAL CONTACTS

▲**Rear Stationary Contact Assembly** Z-33456

▲**Front Stationary Contact Assembly** Z-33455

Movable Contact ▲ X-227800

Movable Contact Spring ▲ B-29071

Single Pole Contact Set Z-34040
(▲One each included in single pole contact set)

Interlock Contact	Part Number
None	Z-21139
NO	Z-21137
NC	Z-21136
NO-NC	Z-21138

NO — Normally Open
NC — Normally Closed

Block Type Overload Relay

(Bulletin 815, Manual Reset Type Illustrated)

[1] OVERLOAD RELAYS	
Description of Relay	Catalog No.
Single Pole—Manual Reset—Side Mounted	815-DOV4
Single Pole—Automatic Reset—Side Mounted	816-DOV4
Single Pole—Manual Reset—Third Overload Relay Kit	1415-N53
Single Pole—Automatic Reset—Third Overload Relay Kit	1416-N53
Two Pole—Manual Reset—Block Type	815-DOV15
Three Pole—Manual Reset—Block Type	815-DOV16
Two Pole—Automatic Reset—Block Type	816-DOV15
Three Pole—Automatic Reset—Block Type	816-DOV16

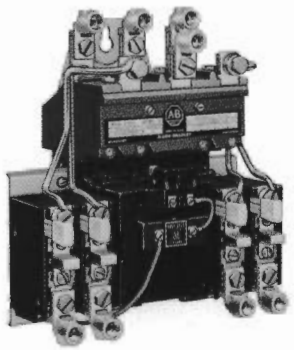
[1] **NOTE** – All replacement overload relays are furnished with wiring lugs. Manual reset overload relays are furnished with spindles. Block type overload relays are not used, **as standard**, on Bulletin 709 starters.

Description of Part	3 PHASE 3 Pole Part Number	2 PHASE, 4 WIRE 4 Pole Part Number
Stationary Contact Block Assembly (includes contacts, spacer and cover)	X-355655	X-355656
Stationary Contact Block Assembly (less contacts)	X-355659	X-355660
Contact Block Spacer (only)	F-20424	F-20776
Contact Block Cover (only)	X-232807	X-232808
Movable Contact Support Assembly (includes contacts and springs)	X-232705	X-232706
Movable Contact Support Assembly (less contacts and springs)	F-20527	F-20777
Yoke and Armature Assembly 60-50 Hz (includes retainers and spring)	Z-31850	Z-31850
Yoke and Armature Assembly 25 Hz (includes retainers and spring)	Z-31854	—
Yoke Assembly (only) 60-50 Hz	X-227198	X-227198
Yoke Assembly (only) 25 Hz	X-264859	—
Armature Assembly (only) 60-50-25 Hz	X-227197	X-227197
Set of Front and Rear Stationary Contacts	Z-23375	Z-23376
Set of Movable Contacts and Springs	Z-21117	Z-21118
Set of Front and Rear Stationary Contacts, Movable Contacts and Springs	[2] X-247290	[2] X-247291

[2] Also available in quantities of Single Pole Sets. Refer to top of page.

OPERATING COILS											
Volts	Hz	3 POLE	Coil Current		Volt-Amperes		4 POLE	Coil Current		Volt-Amperes	
		Coil Number	Inrush	Sealed	Inrush	Sealed	Coil Number	Inrush	Sealed	Inrush	Sealed
120	60	**73A86**	4.82	.356	580	43	**73A803**	5.34	.392	640	47
110	50		5.10	.400	550	44		5.80	.428	640	47
110	60	**73A01**	5.26	.388	580	43	**73A754**	5.82	.428	640	47
95	50		5.12	.404	490	39		5.72	.430	490	41
110	25	**73A05**	2.92	.410	320	45	**73A05**	2.92	.410	320	45
208	60	**73A113**	2.78	.205	580	43	**73A875**	3.08	.226	640	47
240	60	**73A83**	2.41	.178	580	43	**73A804**	2.67	.196	640	47
220	50		2.55	.200	550	44		2.90	.214	640	47
220	60	**73A06**	2.63	.194	580	43	**73A755**	2.91	.214	640	47
220	25	**73A10**	1.46	.205	320	45	**73A10**	1.46	.205	320	45
480	60	**73A288**	1.20	.089	580	43	**73A805**	1.33	.098	640	47
440	50		1.27	.100	550	44		1.45	.107	640	47
440	60	**73A11**	1.32	.097	580	43	**73A756**	1.46	.107	640	47
380	50		1.43	.108	490	39		1.43	.108	490	41
440	25	**73A15**	.74	.120	320	45	**73A15**	.74	.120	320	45
600	60	**73A81**	.965	.071	580	43	**73A987**	1.07	.078	640	47
550	50		1.02	.080	550	44		1.16	.086	640	47
550	60	**73A16**	1.05	.078	580	43	**73A757**	1.16	.086	640	47
550	25	**73A20**	.58	.082	320	45	**73A20**	.58	.082	320	45

ORDERING INFORMATION — Your order cannot be entered unless the following information is given: Part number, description of part, the catalog number and series letter of starter. This renewal parts list applies also to these starters when used on control apparatus listed under other Bulletin numbers.

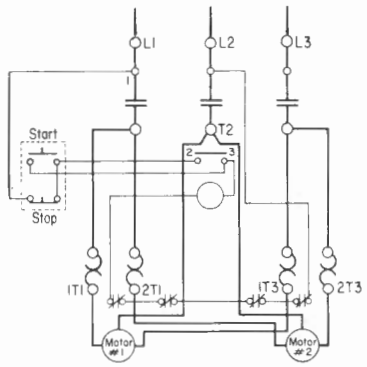


Bulletin 709TM, 3 Phase Two Motor Starter

BULLETIN 709TM — These starters are three pole full voltage starters with additional sets of overload relays. They are capable of simultaneously starting two, three or four motors. Each motor is protected from sustained overloads by two overload relays. These starters are also capable, when combined with a suitable manual drum switch, of controlling two, three and four speed motors. Each speed is adequately protected by two overload relays.

All parts as listed on this parts list for the standard three pole, three phase starters are applicable to the Bulletin 709TM starters. Block type overload relays are used when more than two motors or two speeds are controlled.

TYPICAL WIRING DIAGRAM —

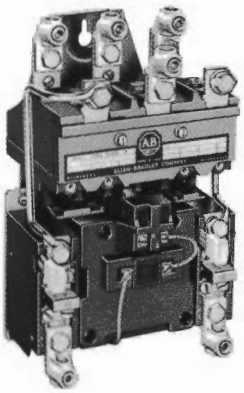


3 Wire Control Connections

ALLEN-BRADLEY COMPANY

MILWAUKEE, WISCONSIN

Full Voltage Starters
Size 4 • Series K Construction



Bulletin 709
3 Phase Starter

OPERATION — These AC Full Voltage Starters are designed for starting of polyphase squirrel cage motors and the primary control of slip-ring motors.

The rapid consistent action of these starters makes them particularly suitable for high speed automatic operations.

Starters may be operated by remote control with push buttons, float switches, thermostats, pressure switches, snap switches, limit switches, or any other form of two or three wire pilot device.

ENGINEERING DATA —

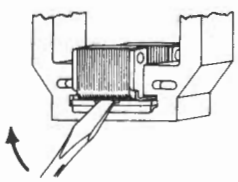
600 VOLTS MAXIMUM • 60 Hz		
[1] Continuous Ampere Rating	Maximum Horsepower Rating	
	Volts	3 Phase
135	120	Separate Control
	208	50
	240	50
	480	100
	600	100

[1] Full load current must not exceed "Continuous Ampere Rating."

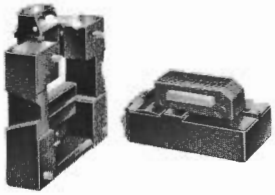
MAINTENANCE — These starters are constructed to be virtually trouble-free. Periodic inspection of the movable and stationary contacts is the only maintenance required.

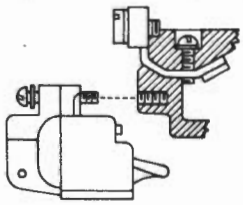
REPAIRS — Starters can be disassembled as depicted in the illustrations on Page 2 of this Parts List. Additional consideration should be given to the following techniques.

REMOVING MAGNET ARMATURE — To remove the magnet armature from the movable contact support, insert screwdriver into slot as illustrated and lift screwdriver in the direction shown. At the same time push the magnet armature out. It may be necessary to wiggle the armature before it can be removed because of the pressure applied by the retainer spring.



REPLACING OPERATING COIL — To replace the operating coil, first insert the magnet yoke into the operating coil as shown. After this has been done, insert both the operating coil and the magnet yoke as a unit into the coil cover. When replacing the coil cover into the switch unit, be sure the operating lever of the interlock contact rests on top of the movable contact support.

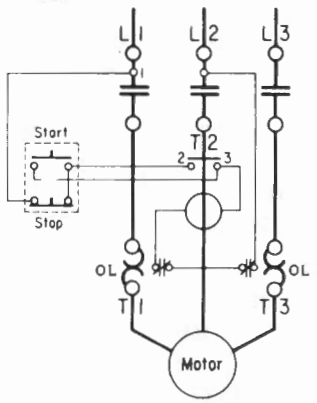




BULLETIN 1495 AUXILIARY CONTACTS — To provide extra pilot circuit contacts, up to four extra Bulletin 1495 auxiliary contacts can be attached to the front of the contact block.

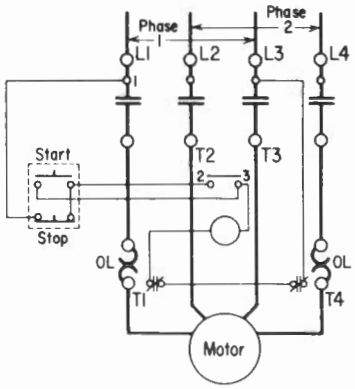
Description of Contact	Catalog No.
Normally Open	1495-F1
Normally Closed (Early Break)	1495-G4
Normally Closed (Late Break)	1495-H0

TYPICAL WIRING DIAGRAMS —



3 Phase Starter

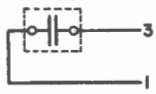
3 Wire Control Connections



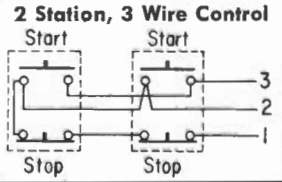
2 Phase, 4 Wire Starter

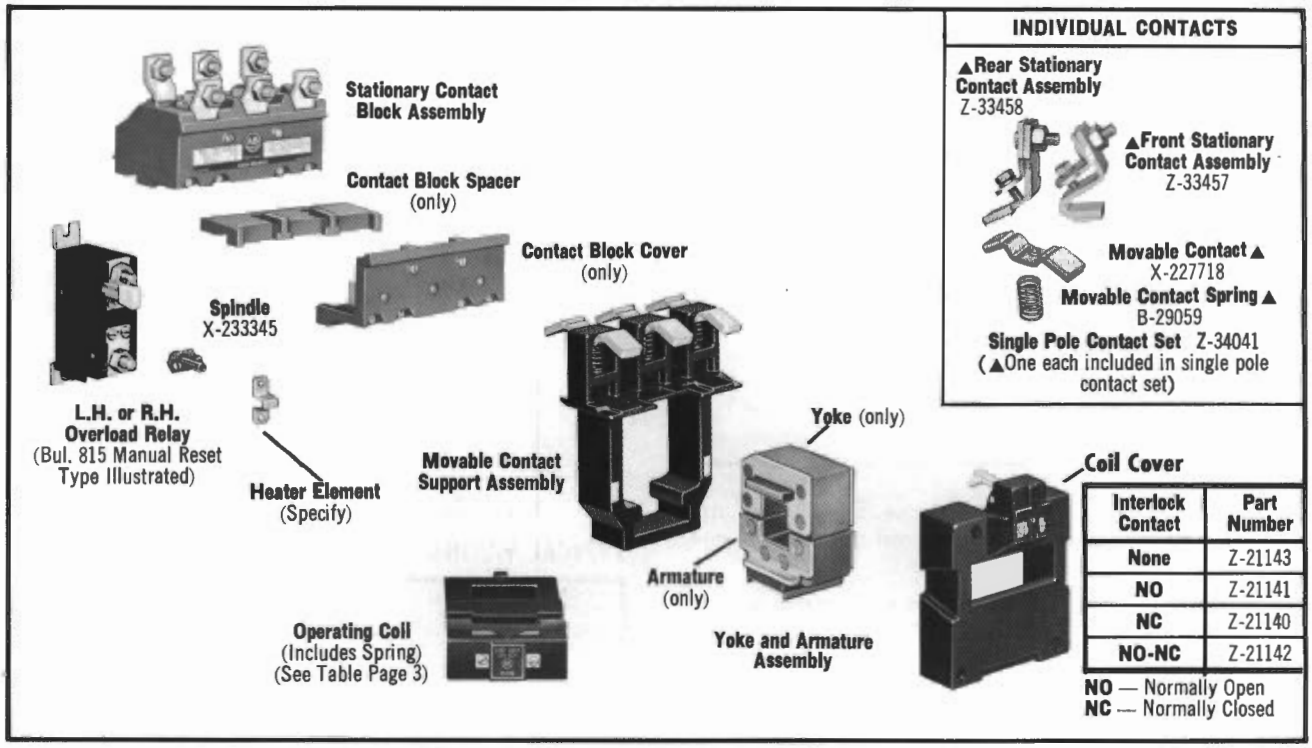
3 Wire Control Connections

2 Wire Control



2 Station, 3 Wire Control





INDIVIDUAL CONTACTS

▲Rear Stationary Contact Assembly Z-33458

▲Front Stationary Contact Assembly Z-33457

Movable Contact ▲ X-227718

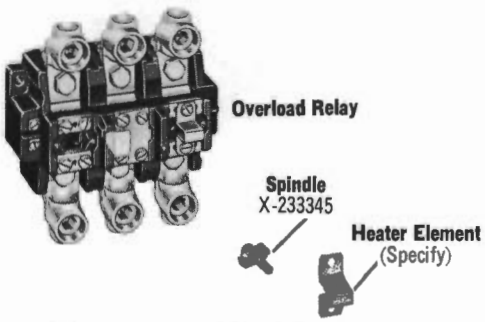
Movable Contact Spring ▲ B-29059

Single Pole Contact Set Z-34041
(▲One each included in single pole contact set)

Interlock Contact	Part Number
None	Z-21143
NO	Z-21141
NC	Z-21140
NO-NC	Z-21142

NO — Normally Open
NC — Normally Closed

Block Type Overload Relay



(Bulletin 815, Manual Reset Type Illustrated)

[1] OVERLOAD RELAYS	
Description of Relay	Catalog No.
Single Pole—Manual Reset—Side Mounted	815-EOV4
Single Pole—Automatic Reset—Side Mounted	816-EOV4
Single Pole—Manual Reset—Third Overload Relay Kit	1415-N54
Single Pole—Automatic Reset—Third Overload Relay Kit	1416-N54
Two Pole—Manual Reset—Block Type	815-EOV15
Three Pole—Manual Reset—Block Type	815-EOV16
Two Pole—Automatic Reset—Block Type	816-EOV15
Three Pole—Automatic Reset—Block Type	816-EOV16

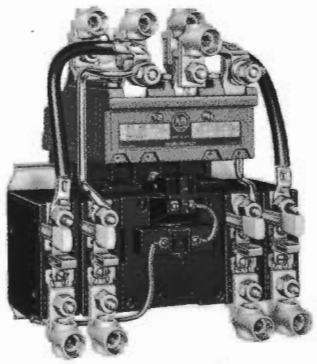
[1] **NOTE** – All replacement overload relays are furnished with wiring lugs. Manual reset overload relays are furnished with spindles. Block type overload relays are not used, **as standard,** on Bulletin 709 starters.

Description of Part	3 PHASE 3 Pole Part Number	2 PHASE, 4 WIRE 4 Pole Part Number
Stationary Contact Block Assembly (includes contacts, spacer and cover)	X-355663	X-355664
Stationary Contact Block Assembly (less contacts)	X-355667	X-355668
Contact Block Spacer (only)	F-20411	F-20784
Contact Block Cover (only)	X-232811	X-232812
Movable Contact Support Assembly (includes contacts and springs)	X-232709	X-232710
Movable Contact Support Assembly (less contacts and springs)	F-20528	F-20738
Yoke and Armature Assembly 60-50 Hz (includes retainers and spring)	Z-31851	Z-31851
Yoke and Armature Assembly 25 Hz (includes retainers and spring)	Z-31855	—
Yoke (only) 60-50 Hz	X-225333	X-225333
Yoke (only) 25 Hz	X-264860	—
Armature (only) 60-50-25 Hz	X-225334	X-225334
Set of Front and Rear Stationary Contacts	Z-23379	Z-23380
Set of Movable Contacts and Springs	Z-21121	Z-21122
Set of Front and Rear Stationary Contacts, Movable Contacts and Springs	[2] X-247294	[2] X-247295

[2] Also available in quantities of Single Pole Sets. Refer to top of page.

OPERATING COILS										
Volts	Hz	3 POLE	Coil Current		Volt-Amperes		4 POLE	Coil Current		Volt-Amperes	
		Coil Number	Inrush	Sealed	Inrush	Sealed	Coil Number	Inrush	Sealed	Inrush	Sealed
120	60	74A86	8.30	.542	1000	65	74A803	9.90	.611	1190	74
110	50		8.55	.636	940	70		10.6	.736	1170	81
110	60	74A01	9.05	.591	1000	65	74A754	10.8	.666	1190	74
95	50		8.84	.616	840	59		11.1	.698	1060	67
110	25	74A05	4.95	.580	550	64	74A05	4.95	.580	550	64
208	60	74A113	4.79	.313	1000	65	74A875	5.71	.352	1190	74
240	60	74A83	4.15	.271	1000	65	74A804	4.95	.305	1190	74
220	50		4.28	.318	940	70		5.30	.368	1170	81
220	60	74A06	4.53	.296	1000	65	74A755	5.40	.333	1190	74
220	25	74A10	2.47	.290	550	64	74A10	2.47	.290	550	64
480	60	74A288	2.08	.135	1000	65	74A805	2.47	.153	1190	74
440	50		2.14	.159	940	70		2.65	.184	1170	81
440	60	74A11	2.26	.148	1000	65	74A756	2.70	.167	1190	74
380	50		2.21	.154	840	59		2.78	.175	1060	67
440	25	74A15	1.24	.145	550	64	74A15	1.24	.145	550	64
600	60	74A81	1.66	.108	1000	65	74A987	1.98	.122	1190	74
550	50		1.71	.127	940	70		2.12	.147	1170	81
550	60	74A16	1.81	.118	1000	65	74A757	2.16	.133	1190	74
550	25	74A20	.990	.116	550	64	74A20	.990	.116	550	64

ORDERING INFORMATION — Your order cannot be entered unless the following information is given: Part number, description of part, the catalog number and series letter of starter. This renewal parts list applies also to these starters when used on control apparatus listed under other Bulletin numbers.

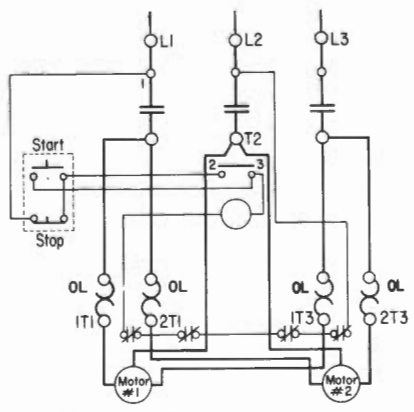


Bulletin 709TM 3 Phase Two Motor Starter

BULLETIN 709TM — These starters are three pole full voltage starters with additional sets of overload relays. They are capable of simultaneously starting two, three or four motors. Each motor is protected from sustained overloads by two overload relays. These starters are also capable, when combined with a suitable manual drum switch, of controlling two, three and four speed motors. Each speed is adequately protected by two overload relays.

All parts as listed on this parts list for the standard three pole, three phase starters are applicable to the Bulletin 709TM starters. Block type overload relays are used when more than two motors or two speeds are controlled.

TYPICAL WIRING DIAGRAM —

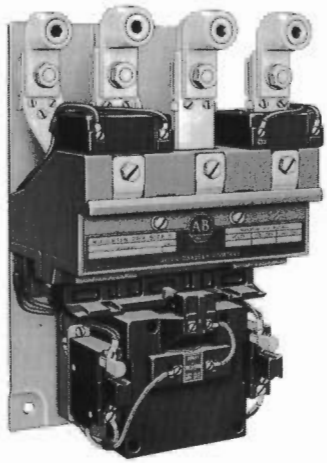


3 Wire Control Connections

ALLEN-BRADLEY COMPANY

MILWAUKEE, WISCONSIN

Full Voltage Starters
Size 5 • Series K Construction



Bulletin 709
3 Phase Starter

OPERATION — These AC Full Voltage Starters are designed for starting of polyphase squirrel cage motors and the primary control of slip-ring motors.

The rapid consistent action of these starters makes them particularly suitable for high speed automatic operations.

Starters may be operated by remote control with push buttons, float switches, thermostats, pressure switches, snap switches, limit switches, or any other form of two or three wire pilot device.

ENGINEERING DATA —

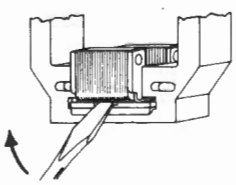
600 VOLTS MAXIMUM • 60 Hz		
[1] Continuous Ampere Rating	Maximum Horsepower Rating	
	Volts	3 Phase
270	120	Separate Control
	208	100
	240	100
	480	200
	600	200

[1] Full load current must not exceed "Continuous Ampere Rating."

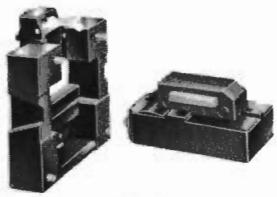
MAINTENANCE — These starters are constructed to be virtually trouble-free. Periodic inspection of the movable and stationary contacts is the only maintenance required.

REPAIRS — Starters can be disassembled as depicted in the illustrations on Page 2 of this Parts List. Additional consideration should be given to the following techniques.

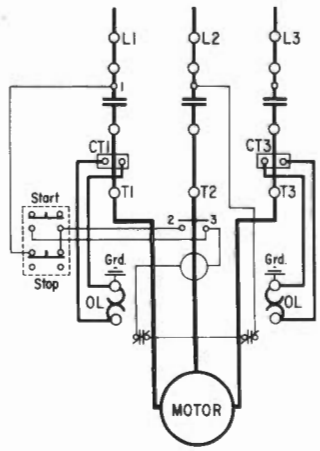
REMOVING MAGNET ARMATURE — To remove the magnet armature from the movable contact support, insert screwdriver into slot as illustrated and lift screwdriver in the direction shown. At the same time push the magnet armature out. It may be necessary to wiggle the armature before it can be removed because of the pressure applied by the retainer spring.



REPLACING OPERATING COIL — To replace the operating coil, first insert the magnet yoke into the operating coil as shown. After this has been done, insert both the operating coil and the magnet yoke as a unit into the coil cover. When replacing the coil cover into the switch unit, be sure the operating lever of the interlock contact rests on top of the movable contact support.

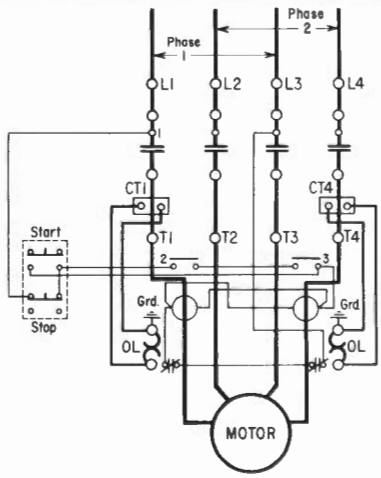


TYPICAL WIRING DIAGRAMS —



3 Phase Starter

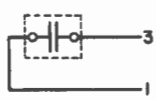
3 Wire Control Connections



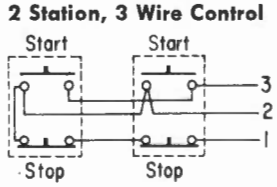
2 Phase, 4 Wire Starter

3 Wire Control Connections

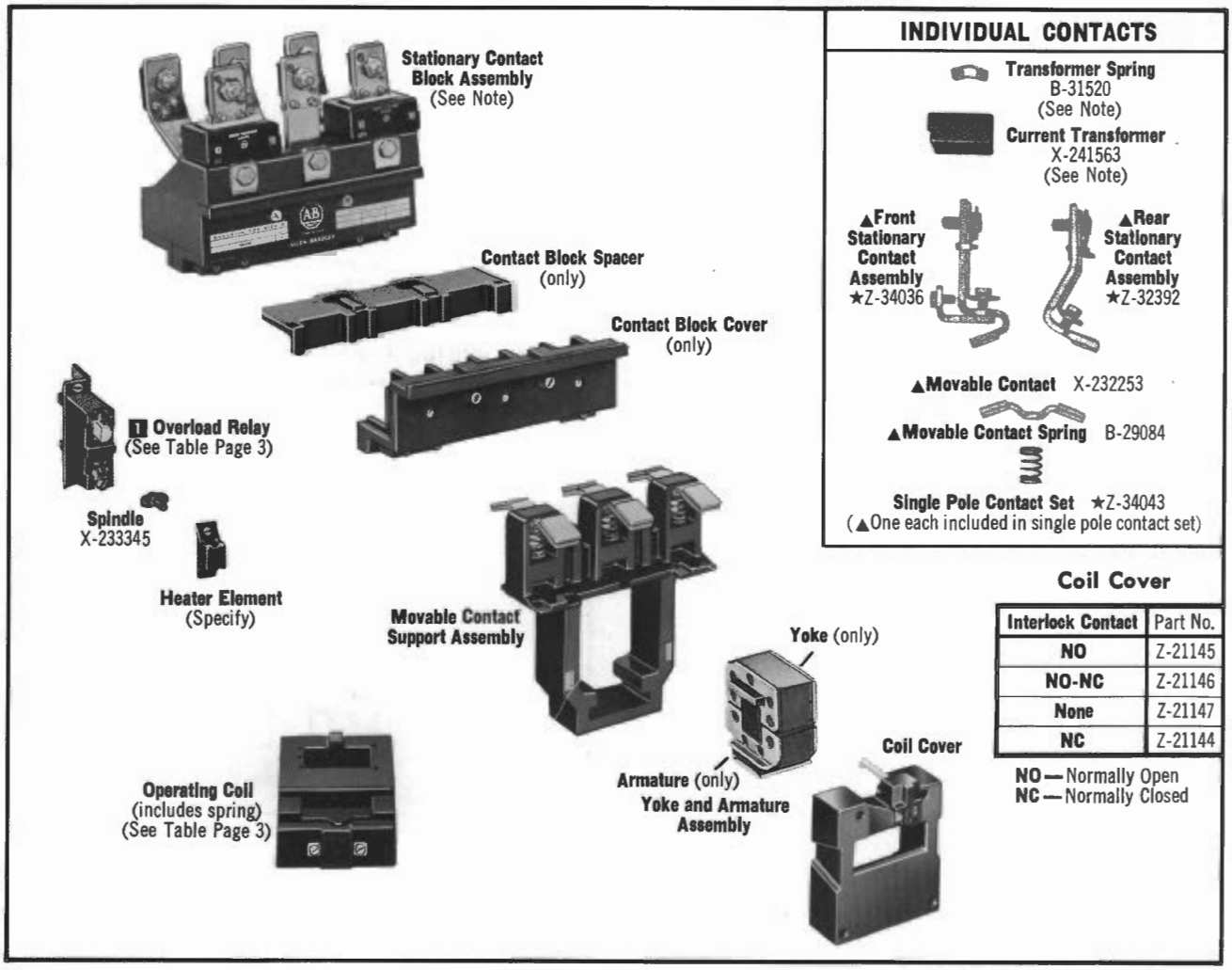
2 Wire Control



2 Station, 3 Wire Control



Renewal Parts List 709-715 — October, 1969
Supersedes Parts List 709-715 Dated January 16, 1964



Coil Cover

Interlock Contact	Part No.
NO	Z-21145
NO-NC	Z-21146
None	Z-21147
NC	Z-21144

NO — Normally Open
NC — Normally Closed

1 Bulletin 815 manual reset type complete with mounting bracket assembly is illustrated.

Description of Part	3 PHASE 3 Pole Part Number	★2 PHASE, 4 WIRE 2 (two) 2 Pole Part Number
Stationary Contact Block Assembly (includes contacts, spacer and cover)	★X-355673	X-355672
Stationary Contact Block Assembly (less contacts)	★X-355724	X-355723
Contact Block Spacer (only)	F-20477	F-20815
Contact Block Cover (only)	X-232815	X-232814
Movable Contact Support Assembly (includes contacts and springs)	★X-232713	X-232712
Movable Contact Support Assembly (less contacts and springs)	F-20798	F-20823
Yoke and Armature Assembly 60-50 Hz (includes retainers and spring)	★Z-31852	Z-31852
Yoke and Armature Assembly 25 Hz (includes retainers and spring)	★Z-31856	—
Yoke (only) 60-50 Hz	X-228029	X-228029
Yoke (only) 25 Hz	X-292563	—
Armature (only) 60-50-25 Hz	X-228113	X-228113
Set of Front and Rear Stationary Contacts	Z-23383	Z-23382
Set of Movable Contacts and Springs	Z-21125	Z-21124
Set of Front and Rear Stationary Contacts, Movable Contacts and Springs	★3 X-247300	3 X-247299

2 Size 5 starters for use on 2 phase, 4 wire applications consist of (two) 2 pole contactors mounted on a common base and equipped with overload protection. Two each of the parts and part assemblies listed in the table are used.

3 Also available in quantities of Single Pole Sets. Refer to top of page.

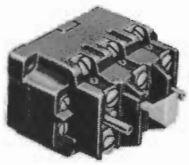
Note – Current transformers and transformer springs **are not** included on the stationary contact block assemblies or in any of the contact sets. They **must be** ordered separately.

★Added or changed since previous issue.

OVERLOAD RELAYS	
Description of Relay	Catalog No.
Left Hand Complete w/Mounting Bracket Assembly **Single Pole** — Manual Reset — Side Mounted	Z-25056
Right Hand Complete w/Mounting Bracket Assembly **Single Pole** — Manual Reset — Side Mounted	Z-25057
Left or **Right Hand** w/o Mounting Bracket Assembly **Single Pole** — Manual Reset — Side Mounted	815-BOV4
Left Hand Complete w/Mounting Bracket Assembly **Single Pole** — Automatic Reset — Side Mounted	Z-25084
Right Hand Complete w/Mounting Bracket Assembly **Single Pole** — Automatic Reset — Side Mounted	Z-25085
Left or **Right Hand** w/o Mounting Bracket Assembly **Single Pole** — Automatic Reset — Side Mounted	816-BOV4
★[1] **Single Pole** — **Third Overload Relay Kit** — Manual Reset	1415-N55
★[1] **Single Pole** — **Third Overload Relay Kit** — Automatic Reset	1416-N55
★**Two Pole** — Manual Reset — Block Type	815-BOV15
★**Three Pole** — Manual Reset — Block Type	815-BOV16
★**Two Pole** — Automatic Reset — Block Type	816-BOV15
★**Three Pole** — Automatic Reset — Block Type	816-BOV16

[1] These kits **only** include current transformers and transformer springs.

Block Type Overload Relay
(Bulletin 815, Manual Reset Type Illustrated)



Overload Relay

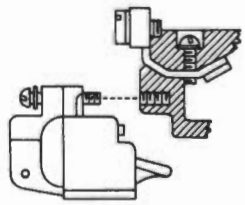
Spindle
X-233345

Heater Element
(Specify)

Note—All overload relays are **furnished less** current transformers and heater elements. Manual reset type overload relays are **furnished with** spindles. Block type overload relays are not used, as standard, on Bulletin 709 starters.

OPERATING COILS						
Volts	**Hz**	**Coil Number**	**Coil Current**		★**Volt-Amperes**	
			Inrush	Sealed	Inrush	Sealed
120	60	**75A86**	16.3	.811	1950	98
110	50		16.2	.890	1785	98
110	60	**75A01**	17.7	.884	1950	98
95	50		17.8	.920	1695	88
110	25	**75A05**	8.5	.665	930	74
208	60	**75A113**	9.4	.468	1950	98
240	60	**75A83**	8.2	.406	1950	98
220	50		8.1	.445	1785	98
220	60	**75A06**	8.9	.442	1950	98
220	25	**75A10**	4.3	.333	930	74
480	60	**75A288**	4.1	.203	1950	98
440	50		4.1	.222	1785	98
440	60	**75A11**	4.5	.221	1950	98
380	50		4.5	.230	1695	88
440	25	**75A15**	2.1	.167	930	74
600	60	**75A81**	3.3	.162	1950	98
550	50		3.3	.178	1785	98
550	60	**75A16**	3.6	.177	1950	98
550	25	**75A20**	1.7	.133	930	74

BULLETIN 1495 AUXILIARY CONTACTS — To provide extra pilot circuit contacts, one to four extra Bulletin 1495 auxiliary contacts can be attached to the front of the contact block.



Description of Contact	Catalog Number
Normally Open	1495-F1
Normally Closed (Early Break)	1495-G5
Normally Closed (Late Break)	1495-H0

ORDERING INFORMATION — Your order cannot be entered unless the following information is given: Part number, description of part, the catalog number and series letter of starter. This renewal parts list applies also to these starters when used on control apparatus listed under other Bulletin numbers.

★**Added or changed since previous issue.**

ALLEN-BRADLEY COMPANY

MILWAUKEE, WISCONSIN

Type N Relay
Catalog Number
700-N400A1

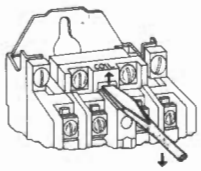
CONTACT RATINGS — The relay contacts and the pneumatic timing unit contacts have a rating as follows:

AC — 300 Volts Maximum, 10 Amps., Non-Inductive, Heavy Pilot Duty.

DC — 115 Volts, 1.1 Amps.; 230 Volts, 0.55 Amps.

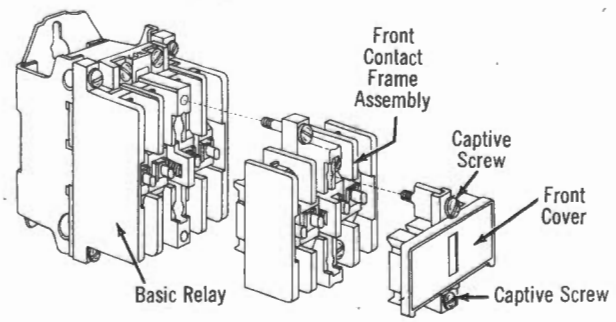
DESCRIPTION — These Bulletin 700 AC Control Relays feature convertible contacts. Each relay pole is an individual unit and is convertible from normally open to normally closed and vice versa. For converting details see instructions in column to the right.

REPAIRS — Relays disassemble as depicted in the illustrations on the back page. Additional consideration should be given to the coil removal technique below.

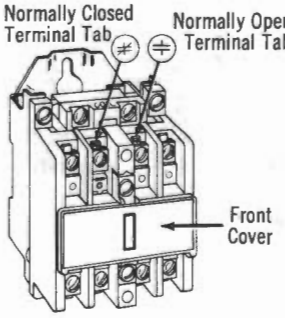


Coil Replacement — Insert a screwdriver tip into the slot between coil terminals. Using the screwdriver as a lever, pry the coil unit upward. See illustration. The coil along with the magnet armature, spring and yoke remove as a unit. The magnet armature is held to the coil by a retaining clip. Note the retaining clip's position before removing. Secure the spring and armature to the replacement coil by means of the retaining clip as previously noted. Replace the yoke and insert the coil unit into the switch assembly and press firmly until the unit "clicks" in place. Should the coil inadvertently be replaced without the armature and yoke in place it will be necessary to remove the entire contact structure from the mounting frame to free the coil.

ADDING A FRONT MOUNTED CONTACT FRAME ASSEMBLY — A front contact frame assembly can be added to a basic relay only. Remove front cover by loosening the two captive screws. Attach front contact frame assembly to basic (2-4 pole) assembly. Replace front cover on front contact frame assembly. Refer to listings on the back page.



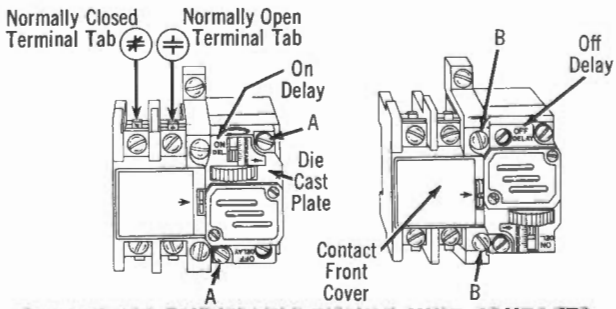
CONVERTING CONTACTS—To convert contact cartridges, first remove front cover by loosening the two captive screws. Remove the two terminal screws of the cartridge to be converted and lift out the contact cartridge. Turn the contact cartridge over, set it back in the relay and replace the screws. Replace front cover. The terminal tab on each end of the contact cartridge indicates the contact arrangement. All contact cartridges have the same easy convertibility.



ADDING A TIMING UNIT— Both the Type NT pneumatic timing unit and the Bulletin 852S solid state timing relay can be added to 2-4 pole relays. The pneumatic timing unit is arranged to be directly mounted on the front of a basic relay and secured with the two captive mounting screws. The front cover on the relay is **not** removed. The solid state timing relays are arranged with a mounting plate for panel mounting. The mounting plate must be removed and the timing relay must be mounted on the control relay with the included resilient hardware per the instructions enclosed with the timing relay.

CONVERTING SOLID STATE TIMING OPERATION — Loosen the two black cover nameplate screws. Remove the cover nameplate carefully as the potentiometer leads remain connected. Lift the gray plug-in molding and rotate 180°. Replace the molding in the rotated position and secure the cover nameplate. The operation, On-Delay or Off-Delay, is indicated at the lower right side of timer.

CONVERTING PNEUMATIC TIMING OPERATION — To convert timing unit from On-Delay operation to Off-Delay operation or vice versa loosen two captive screws (A) on the die cast plate. Remove the die cast plate from the relay and rotate 180°. Replace the die cast plate in rotated position and tighten screws. Type of operation is indicated at the top of the die cast plate.



CONVERTING PNEUMATIC TIMING UNIT CONTACTS — To convert contact cartridges of the timing unit, first remove the contact front cover by loosening the two captive screws (B). Remove the two terminal screws and lift out the contact cartridge. Turn the contact cartridge over, set it back in the timing unit and replace the screws. Replace contact front cover. The terminal tab on each end of the contact cartridge indicates the contact arrangement.

IMPORTANT — DO NOT remove unused contact cartridges from the timing unit. Faulty operation could result. Timing unit contact cartridges **ARE NOT** interchangeable with the front frame contact cartridge 700-C2.

Instructions 700-800—August, 1970
Supersedes Instructions 700-800 Dated April, 1970

SOLID STATE TIMING RELAYS —

With External Potentiometer Unit

With Self-Contained Potentiometer

Solid state timing relays with either self-contained or with external potentiometers are available for mounting on 2-4 pole relays. Several timing ranges are available. Refer to Handy Catalog for listings, and Instructions 852S-801 for operating details.

PNEUMATIC TIMING UNITS —

Timer Contact Cartridge (Tan) X-302184

Timing Range – 0.2 to 60 seconds ± 15% of setting.

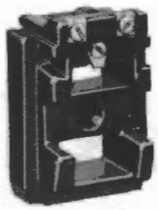
Arranged for Mounting on 2-4 Pole Relays Cat. No. 700-NT.
Arranged as Timer (base frame cartridges omitted) Cat. No. 700-NPT.

NOTE

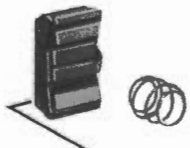
SERIES A CONSTRUCTION RELAYS — When it is necessary to replace either the operating coil or the yoke and armature assembly on a Series **A** construction relay it is **required that both** the operating coil and the yoke and armature assembly be replaced simultaneously with listed Series **B** parts.

SERIES B CONSTRUCTION RELAYS — All listed parts are replacements for Series **B** construction relays.

Coil Volt-Amperes			
60 Hz		50 Hz	
Inrush	Sealed	Inrush	Sealed
134	23	120	24



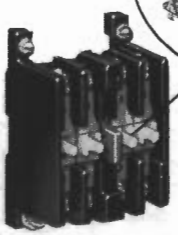
Operating Coil (Refer to Note above and Coil Table)



2 Yoke and Armature Assembly (Refer to Note above) X-310650

1 Base Contact Frame Cartridge (Gray) Catalog No. 700-C1

Front Contact Frame Cartridge (Gray) Catalog No. 700-C2



Base Contact Frame Assembly (Less all cartridges) X-310652

Front Contact Frame Assembly (Less all cartridges) X-310649
w/2 cartridges Cat. No. 700-NA20
w/4 cartridges Cat. No. 700-NA40

Front Cover Assembly X-310653

1 For a pair of overlap contact cartridges (black) for base frame mounting (only), specify Catalog No. 700-C11Z.

2 Includes necessary retaining hardware.

OPERATING COILS (See Note above)				
Volts	Hz	Coil Number	Coil Current	
			Inrush	Sealed
24	60	84AB27	5.63	.960
	50	84AB28	5.00	1.00
32	60	84AB30	4.22	.72
	50	84AB31	3.75	.75
48	60	84AB134	2.81	.48
	50	84AB553	2.50	.50
64	60	84AB33	2.11	.36
	50	84AB34	1.88	.380
110	60	84AB01	1.23	.209
95	50		1.26	.202
120	60	84AB86	1.12	.192
110	50		1.09	.218

OPERATING COILS (See Note above)				
Volts	Hz	Coil Number	Coil Current	
			Inrush	Sealed
208	60	84AB113	.65	.110
220	60	84AB06	.61	.104
240	60	84AB83	.56	.096
220	50		.545	.109
300	60	84AB974	.45	.077
	50	84AB978	.40	.080

ORDERING INFORMATION — Your order cannot be entered unless the following information is given: Part number, description of part, the catalog number and series letter of relay. This instruction sheet applies also to these relays when used on control apparatus listed under other Bulletin numbers.

BARKSDALE VALVES

Form No. of 1004 Printed in U.S.A.

Trouble-Shooting Pointers on Diaphragm and Bourdon Tube Pressure Switches

Suspected Pressure Switch Trouble	Things To Check	Probable Causes	Remedy
A. Will not actuate at desired pressure.	1. Check catalog for range of switch. 2. Disconnect switch electrically. 3. Apply pressure to switch and check actuation point with accurate gauge. 4. Maximum surge pressure in system. 5. Maximum current and voltage through switch with ammeter and voltmeter.	1. Desired setting out of switch range. 2. Switch not set at proper pressure. 3. Pressure gauge defective. 4. Defective switch element. 5. Over stressed or fatigued pressure sensing element. 6. Loose adjusting screw or bracket. 7. Surplus electrical leads interfering with switch action. 8. Current or voltage beyond switch capacity. 9. Surge pressures in system exceed proof pressure of switch.	1. Replace pressure capsule or bourdon tube with proper range. 2. Readjust switch. 3. Replace pressure gauge. 4. Replace switch element. 5. Replace pressure capsule (check cycling rate for possible piston switch application). 6. Replace or tighten. 7. Remove surplus from area around switch element. 8. Install relay or switch element with higher rating. 9. Replace pressure capsule, bourdon tube or switch with proper proof pressure.
B. Will not reactuate at desired pressure.	1. Check catalog for actuation value range. 2. Check 2, 4 and 5 under A above. 3. Apply pressure to switch and check actuation value with accurate gauge.	1. Specification does not match switch. 2. See 3 thru 9 Trouble A.	1. Change specification or get proper pressure switch. 2. See 3 thru 9 Trouble A.
C. Rapidly actuates and reactivates or chatters or unwanted actuations.	1. Check for instantaneous rapid pressure fluctuations in system. 2. Mechanical vibration of switch.	1. Peaks and valleys of surges are in excess of actuation value of switch. 2. Vibration causes unwanted actuation when switch is near set point.	1. (a) Put surge dampener on switch. (b) Replace with pressure switch of larger actuation value. 2. Change position of switch or shock mount.
D. Actuation point changes with temperature.	1. Check maximum and minimum temperatures. 2. Check for loose adjustment screw or bracket.	1. Temperature changes drastic (i.e. over plus or minus 50°F).	1. (a) Readjust for changes. (b) Set switch at highest possible temperature to minimize effect of changes. 2. Tighten or replace screws.
E. Actuation point of switch changes over period of time.	1. Maximum current through switch. 2. Number of pressure cycles on switch. 3. Moisture in switch.	1. Overloading of switch contacts. 2. Service life of switch exceeded (consult data). 3. Corrosion of parts.	1. Replace with pressure switch with higher current rating. 2. Replace pressure switch. 3. Seal conduit.
F. Cannot get current through switch when actuates or reactivates.	1. Check for power at switch. 2. Check maximum current through switch. 3. Poor electrical connections. 4. Desired electrical circuit.	1. Line not "hot." 2. Corroded or loose connections. 3. Connected to wrong leads on switch. 4. Contacts fused.	1. Get power to switch. 2. Make new or tight connection. 3. Make proper connection (consult wiring diagram or color code). 4. Replace pressure switch.

Adjustment Instructions For Barksdale Pressure Switches

GENERAL

1. Check proof pressure of switch on name plate or catalog. NEVER EXCEED THIS PROOF PRESSURE.
2. Note the adjustable range of switch (increasing and decreasing pressure) as listed in the catalog.
3. Check the catalog listing for actuation value of the switch.

EQUIPMENT REQUIRED

1. Easily adjusted pressure source capable of producing a pressure equal to proof pressure of switch.
2. Accurate pressure gauge (manometer, etc.) connected to pressure source.
3. Small, low voltage, battery operated "bug light" with alligator clips on leads.

CAUTION

1. ALWAYS CHANGE PRESSURE SETTINGS GRADUALLY.
2. Always check switch setting before making any adjustments. Refer to Chart A.

SET UP

1. Remove terminal strip cover (or explosion proof cover) and adjusting screw cover (or plug).
2. Connect pressure switch to pressure source.

CHART A

SETTING FOR INCREASING PRESSURE	SETTING FOR DECREASING PRESSURE
1. Connect bug light to N.O. and common leads or terminal (see Note 1). Bulb should not light with zero pressure. Consult Chart B if bulb lights.	1. Connect bug light to N.C. and common leads or terminal (see Note 1). Bulb should light with zero pressure. Consult Chart B if bulb does not light.
2. Raise pressure and check the point at which bulb lights. THIS IS THE SET POINT. (If bulb does not light at proof pressure, consult Chart B.)	2. Raise pressure until light goes out. (If bulb stays lighted up to proof pressure, consult Chart B.)
3. Drop pressure to zero. Raise or lower setting by turning adjusting screw. (See Notes 2 and 3.) Use maximum ¼ turn on adjustment screw.	3. Slowly decrease pressure and check point at which bulb lights. THIS IS THE SET POINT.
4. Repeat instructions 2 and 3 (above) until desired set point is reached. Use smaller increment turns as intended setting is approached.	4. Drop pressure to zero. Raise or lower setting by turning adjustment screw. (See Notes 2 and 3.) Use maximum ¼ turn on adjustment screw.
5. Raise pressure to maximum operating point; then drop to zero. Repeat instruction 2 (above).	5. Repeat instructions 2 and 3 (above) until desired setting is reached. Use smaller increment turns as intended setting is approached.
6. Note pressure difference between points where bug bulb lights and goes out. THIS IS THE ACTUATION VALUE OF THE SWITCH.	6. Raise pressure to maximum operating point; then drop to zero. Repeat instructions 2 and 3 (above).
7. Repeat instruction 2 (above) several times.	7. Note pressure difference between points where bug bulb lights and goes out. THIS IS THE ACTUATION VALUE OF THE SWITCH.
	8. Repeat instructions 2 and 3 (above) several times.

Note 1. For proper electrical connection follow colors of wire insulation or instructions on terminal code tag attached to switch.

Note 2. Dual control switches should be set one side at a time. Recheck both sides after final setting.

Note 3. Turning directions will be found inside the adjustment screw cover or switch cover.

CAUTION! Do not force adjusting screw when it becomes difficult to turn.

CHART B

HOW TO ADJUST FOR IMPROPER BUG LIGHT ACTION

Bug light connected to N.O. and common lead or terminal	Adjustment for correct bug light action	Bug light connected to N.C. and common lead or terminal
PROBLEM		
1. Bug light on at zero gauge pressure (should be off).	1. Turn adjusting screw toward increased pressure setting until desired light response is obtained.	1. Bug light off at zero gauge pressure (should be on).
2. Bug light fails to go on at pressures up to proof pressure.	2. Regulate pressure to middle of adjustable range of switch. Turn adjusting screw toward decreased pressure setting until desired light response is	2. Bug light on at proof pressure (should be off).

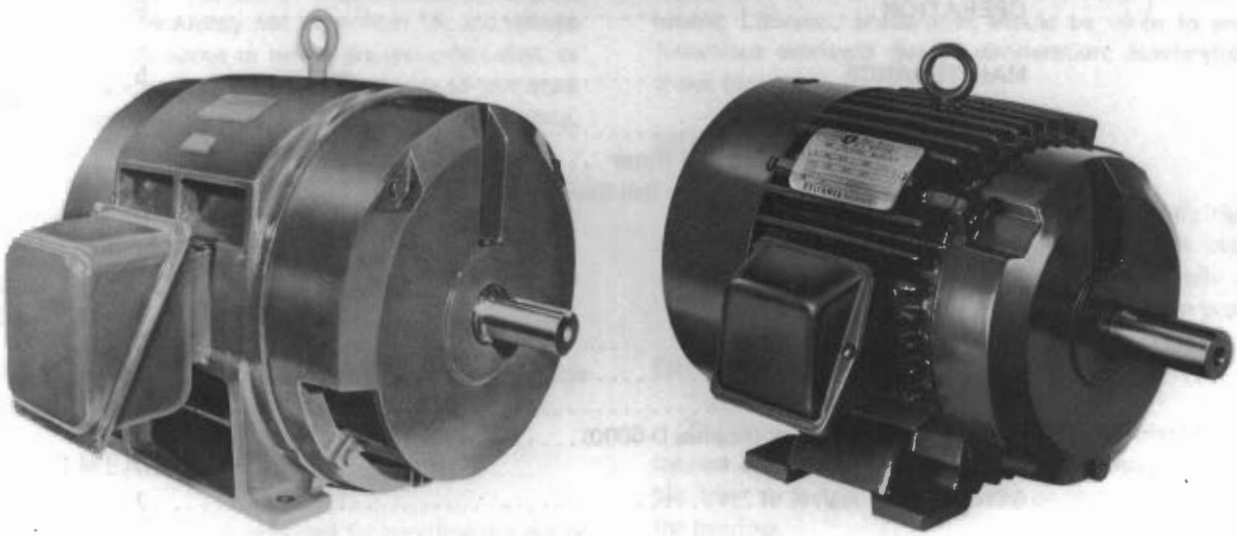
APRIL, 1972

INSTRUCTION MANUAL B-3620-6

INSTALLATION, OPERATION AND CARE OF

RELIANCE

STANDARD INTEGRAL HORSEPOWER INDUCTION MOTORS



IMPORTANT: It is important that these instructions be studied by the men installing and operating this equipment. Read thoroughly before starting. Keep these instructions for future reference.

RELIANCE ELECTRIC COMPANY

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GENERAL 7

RECEIVING AND HANDLING

ACCEPTANCE

Thoroughly inspect this equipment before accepting shipment from the transportation company. If any of the goods called for in the bill of lading or express receipt are damaged or the quantity is short, do not accept them until the freight or express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight or express agent at once and request him to make an inspection. We will be very happy to assist you in collecting claims for loss or damage in shipment; however, this willingness on our part does not remove the transportation company's responsibility in reimbursing you for collection of claims or replacement of material. Claims for loss or damage in shipment must not be deducted from the Reliance invoice, nor should payment of the Reliance invoice be withheld awaiting adjustment of such claims, as the carrier guarantees safe delivery.

If considerable damage has been incurred and the situation is urgent, contact the nearest Reliance District Office for assistance. Please keep a written record of all communications.

STORAGE

Equipment which is not going to be used immediately, should not be unpacked until ready for use. If this equipment is to be stored for any period of time prior to installation, the area storage should be clean and dry, protected from low temperature, rapid or extreme changes in humidity, oil, dirt, and similar adverse conditions. Equipment storage should be inspected periodically and the shaft rotated approximately every six months. Refer to Service Bulletin B-8078 for extended storage.

UNPACKING

After unpacking and inspection to see that all parts are in good condition, turn the shaft by hand to be sure there are no obstructions to free rotation. Equipment which has been in storage for sometime should be tested and relubricated prior to being put into service. Refer to "Test for General Condition" and "Lubrication" for procedure to be performed after extended storage.

Equipment with roller bearings is shipped with a shaft block at the opposite pulley end. In removing the shaft block, be sure to replace the bolts which are used to hold the shaft block in place during shipment.

WARRANTY

The Reliance Electric Company warrants workmanship and materials on this motor for a period of one year from date of shipment from the Reliance factory. In every case concerning warranty, contact the nearest Reliance Sales Office or authorized Reliance Service Shop.

INSTALLATION

INSPECTION

After the motor is unpacked, examine the nameplate data to see that it agrees with the power circuit to which it is to be connected. The motor is guaranteed to operate successfully with frequency not more than 5% and voltage not more than 10% above or below the nameplate data, or combined variation of voltage and frequency of not more than 10% above or below nameplate data. Efficiency, power factor and current may vary from nameplate data.

Before connecting the motor to an electrical supply inspect for any damage resulting from shipment. Turn the shaft by hand to insure free rotation.

LOCATION

The motor should be installed in a location compatible with the motor enclosure and specified ambient.

LIFTING MEANS

When a lifting means is provided for handling the motor or generator, it should not be used to lift the motor or generator plus additional equipment such as gears, pumps, compressors, or other driven equipment. In the case of assemblies on a common base, any lifting means provided on the motor or generator should not be used to lift the assembly and base but, rather, the assembly should be lifted by a sling around the base or by other lifting means provided on the base. In all cases, care should be taken to assure lifting in the direction intended in the design of the lifting means. Likewise, precautions should be taken to prevent hazardous overloads due to deceleration, acceleration or shock forces.

MOUNTING

Mount the motor on a foundation sufficiently rigid to prevent excessive vibration. Ball-bearing motors may be mounted with the feet at any angle. After carefully aligning the motor with the driven unit, bolt securely in place.

DRIVE

The pulley, sprocket, or gear used in the drive should be located on the shaft as close to the shaft shoulder as possible. Heat to install. Driving a unit on the shaft will damage the bearings.

Belt Drive: Align the pulleys so that the belt will run true; tighten the belt just enough to prevent slippage, any tighter will cause premature bearing failure. If possible, the lower side of the belt should be the driving side.

INSTALLATION (Cont'd)

Chain Drive: Mount the sprocket on the shaft as close to the bracket as possible. Align the sprockets so that the chain will run true. Avoid excessive chain tension.

Gear Drive and Direct Connection: Accurate alignment is very essential. Secure the motor and driven unit rigidly to the base.

ROTATING PARTS

Rotating parts, such as couplings, pulleys, external fans, and unused shaft extensions, should be permanently guarded against accidental contact with hands or clothing. This is particularly important where the parts have surface irregularities such as keys, keyways or set screws. Some satisfactory methods of guarding are:

1. Covering the machine and associated rotating parts with structural or decorative parts of the driven or driving equipment.

2. Providing covers for the rotating parts. The openings in or at the edges of such covers should not be over 1/2 inch wide (3/4 inch if the rotating parts are more than 4 inches from the opening) in the direction, usually above and to the side, from which contact is to be expected. In other directions where other stationary parts, such as a subbase provide partial guarding, somewhat wider openings may be used. Covers should be sufficiently rigid to maintain adequate guarding in normal service.

WIRING

Connect the motor to the power supply according to the diagram on the motor nameplate. For most 230 and 460 volt motors, nine leads are brought out from the stator windings so that the motor may be connected for either 230 or 460 volts.

GROUNDING

The frames and other metal exteriors of motors and generators (except for insulated pedestal bearings) usually should be grounded to limit their potential to ground in the event of accidental connection or contact between live electrical parts and the metal exteriors. See the *National Electrical Code*, Article 430 for information on grounding of motors, Article 445 for grounding of generators, and Article 250 for general information on grounding. In making the ground connection, the installer should make certtain that there is a solid and permanent metallic connection between the ground point, the motor or generator terminal housing, and the motor or generator frame. A common method of providing a ground is through a grounded metallic conduit system.

Motors with resilient cushion rings are usually supplied with a bonding conductor across the resilient member (see MG 2-2.06). Some motors are supplied with the bonding conductor on the concealed side of the cushion ring to protect the bond from damage. Motors with bonded cushion rings should usually be grounded at the time of installation in accordance with the above recommendations for making ground connections. When motors with bonded cushion rings are used in multimotor installations employing group fusing or group protection, the bonding of the cushion ring should be checked (see MG 2-2.06) to determine that it is adequate for the rating of the branch circuit overcurrent protective device being used.

There are applications where grounding the exterior parts of a motor or generator may result in greater hazzard by increasing the possibility of a person in the area simultaneously contacting ground and some other nearby live electrical part of other ungrounded electrical equipment. In portable equipment it is difficult to be sure that a positive ground connection is maintained as the equipment is moved, and providing a grounding conductor may lead to a false sense of security. When careful consideration of the hazards involved in a particular application indicate the machine frames should not be grounded or when unusual operating conditions dictate that a grounded frame cannot be used, the installer should make sure the machine is permanently and effectively insulated from ground. In those installations where the machine frame is insulated from ground, it is recommended that appropriate warning labels or signs be placed on or in the area of the equipment by the installer.

STARTING

BEFORE STARTING MOTOR, REMOVE ALL UNUSED SHAFT KEYS AND LOOSE ROTATING PARTS TO PREVENT THEM FROM FLYING OFF.

When starting the motor, check the following items:

1. The rotor should turn freely when disconnected from the load.

2. Driven machine should be unloaded when first starting the motor.

The motor should run smoothly with little noise. If the motor should fail to start and produces a decided hum, it may be that the load is too great for the motor or that it has been connected improperly. Shut down immediately and investigate for trouble.

DRAIN PLUGS

If motor is totally enclosed fan-cooled or non-ventilated it is recommended that condensation drain plugs be removed. These are located in the lower portion of the endshields. Totally enclosed fan-cooled "XT" motors are equiped with automatic drains which should be left in place as received.

INSTALLATION (Cont'd)

ROTATION

To reverse the direction of rotation, disconnect from power source and interchange any two of the three line leads for three phase motors, for two phase four wire, interchange the line leads on any one phase. For two phase three wire, interchange phase one and phase two line leads.

TEMPERATURE RISE

Under normal operating conditions, with the motor applied in accordance with the nameplate rating, the temperature rise will not exceed the proper limits. Always use a thermometer to determine the heating of a motor. The hand is not reliable in determining whether or not the motor is too hot.

TEST FOR GENERAL CONDITION

If the motor has been in storage for an extensive period or has been subjected to adverse moisture conditions, it is best to check the insulation resistance of the stator winding with a megohmeter.

If the resistance is lower than one megohm the windings should be dried in one of the two following ways:

1. Bake in oven at temperatures not exceeding 90°C. until insulation resistance becomes constant.

2. With rotor locked, apply low voltage and gradually increase current through windings until temperature measured with thermometer reaches 194°F. Do not exceed this temperature.

INITIAL LUBRICATION

"Reliance motors are shipped from the factory with the bearings properly packed with grease and ready to operate. Where the unit has been subjected to extended storage (6 months or more) the bearings should be relubricated prior to starting."

OPERATION

Due to the inherent characteristics of insulating materials, abnormally high temperatures shorten the operating life of electrical apparatus. The total temperature, not the temperature rise, should be the measure of safe operation. The class of insulation determines the maximum safe operating temperature. Aging of insulation occurs at an accelerated rate at abnormally high temperatures. A general rule for gauging the effect of excessive heat is that for each 10°C. rise in temperature above the maximum limit for the insulation, the life of the insulation is halved.

Unbalanced voltage or single-phase operation of polyphase machines may cause excessive heating and ultimate failure. It requires only a slight unbalance of voltage applied to a polyphase motor to cause large unbalance currents and resultant overheating.

Periodic checks of phase voltage, frequency and power consumption of a motor while in operation are recommended; such checks assure the correctness of frequency and voltage applied to the motor and yield an indication of the load offered by the apparatus which the motor drives. Comparisons of this data with previous no-load and full-load power demands will give an indication of the performance of the complete machine. Any serious deviations should be investigated and corrected.

Stator troubles can usually be traced to one of the following causes:

Worn bearings	Operating single phase
Moisture	Poor insulation
Overloading	Oil and dirt

Dust and dirt are usually contributing factors. Some forms of dust are highly conductive and contribute materially to insulation breakdown. The effect of dust on the motor temperature through restriction of ventilation is a principal reason for keeping the windings clean.

Squirrel-cage rotors are rugged and, in general, give little trouble. The first sympton of a defective rotor is lack of torque. This may cause a slowing down in speed accompanied by a growling noise or perhaps failure to start the load.

This is caused by an open or high resistance joint in the rotor bar circuit. Such a condition can generally be detected by looking for evidence of localized heating.

Rotating parts, such as couplings, pulleys, internal-external fans and unused shaft extensions should be permanently guarded against accidental contact with hands or clothing.

MAINTENANCE

The fundamental principle of electrical maintenance is KEEP THE APPARATUS CLEAN AND DRY. This requires periodic inspection of the motor, the frequency depending upon the type of motor and the service.

MAINTENANCE (Cont'd)

The following should be checked at regular intervals:

1. Windings should be dry and free of dust, grease, oil, and dirt. Windings may be cleaned by suction cleaners or by wiping. Nozzles on suction type cleaners should be non-metallic. Gummy deposits of dirt and grease may be removed by using a commercially available low volatile solvent. Do not use gasoline or other inflammable solvents.

2. Terminal connections, assembly screws, bolts and nuts should be tight. They may loosen if motor is not securely bolted and tends to vibrate.

3. Insulation resistance of motors in service should be checked periodically at approximately the same temperature and humidity conditions to determine possible deterioration of the insulation. When such measurements at regular intervals indicate a wide variation, the cause should be determined. Motor should be reconditioned if the motor has been subjected to excessive moisture, or by re-winding or re-insulating if necessary. Enclosed motors require very little attention. Be sure that external air chamber of fan-cooled motors does not become clogged with foreign material which will restrict passage of air.

DISASSEMBLY

If it becomes necessary to disassemble the motor, care should be taken not to damage the stator windings as the insulation may be injured by improper or rough handling. Precautions to keep bearings clean should be exercised.

Before removing either end shield:

1. Disconnect motor from power source. Tag the leads to insure proper reconnection.

2. Remove motor from mounting base.

3. Make end brackets relative to position on frame so they can be easily replaced.

REMOVING BRACKETS AND ROTOR

4. Remove bearing cartridge nuts or screws.

5. Remove front end bracket bolts.

6. Pull bracket.

7. Remove back end bracket in same manner.

8. Remove rotor.

REMOVING AND REPLACING BALL BEARINGS

Bearings should not be removed unless they are to be replaced. When removal is necessary, use a bearing puller if possible. If a puller is not accessible and a hammer must be used, the blows should be transmitted through a hard wood or fibre block. A bearing puller may be rigged by using a metal plate, with holes drilled to match the tapped holes in the inner cap. Use care to keep the pressure equal to prevent breaking the cap.

To install a bearing, use a steady pressure on the inner race. One method is to use a piece of pipe of the correct size to slip over the shaft. If a hammer is used, the blows should be transmitted through a block of wood or fibre. All bearings must be replaced with the identical part used by Reliance. In many cases special bearings are used which cannot be identified by markings on bearing.

The majority of bearings used now have a C3 internal looseness. For precautions in handling ball bearings, refer to Instruction Manual A-3611.

REASSEMBLY

Follow reverse procedure as outlined for Disassembly. Having marked the brackets in the original position, replace as marked.

LUBRICATION

INITIAL LUBRICATION

Grease lubricated motors are properly lubricated at the time of manufacture and it is not necessary to lubricate at time of installation. If the motor has been in storage for a period of six months or greater, lubricate before starting. Below is a list of recommended types of grease. These have all been tested and should be used whenever possible.

RELUBRICATION

To lubricate, remove filler plug and with motor running or at rest grease with clean lubricant until grease appears at drain hole or along shaft. 1/2 to 1 cu. inch of grease is sufficient in small sizes, proportionately more in large HP motors.

LUBRICATION (Cont'd)

RELUBRICATION PERIOD

For relubrication period, follow instruction plate on motor. If no plate is provided, relubricate per the following table:

HP at 1800 RPM or Less	Standard Conditions	Severe Conditions	Extreme Conditions
1/8 7 1/2	3 years	1 year	6 months
10 - 40	1 -2 years	6 mo.-1 yr.	3 months
50 - 150	1 year	6 months	3 months
200 & Up	9 mo. - 1 yr.	6 months	3 months
All Motors Over 1800 RPM	6 months	3 months	3 months

Standard Conditions: Eight hours per day, normal or light loading, clean 100°F. maximum ambient.

Severe Conditions: Twenty-four hour per day operation, or shock loading, vibration, or dirt or dust 100-150°F, ambient.

Extreme Conditions: Heavy shock or vibration, dirt or dust.

For units with roller bearings divide above times by 3.

For motors operating in ambients between 0°F. and 120°F., use the following lubricants or their equal.

Standard Oil Co. of California - Chevron SR1** No. 2
Standard Oil Co. of Indiana - Stanobar No. 2
Standard Oil Co. of New Jersey - Andok C* and B
Master Lubricants Co. - Lubriko M-6, M-21, and M-32
New York and New Jersey Lubricant Co. - F-925, S-58 and S-58-M
Gulf Refining Co. - Precision No. 2 and No. 3
The Texas Co. - Starfak H, M, and No. 2
Sinclair Refining Co. - A. F. No. 2
Tidewater Associated Oil Co. - Tycol Armitage 0
Union Oil Co. of California - Strona Ht - 1
Shell Oil Co. - Alvania No. 2
Socony Mobil Oil Co. - Mobilux Grease No. 2

* Not recommended for roller bearings.
** Standard lubricant supplied on new units.

For operation in other ambient temperatures, refer to motor tag 162214 or nearest Reliance Sales Office.

SLEEVE BEARINGS (FRAMES D–5000)

Motors with sleeve bearings are shipped from the factory without oil. Fill the reservoirs to the center of the oil level gauge (minimum) to 3/8 above center (maximum) with a good grade of turbine oil as recommended for electric motor and generator use by a reputable oil manufacturer.

THESE OILS MAY BE USED

Mobil DTE Light or Heavy Medium
Texaco Regal A or PC

Use Oil of the viscosity range indicated in the following table:

Speed Range RMP	Recommended Viscosity Range SSU @ 100°F
1500 and below	250-350
1800 and over	100-200

Watch oil rings when first starting to see that they revolve.

Change oil every six months or more often under severe operation conditions.

CONSTANT LEVEL OILER

When supplied, refer to instructions accompanying the constant level oiler.

GENERAL

For special motors for use by United States Government including special specifications, master plans, etc., refer to the applicable master plans and specifications involved.

RELIANCE ELECTRIC COMPANY

FOR FRESH IDEAS IN AUTOMATION . . .

General Offices, 24701 Euclid Avenue, Cleveland, Ohio 44117

Bulletin **B-3620-6**

Printed in U.S.A.

47225M

IMPORTANT!

Directions for Mounting and Lubricating

FAFNIR
INDUSTRIAL UNITS

Equipped with Relubricatable Mechani-Seal or Plya-Seal Ball Bearings

THE FAFNIR BEARING CO.
NEW BRITAIN, CONNECTICUT
DIVISION OF textron

FAFNIR
BALL BEARING
TRANSMISSION EQUIPMENT

Single Pillow Blocks
Double Pillow Blocks
Lineshaft Boxes
Countershaft Boxes
Blower and Fan Boxes
Cartridge Units
Special Applications

GUARANTEE

The Fafnir Bearing Company will replace, free of charge, within one year from date of sale, any bearing which in its judgment has failed because of defective material or workmanship, provided it has been shown to have been properly mounted, adequately lubricated, and not subjected to abuse in operation or assembling. Such bearings must be returned to the factory, charges prepaid, and with complete information as to service. Fafnir assumes no responsibility for contingent or consequential damage in any event. This guarantee is in lieu of all warranties either expressed or implied.

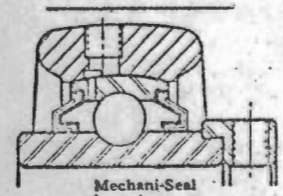
FORM FIB'GT
PRINTED IN U. S. A.

FAFNIR PRELUBRICATED MECHANI-SEAL AND PLYA-SEAL TRANSMISSION UNITS

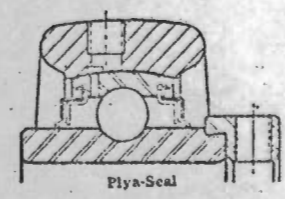
INSTALLATION

NOTE: Shaft should be free from burrs. If old shaft is used, be sure ball bearing is not seated on worn section.

1. Locate assembled unit in position, and line up shaft carefully. Fafnir self-aligning units will automatically compensate for misalignment, but shaft must be straight. Bolt unit securely to supporting structure.



Mechani-Seal



Plya-Seal

2. Slide collar against cam end of inner ring. Engage cams by rotating collar until it slides over cammed end of inner ring. Lock collar by tapping lightly in direction of shaft rotation. Tighten set screw. To disassemble, loosen set screw and tap collar in direction opposite shaft rotation.

NOTE: After installation of this unit and determination of correct rotation, check for proper engagement of collar and tightness of set screw.

LUBRICATION

Bearings have been factory prelubricated with high quality grease and for Normal conditions of Service require no further lubrication.

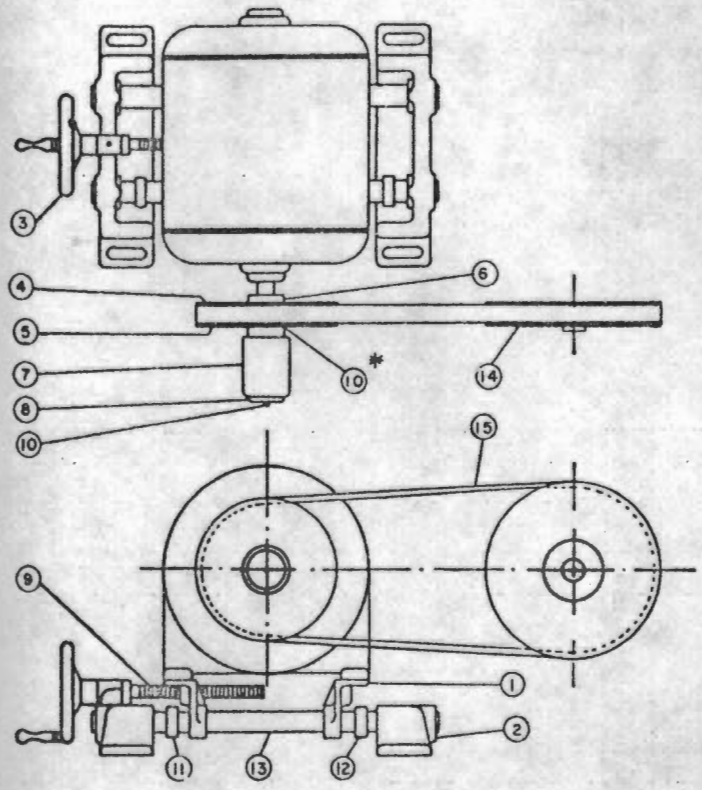
Normal Service is considered as operation in a clean, dry, atmosphere at temperatures between −20°F and 180°F and at shaft surface speeds up to 2100 ft. per minute. This corresponds to a 1" shaft at 8000 RPM, a 2" shaft at 4000 RPM or a 3" shaft at 2760 RPM.

Where service is Abnormal with respect to speed, temperature, exposure to moisture, dirt or corrosive chemicals, or where extremely long life is required, periodic relubrication may be advisable. To relubricate remove pipe plug and replace with a standard 1/8 pipe thread grease fitting. The Fafnir Bearing Company will advise of suitable greases for abnormal service on request.

For bearing replacements, order by number on seal (not on inner or outer ring).

INSTALLATION AND MAINTENANCE for ROTO-CONE®

Variable speed motor pulley



1. MOTOR MOUNT	6. SET SCREWS	11. STOP COLLAR
2. BAR SUPPORT	7. SPRING COVER	12. STOP COLLAR
3. HANDWHEEL	8. END CAP	13. SLIDE ROD
4. INNER DISC	9. ADJUSTING SCREW	14. DRIVEN SHEAVE
5. OUTER DISC	10. GREASE FITTING(S)	15. BELT

INSTALLATION

1. Bolt motor to mount 1 and turn the handwheel 3 to move motor to completely forward position.
2. Check motor shaft and key. Key length should be approximately same as the bore diameter. Tolerances on shaft extension diameters should be: ¼" to 1½" inclusive + .0000", – .0005"; 1⅝" to 2" inclusive + .000", – .001". Undersize shaft diameters will cause excessive vibration.
3. Mount ROTO-CONE pulley on motor shaft and tighten the two set screws 6 at the end of pulley shaft, then LUBRICATE through grease fitting(s) 10 until grease appears at opposite end of pulley shaft. In mounting, do not strike pulley disc 5 or exert undue force.
4. Wedge open the ROTO-CONE Pulley to allow the belt sufficient space to pass easily into the pulley and over the driven sheave. Avoid prying the belt.
5. Align ROTO-CONE Pulley and driven sheave and bolt feet of bar support 2 in position. *Alignment must be accurate* to avoid undue belt vibration and wear.
6. Turn on motor and turn handwheel until belt is at maximum speed position. Set stop collar 12 at this position.
7. Turn handwheel until belt is at minimum speed position . . . just above the hub but not touching . . . and set stop collar 11 at this position.

MAINTENANCE

1. The faces of the discs and belt should be kept clean and free from grease or other liquids.
2. **IMPORTANT; the pulley should be run through its speed range after each 8 hours of operation in order to renew the lubricant on all working surfaces.**
3. If the pulley acts sluggish, that is, it does not close fast enough, it should be flushed out thoroughly with kerosene.

   To Flush Pulley . . . With pulley mounted on motor shaft or an arbor, force kerosene from a grease gun through the grease fitting(s) 10 until the kerosene flows from the various openings in the pulley. Open and close pulley several times to make sure the kerosene reaches all gummy or caked grease. Remove pulley from shaft and drain all kerosene. Relubricate with the proper lubricant.
4. The pulley should be flushed out approximately once every six months to remove any accumulation of dirt or old grease.

LUBRICATION

This pulley is guaranteed for workmanship and material. The manufacturer will not be held responsible for failures when greasing instructions are not followed.

1. Position outer edge of belt approximately flush with outside diameter of pulley disc.
2. Lubricate through fitting(s) 10 until sufficient lubricant has been applied. * Applies to model 1320, 1325, & 1330.
3. Run belt to minimum pitch diameter and return. If sufficient lubricant has been applied, a film of grease will be deposited on the motor end of the pulley shaft. Repeat until grease is indicated.
4. **Lubricate after each 40 hours of operation.**

The lubricant to be used should be a neutral mineral grease, free of acid, alkali, or sulphur. The following is a list of recommended greases.

All Pulleys are Pre-lubricated
at the Factory with Lubriplate No. 907

MANUFACTURER	TRADE NAME of GREASE
FISKE BROTHERS REFINING CO . . .	Lubriplate No. 907
Atlantic Refining Company	Atlantic Lubricant 52
Gulf Refining Company	Supreme Grease No. 2
Shell Oil Company	Alvania EP Grease No. 2
Standard Oil	Amolith Grease No. 2

GERBING *manufacturing corporation* ELGIN, ILLINOIS

Printed in U.S.A. No. 769

INSTALLATION AND MAINTENANCE for ROTO-CONE® COMPOUND DRIVES

1. Adjust motor and machine shafts to correct centers and make sure shafts are parallel.

2. Check motor shaft and key. Key length should be approximately same as bore diameter. Tolerance on shaft extension diameter should be + .0000", -.0005", for ¼" to 1 ½" inclusive and + .000" for 1 5/8" to 2" inclusive. Undersize shaft diameters will cause excessive vibration.

3. Place type "W" pulley on motor shaft as close to shaft bearing as possible. Lock in place with two set screws (2) at end of pulley shaft.

4. Place spring loaded pulley on machine shaft.

5. Install torque rod thru eye bolt.

6. Turn handwheel (1) to separate discs on type "W" pulley.

7. Place belt at minimum pitch diameter of type "W" pulley.

8. Carefully separate discs on spring loaded pulley and place belt between discs. Turn "W" pulley handwheel to take up slack in belt making sure belt doesn't slip out of spring loaded pulley.

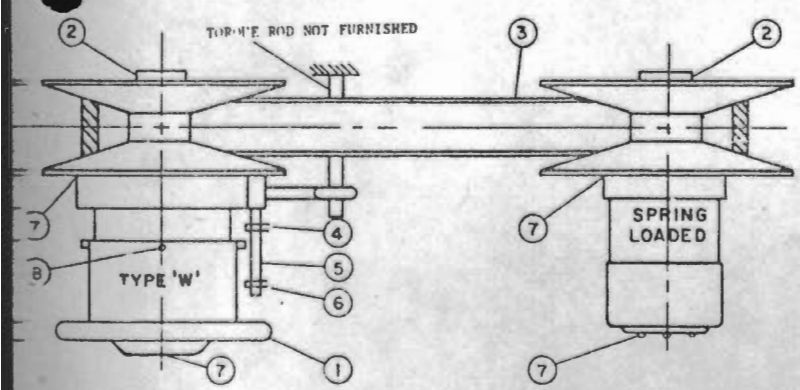
9. Align spring loaded pulley with type "W" pulley so that belt will track in a straight line. Alignment must be accurate to avoid undue belt vibration and wear. Lock spring loaded pulley in place with set screws (2) on end of pulley shaft. (5)

10. Lubricate both pulleys through grease fittings (7) until grease appears at opposite end of pulley assembly.

11. Turn on motor and turn handwheel (1) until desired low speed is reached and set spring limit clip (4) on limit bar (5) at this position.

12. Turn handwheel (1) in opposite direction until desired high speed is reached and set spring limit clip (6) at this position.

13. If necessary, tighten set screw (8) to prevent handwheel from turning by itself when pulley is running.



MAINTENANCE

1. The faces of the discs and belt should be kept clean and free from grease or other liquids.
2. IMPORTANT: the pulley should be run through its speed range after each 8 hours of operation in order to renew the lubricant on all working surfaces.
3. If the pulley acts sluggish, that is, it does not close fast enough, it should be flushed out thoroughly with kerosene.

   TO FLUSH PULLEY . . . With pulley mounted on motor shaft or an arbor, force kerosene from a grease gun through the grease fitting(s) (7) until the kerosene flows from the various openings in the pulley. Open and close pulley several times to make sure the kerosene reaches all gummy or caked grease. Remove pulley from shaft and drain all kerosene. Relubricate with the proper lubricant.
4. The pulley should be flushed out approximately once every six months to remove any accumulation of dirt or old grease.

LUBRICATION

These pulleys are guaranteed for workmanship and material. The manufacturer will not be held responsible for failures when greasing instructions are not followed.

1. With motor running turn handwheel (1) until belt is at one to one speed position. Turn motor off.
2. Lubricate through fittings (7) until sufficient lubricant has been applied.
3. Turn on motor and run pulley through speed range. If sufficient lubricant has been applied, a film of grease will be deposited on the motor end of the pulley shaft. Repeat until grease is indicated.
4. Lubricate after each 40 hours of operation.

The lubricant to be used should be a neutral mineral grease, free of acid, alkali, or sulphur. The following is a list of recommended greases.

All Pulleys are Pre-lubricated
at the Factory with Lubriplate No. 907

MANUFACTURER	TRADE NAME of GREASE
FISKE BROTHERS REFINING CO . . .	Lubriplate No. 907
Atlantic Refining Company	Atlantic Lubricant 52
Gulf Refining Company	Supreme Grease No. 2
Shell Oil Company	Alvania EP Grease No. 2
Standard Oil	Amolith Grease No. 2

GERBING Manufacturing Corporation ELGIN, ILLINOIS PHONE 741-2790
Area Code 312

IL-72

WINSMITH

SUGGESTIONS FOR INSTALLATION AND LUBRICATION

This Engineering Service Bulletin is designed to enable users to obtain the best possible performance from their Winsmith Speed Reducers. In addition, the services of our Engineering Department are at your disposal at all times to help you solve any phase of your speed reducer problems.

WINSMITH
DIVISION OF UMC INDUSTRIES, INC.
Springville, New York 14141

12:1-A1a Rev. 1

ENGINEERING SERVICE BULLETIN

IL-72 | LUBRICANTS FOR SPEED REDUCERS

WORM GEAR REDUCERS

Ambient Temperature	-30 to 15° F	16 to 50° F	51 to 110° F	111 to 165° F
Max. Operating Temp.	150	185	225	225
Viscosity at 210° F, SUS	40 to 90	90 to 125	125 to 190	190 to 350
Compounded with	(Optional)	3 to 10% Acidless Tallow or E. P. base	3 to 10% Acidless Tallow or E. P. base	3 to 10% Acidless Tallow or E. P. base
AGMA Lubricant		#7 Compound	#8 Compound	
Cities Service Oil Co.	Pacemaker Oil #1	Trojan Compound L-2	Trojan Compound L-4	Trojan Compound L-5
Fiske Bros. Refining Co.	Lubriplate #3	Lubriplate #8	Lubriplate #8	Lubriplate APG #250
Gulf Oil Corporation	Multi Purp. Gear. Lub. #80	E. P. Lubricant #115	E. P. Lubricant #145	E. P. Lubricant #250
Shell Oil Company	Macoma Oil #33	Macoma Oil #69	Valvata Oil #J 78	Valvata Oil #J 83
Sinclair Refining Co.	Duro Oil #160	#87 Heavy Duty Oil	Superheat Valve Oil	Pennant EP Oil #7
Keystone Lub. Co.	78-6 EP Oil	WG-1X Oil	WG-B Oil	#009 Oil
Sun Oil Company	Sunep #1070	Sunep #1110	Sunep #1150	HV Cylinder Oil
Mobil Oil Co.	Vactra Oil #2	Mobil Compound #DD	Mobil Cyl. Oil #600 W	Mobil Cyl. Oil #600W
Texaco	Meropa Lub. #1	Meropa Lub. #3	Meropa Lub. #6	Meropa Lub. #6

HELICAL GEAR REDUCERS 700-800-900 HELICAL HOLLOW SHAFT

Ambient Temp.	-30 to 15° F	16 to 50° F	51 to 110° F	111 to 165° F
Max. Operating Temp.	150	185	225	225
Viscosity at 100° F, SUS	95 - 280	280 - 360	490 - 700	700 - 1200
AGMA Lubricant	#0	#2	#3	#4
Cities Service Oil Co.	Pacemaker Oil #1	Trojan Compound L-00	Trojan Compound L-0	Trojan Compound L-2
Fiske Bros. Refining Co.	Lubriplate #1	Lubriplate #2	Lubriplate #3	Lubriplate #4
Gulf Oil Corporation	Paramount #42	Harmony #53	Harmony #69	Harmony #97
Shell Oil Company	Clavus Oil #33	Vitrea Oil #33	Vitrea Oil #69	Vitrea Oil #72
Sinclair Refining Co.	Duro Oil #160	Rubilene Oil Light Med.	Rubilene Oil Med. Heavy	Rubilene Oil Heavy
Keystone Lub. Co.	78-6 EP Oil	WG-5X Oil	WG-2 Oil	WG-1X Oil
Sun Oil Company	Solnus #100 or #150	Sunep #1050	Sunep #1070	Sunep #1070
Mobil Oil Co.	Vactra Oil #2	Mobil Compound #AA	Mobil Compound #BB	Mobil Cylinder Oil #600W
Texaco	Meropa Lub. #1	Meropa Lub. #1	Meropa Lub. #2	Meropa Lub. #3

PLANETARY GEAR REDUCERS

Ambient Temperature	-30 to 15° F	16 to 50° F	51 to 110° F	111 to 165° F
Max. Operating Temp.	150	185	225	225
Viscosity at 100° F, SUS	95 - 280	280 - 360	490 - 700	700 - 1200
AGMA Lubricant	#0	#2	#3	#4
Cities Service Oil Co.	Pacemaker Oil #1	Trojan Compound L-00	Trojan Compound L-0	Trojan Compound L-2
Fiske Bros. Refining Co.	Lubriplate #2	Lubriplate #3	Lubriplate #4	Lubriplate #4
Gulf Oil Corporation	Paramount #42	Harmony #53	Harmony #69	Harmony #97
Shell Oil Company	Macoma Oil #33	Macoma Oil #33	Macoma Oil #69	Macoma #72
Sinclair Refining Co.	Duro Oil #160	Rubilene Oil Light Med.	Rubilene Oil Med. Heavy	Rubilene Oil Heavy
Keystone Lub. Co.	78-6 EP Oil	WG-5X Oil	WG-2 Oil	WG-1X Oil
Sun Oil Company	Solnus #100 or #150	Sunep #1050	Sunep #1070	Sunep #1070
Mobil Oil Co.	Vactra Oil #2	Mobil Compound #AA	Mobil Compound #BB	Mobil Compound #FF
Texaco	Meropa Lub. #1	Meropa Lub. #1	Meropa Lub. #2	Meropa Lub. #3

WINSMITH
DIVISION OF
UMC INDUSTRIES, INC.
Springville, N. Y. 14141
Phone 716-592-9311
Telex-91-388

• The above tables are for speeds when the worm is revolving at 1800 R.P.M. The peripheral speed of the gears governs the period of tooth contact and determines the length of time the film must withstand the pressures. When speeds are high, the time is very short and the loads are usually light and as a result an oil of comparatively low viscosity should be used. When speeds are low and the loads heavy, the contact time is considerably longer and an oil of higher viscosity should be used.

FORM 5006

LITHO IN U. S. A.

ENGINEERING SERVICE BULLETIN

IL-72

SUGGESTIONS FOR INSTALLATION AND LUBRICATION OF WINSMITH SPEED REDUCERS

PROPER SELECTION

Granting that the unit selected or recommended is large enough for the work it is to do and that, in selection, due consideration has been given to the character of the load (steady or shock) and kind of duty (8-hour, 24-hour daily; or intermittent), your Winsmith Speed Reducer should give dependable service for a wholly acceptable length of time. Careful consideration should be given to other factors, all of them important, and all of them directly affecting the operating satisfaction and life of all Speed Reducers. Some of these factors are as follows:

PROPER ALIGNMENT

1. The various drive members should be aligned as accurately as possible to guard against unusual stresses and overloads imposed by misalignment.

2. If a motor is to be direct connected to the Winsmith Speed Reducer, a FLEXIBLE coupling should be used. It should be remembered that a flexible coupling is not a universal joint. Most types are of very limited flexibility. The coupling, the reducer, or the motor will suffer damage or rapid wear if care is not taken at installation to insure alignment well within the limits recommended by the manufacturer. In general, on ordinary couplings it has been considered good practice to have as lateral alignment from .002 to .008 inches for high speed drives of about 1800 RPM. There should be very little angularity between shafts.

To properly install a flexible coupling, start up the motor so that the rotor will center itself electrically, then check the distance between shafts to determine whether the proper space has been allowed. Then lay a scale across the shafts at several points around the periphery and test for concentricity with a feeler gage. If a .005" feeler gage will not go through, the alignment should be proper. Dowel the motor and reducer to the base so they will not shift.

Never use a rigid type coupling to connect Speed Reducer and Prime Mover.

It is hardly possible to place two shafts in exact alignment and, even if it were possible, the settling of a building, or of the drive foundation itself, would in time cause some degree of misalignment and consequent trouble if a rigid type coupling was employed.

3. A common base-plate to support the motor and reducer as a complete drive-unit will preserve the original alignment between motor and reducer shafts. This may be a steel base supplied by us, or one fabricated locally. A structural steel base, consisting of channel or angle members, with suitable gusset plates, and welded to form an integral bed-plate, may be fabricated at a reasonable cost.

If a structural steel base is used, the plate should be at least equal in thickness to the diameter of the bolts used to fasten the speed reducer to the base plate. Also, for sufficient rigidity, the design in general including angle or channel members should be substantial enough to prevent flexing under vibration.

After the first week or two of operation all of the bolts and nuts used to fasten the reducer and motor, pedestal, etc., to the base plate should be retightened. Vibration tends to loosen the nuts even if tight initially.

LUBRICATION

After your Winsmith Speed Reducer is properly installed, be sure, before operation:

1. That the quantity of oil in the housing is never too great. The oil level indicated on each unit is for operation at worm speeds of 1800 RPM unless noted otherwise on the name plate. It may be necessary to raise this level for slower operating speeds or to lower it for higher speeds.

When the bearings are not adequately lubricated by the splash system, grease fittings are provided. They should be pressure lubricated with a short fiber grease with a work penetration of 310 td 340 at 77° F. and an ASTM drop point of 350° F. minimum.

2. That any one of the recommended (or equivalent) lubricants is used, of grade or viscosity suited to the particular type of Winsmith Speed Reducer installed, and to the correct operating conditions and temperature. (see page 4) The reducer left the factory with the propar amount of lubricant. Check to determine whether oil is to level plug before operating. The oil in a new unit should be drained at the end of ten days if operation is of 24 hours per day duration, or at the end of 30 days when the operation is of 8 hours per day. The case should then be thoroughly flushed with light flushing oil. Fill to oil level with new oil of the proper grade. After this a change of oil every 2500 hours of operation, or every six months, whichever occurs first is sufficient for reducers operating under normal conditions. Where operating conditions are severe, such as a rapid rise and fall in temperature of the gear case, with accompanied sweating of the inside walls and resulting formation of sludge, or where operation is in moist or dusty atmosphere, or in the presence of chemical fumes, it may be necessary to change the oil at intervals of one to three months.

If the reducer is to stand idle for a length of time as when stored as a spare, it is well to fill with a suitable rust-preventative for protection of interior parts which might otherwise corrode or rust when reducer sweats.

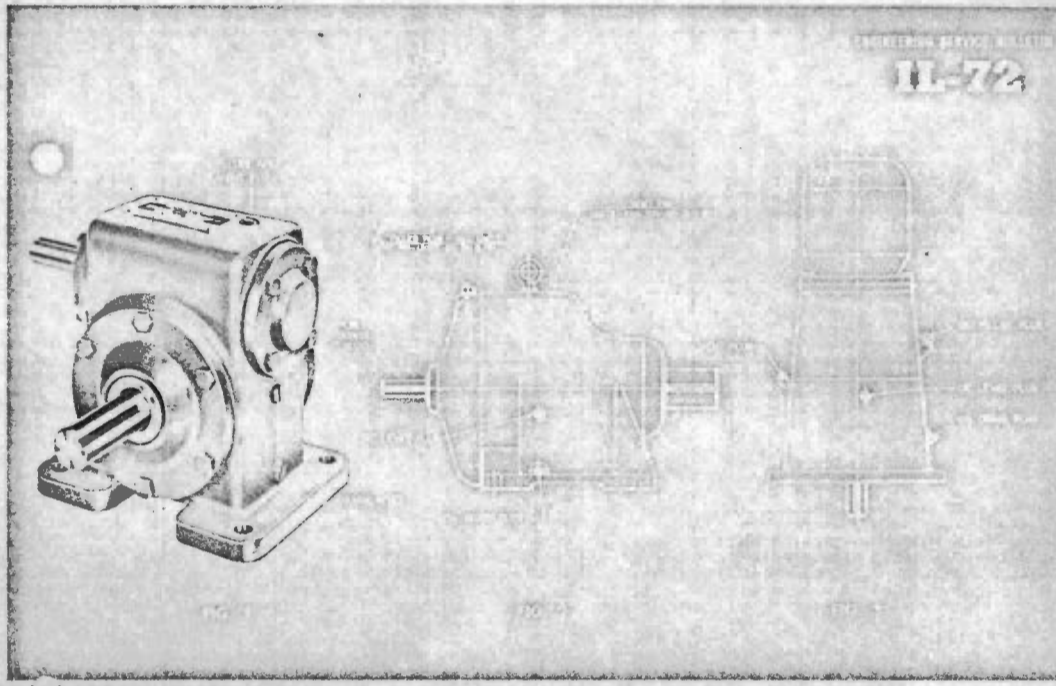
A DRAIN PLUG at or near the bottom (base flange) of the reducer housing is provided for oil removal. (see Fig. 1)

OIL TEMPERATURE and OIL RETENTION

Too high an oil temperature may be the result of one or more of these contributing factors:

1. AN OVERLOAD, especially a continuous overload on the reducer. This might be due to the selection, originally, of too small a unit.

2. Or, an overload imposed by replacing the original motor with a larger one to take care of a load greater than originally contemplated. For example, the lengthening of a conveyor to meet a need for increased production. In such cases, it is not uncommon to increase the motor size and forget to install a larger Speed Reducer equal to the larger motor and the increased load.



3. TOO MUCH OIL IN THE REDUCER. This causes churning of the oil which often results in overheating. Pressure also builds up, which combined with the excessive heat, will in time ruin the oil seals and cause oil leakage at the shaft openings in the reducer housing.

4. TO PREVENT LOSS OF OIL while the units are in transit, Winsmith Worm Gear Speed Reducers are shipped with a brass pin in the vent or filler plug. This pin must be removed before the reducer is put into operation. If conditions are severe, and dust or moisture is likely to enter this hole, the reducer should be protected with an airvent such as Alemite No. 304810.

The hole in the vent plug helps to prevent pressure building up within the housing and thus guards against destruction of the oil seals and consequent oil leakage.

Likewise, there is a brass pin in the filler plug of the Horizontal Type Planetary Speed Reducers, Nos. 1H, 7H, and 11H, (See Fig. 2).

Models No. 21H, 31H, 41H, 51H, and 61H Horizontal Type are filled by removing the lifting eyebolt at the top of the housing. The eyebolt in these four sizes has a hole drilled down through it which meets with a drilled hole at right angles to form a breather or vent when the brass pin is removed from the hole.

This brass pin is in place in the eyebolt when the Speed Reducer is shipped to prevent loss of oil in transit.

Be sure to remove this brass pin from the eyebolt before operating the reducer so as to prevent pressure building up. The purpose of such a vent or breather hole provided in a speed reducer housing is to equalize pressure within the housing with outside or atmospheric pressure.

All Vertical Type, Winsmith PLANETARY SPEED REDUCERS are provided with a A FITTING having a drilled hole which serves as a vent or breather opening. To prevent loss of lubricant while these units are in transit, a brass pin is inserted. (See Fig. 3). Be sure to remove this brass pin from the vent plug before operating the reducer so as to provide proper ventilation.

5. WHAT IS TOO HIGH AN OIL TEMPERATURE? Worm Gear Speed Reducers, although quieter in operation than most other types of gearing, have a tendency to run somewhat warmer.

Any speed reducer housing containing oil that is even 130° or 140° will seem very hot, indeed, to the touch. Yet oil temperatures from 140° to 200° are not uncommon. Up to 200° F., there is no cause for alarm.

If any properly installed Speed Reducer, not overloaded, containing a suitable grade and the right amount of oil, seems (to the touch) to be running quite hot, yet otherwise performing satisfactorily, there should be nothing to cause undue concern. By taking an occasional oil temperature reading it can be readily determined whether the temperature rises after the reducer is started in operation, until it reaches a fairly fixed maximum temperature, or continues the temperature rise without reaching an apparent maximum. If the temperature continues to rise without seeming to reach a maximum point, then a detailed investigation of the entire drive should be made to determine the cause.

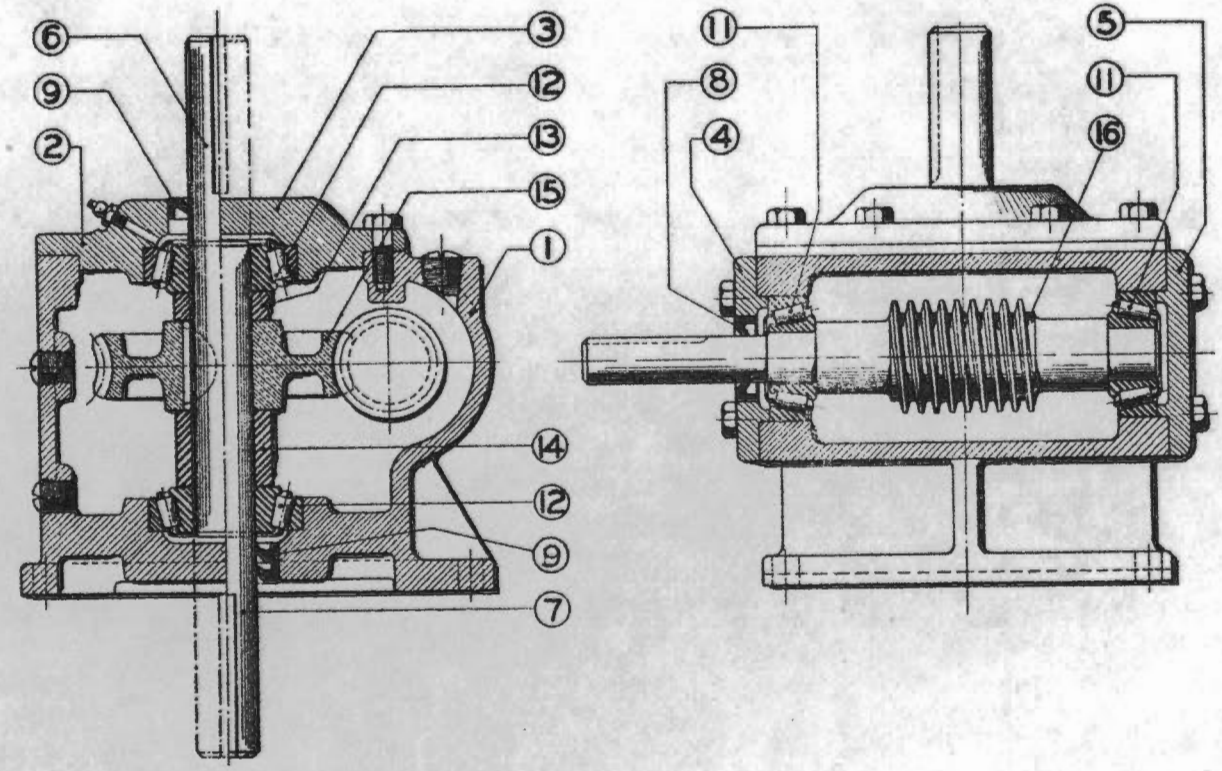
Any Speed Reducer will usually operate at a somewhat higher average temperature when running continuously than when running intermittently. When operating continuously, a unit has no idle period which would allow generated heat to dissipate.

PARTS

"CV" Series Reducers

STANDARD RATIOS AND DETAILS

Part No.	DESCRIPTION
1	Housing
2	Slow Speed Cover — Open
3	Slow Speed Cover Closed (Not Shown)
4	High Speed Cap — Open
5	High Speed Cap — Closed
5a	High Speed Adapter (Not Shown) Used with Part 5 Units 10 thru 14 inclusive
6	Slow Speed Shaft — Top Extension
7	Slow Speed Shaft — Bottom Extension
8	High Speed Oil Seal
9	Slow Speed Oil Seal
* 11	Roller Bearing — High Speed Single Row
	Double Row
12	Roller Bearing — Slow Speed
13	Slow Speed Spacer — Short
14	Slow Speed Spacer — Long
15	Slow Speed Worm Gear — Bronze
16	High Speed Worm Shaft — Integral
26	High Speed Locknut (Not Shown) Used on Units No. 10 thru No. 14 inclusive
27	High Speed Lockwasher (Not Shown) Used on Units No. 10 thru No. 14 inclusive

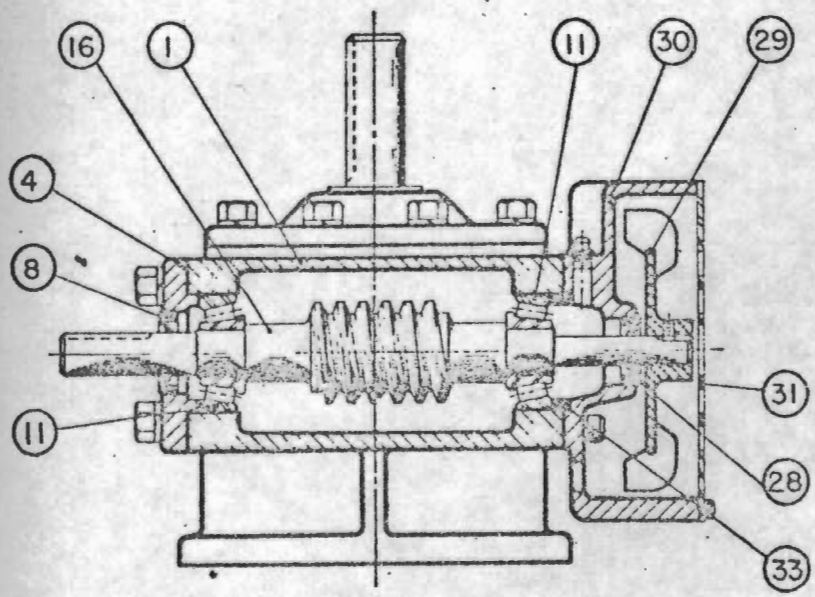


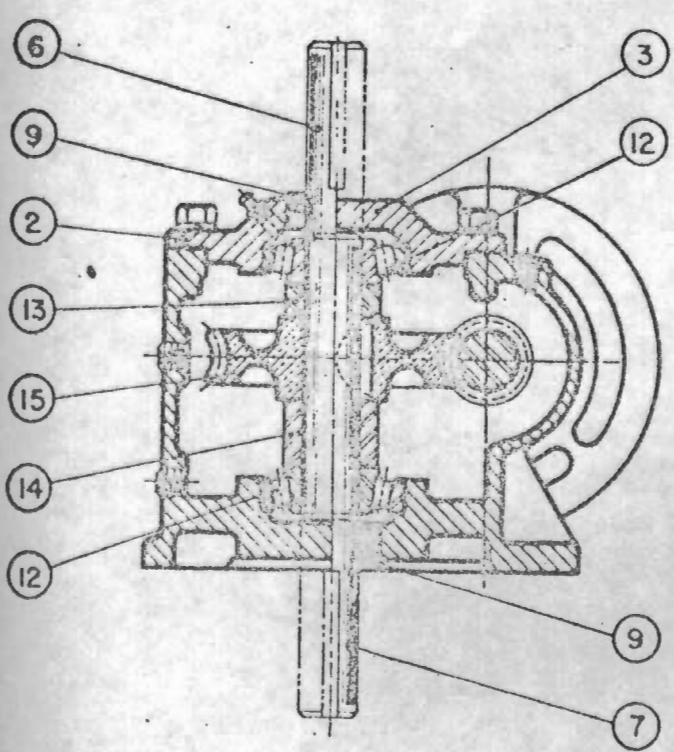
* Units 1 thru 9 use two single row bearings. Units 10 thru 14 use one single row and one double row bearing.

"FCV" Series Reducers

PARTS

STANDARD RATIOS AND DETAILS





Part No.	DESCRIPTION
1	Housing
2	Slow Speed Cover — Open
3	Slow Speed Cover — Closed (Not Shown)
4	High Speed Cap — Open
5a	High Speed Adapter (Not Shown) Used with Unit 10 thru 14 inclusive
6	Slow Speed Shaft — Top Extension
7	Slow Speed Shaft — Bottom Extension
8	High Speed Oil Seal Shaft — Extension End
9	Slow Speed Oil Seal
* 11	Roller Bearing — High Speed Single Row
	Double Row
12	Roller Bearing — Slow Speed
13	Slow Speed Spacer — Short
14	Slow Speed Spacer — Long
15	Slow Speed Worm Gear — Bronze
16	High Speed Worm and Shaft Integral
26	High Speed Locknut (Not Shown) Used on Units No. 10 thru No. 14 inclusive
27	High Speed Lockwasher (Not Shown) Used on Units No. 10 thru No. 14 inclusive
28	Oil Seal High Speed Fan End
29	Fan
30	Fan Housing and Cap
31	Fan Housing Cover
33	Fan Housing Spacer

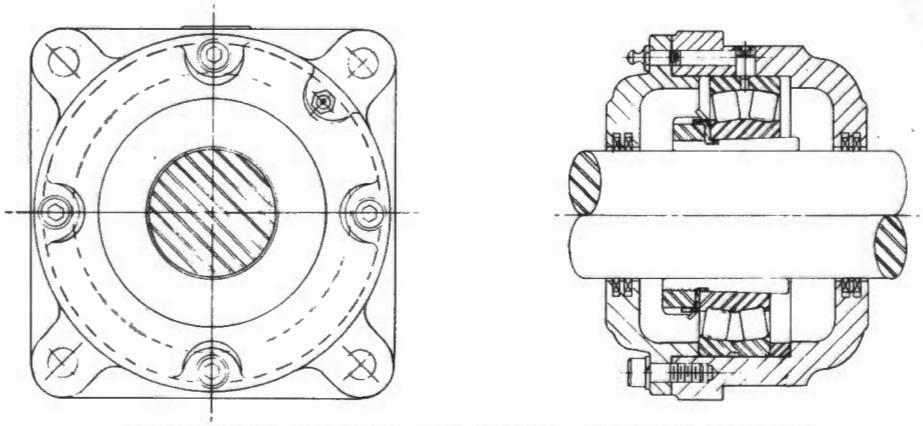
* Units 1 thru 9 use two single row bearings. Units 10 thru 14 use one single row and one double row bearing.

Winsmith

POWER TRANSMISSION

DIVISION UMC INDUSTRIES, INC.
SPRINGVILLE - Erie County - N. Y. 14141

Service Instructions



LINK BELT BS-223459
2 3/16

Service Instructions for BS223459 (FC-LB6800 — 2-3/16) fixed open end flange cartridge block shown on Assembly Drawing BY408232.

GENERAL

These instructions are provided to aid in the proper installation, operation and maintenance of these units. They should be carefully read and followed. Failure to do so may result in unsatisfactory service as well as serious personal injury or property damage.

A. Keep dirt, water and metal chips off all parts.

B. Hammer blows, overheating, or improper use of force can damage these precision parts.

C. Bearings must be correctly forced up their tapered adapter sleeves to obtain the correct clearance removal. Improperly tightened bearing and adapter assemblies may slip or turn on the shaft.

D. Housing mounting bolt and cover bolt tightness is important to prevent the housing from shifting, and to adequately support loads.

E. Check for final alignment and free rotation before machine start up.

F. Units must be adequately and correctly lubricated. A bearing not properly lubricated can run to destruction and possibly cause damage to other components.

INSTALLATION

1. Check shaft to be sure it is machined to correct size, tolerance, surface finish and is free of nicks and burrs.

2. A shaft with a pair of bearings has one fixed and one expansion unit. The fixed unit is located adjacent the drive end and takes any thrust loads. In locating bearings take into account that tightening the adapter assembly correctly moves the bearing 1/32 to 1/16 inch further up the tapered adapter sleeve.

3. The BS223469 is a fixed unit shipped assembled. There is no need to remove the bearing from the housing when the unit is to be located adjacent the drive. For this location just unbolt cover and remove it, the locknut and the lockwasher.

4. With shaft in position slide bearing-housing assembly into frame using mounting bolts to pull it in. Draw up mounting bolts snugly, but do not final tighten.

5. Locate the bearing and sleeve on the shaft in the desired position and install locknut and lockwasher but do not tighten beyond finger tight at this time.

6. The bearings may be mounted by either of two methods to achieve the required clearance removal.

METHOD NO. 1

a. Measure the initial built-in bearing clearance across the top roller on the outside by sliding the largest possible feeler gage between the roller and raceway. A snug or hard feel is recommended. It must be possible to remove the shim by pulling it straight out. A check of the lower roller on the outside by feel to assure that the inner ring-roller assembly is still centered with respect to the outer ring is suggested prior to making clearance readings.

b. Correct bearing installation requires forcing the bearing up the tapered O.D. of the sleeve until the bearing measured clearance is reduced by .0010 to .0020 inch. The preferred method of tightening is to use a spanner wrench and tighten the locknut until snug. Hold the adapter sleeve from turning until firmly seated. Using a soft steel bar and hammer, drive against the face of the locknut to relieve the thread pressure. Retighten the locknut and repeat. Periodically measure the bearing clearance until the correct reduction is obtained.

c. Bend a tang of the lockwasher down into one of the locknut slots. Use the slot which is most nearly lined up with a tang moving the locknut in the direction of tightening until the tang is aligned.

METHOD NO. 2

a. Tighten the locknut until there is a line-to-line fit between the adapter bore and shaft. At this point, no internal clearance has been removed and any advancement of the locknut will result in a reduction of internal clearance due to interference between the bearing bore and tapered seat.

b. Mark a suitable lockwasher tang and the mating area of the locknut. Count in the direction of tightening eleven (11) tangs and mark the eleventh tang. Using a soft steel bar and hammer, drive against the face of the locknut to relieve the thread pressure. Tighten the locknut and repeat until the marked area on the locknut is in line with the marked eleventh tang.

c. Bend a tang of the lockwasher down into one of the locknut slots. Use the slot which is most nearly lined up with a tang moving the locknut in the direction of tightening until the tang is aligned.

7. Install cover and draw bolts up snugly, but do not final tighten.

8. If the BS223459 unit is to be applied as an expansion unit, the bearing must be removed from the housing in order to remove the spacer ring. While the bearing is removed from the housing a depth measurement should be made and the bore or the shaft marked with a scratch so that the bearing may be replaced in the approximate center of its expansion range.

9. With shaft in position install bearing-housing assembly into frame and follow the procedure outlined in steps 4, 5, 6 and 7.

10. Tighten all cover bolts to a torque of 45 to 50 foot pounds.

11. While the mounting bolts are still snug check alignment and freedom of rotation. The housing and shaft clearance at the seals is small and can be visually checked for uniformity all the way around. Align by shimming or shifting and tighten all mounting bolts to a torque of 65 - 75 foot-pounds.

12. Grease lubrication is recommended with this unit for the reported maximum operating speed of 2600 RPM. A multi-purpose roller bearing grease of NLGI grades 1 or 2 with rust inhibitors and anti-oxidant additives and a suggested minimum oil viscosity of 400 SSU at 100°F should be used. The unit should be filled approximately 75 percent (8.3 ounces) full of the selected grease after assembly by adding it through the fitting.

13. Relubrication of the unit should be through the fitting with approximately 1 ounce of grease. For operation at 2600 RPM the unit should be relubricated on an approximate 4 month interval, while an approximate 6 month interval is suggested for operation at 1400 RPM.

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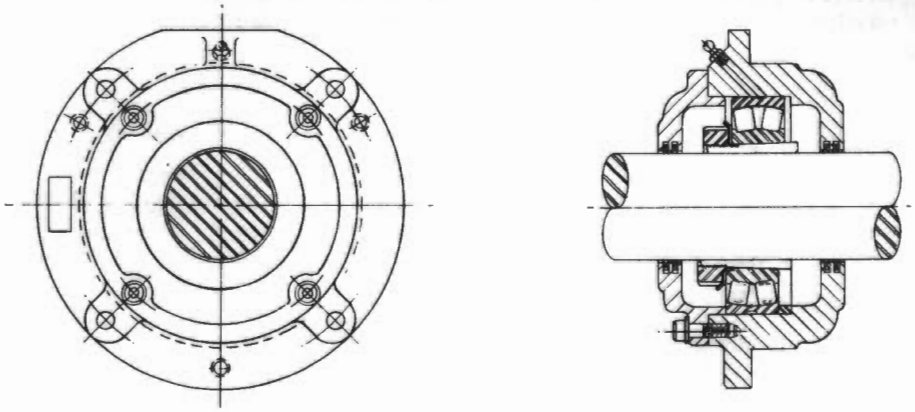
5270 Hanson Court • Minneapolis, Minnesota 55422
(612) 537-3611 • TELEX 29-0284

Service Instructions



LINK BELT BS-223616
2 15/16

Service Instructions for BS223616 (FC-LB6800X3 — 2-15/16) fixed open end flange cartridge block shown on assembly drawing BY408237.

GENERAL

These instructions are provided to aid in the proper installation, operation and maintenance of these units. They should be carefully read and followed. Failure to do so may result in unsatisfactory service as well as serious personal injury or property damage.

A. Keep dirt, water and metal chips off all parts.

B. Hammer blows, overheating, or improper use of force can damage these precision parts.

C. Bearings must be correctly forced up their tapered adapter sleeves to obtain the correct clearance removal. Improperly tightened bearing and adapter assemblies may slip or turn on the shaft.

D. Housing mounting bolt and cover bolt tightness is important to prevent the housing from shifting, and to adequately support loads.

E. Check for final alignment and free rotation before machine start up.

F. Units must be adequately and correctly lubricated. A bearing not properly lubricated can run to destruction and possibly cause damage to other components.

INSTALLATION

1. Check shaft to be sure it is machined to correct size, tolerance, surface finish and is free of nicks and burrs.
2. A shaft with a pair of bearings has one fixed and one expansion unit. The fixed unit is located adjacent the drive end and takes any thrust loads. In locating bearings take into account that tightening the adapter assembly correctly moves the bearing 1/32 to 1/16 inch further up the tapered adapter sleeve.
3. The BS223616 is a fixed unit shipped with housing and cover assembled and the bearing and adapter assembly packaged separately. When the unit is to be located adjacent the drive, unbolt cover and remove. With spacer ring in place install bearing with adapter sleeve in housing.
4. With shaft in position slide bearing-housing assembly into frame using mounting bolts to pull it in. Draw up mounting bolts snugly, but do not final tighten.
5. Locate the bearing and sleeve on the shaft in the desired position and install locknut and lockwasher but do not tighten beyond finger tight at this time.
6. The bearings may be mounted by either of two methods to achieve the required clearance removal.

METHOD NO. 1

a. Measure the initial built-in bearing clearance across the top roller on the outside by sliding the largest possible feeler gage between the roller and raceway. A snug or hard feel is recommended. It must be possible to remove the shim by pulling it straight out. A check of the lower roller on the outside by feel to assure that the inner ring-roller assembly is still centered with respect to the outer ring is suggested prior to making clearance readings.

b. Correct bearing installation requires forcing the bearing up the tapered O.D. of the sleeve until the bearing measured clearance is reduced by .0015 to .0025 inch. The preferred method of tightening is to use a spanner wrench and tighten the locknut until snug. Hold the adapter sleeve from turning until firmly seated. Using a soft steel bar and hammer, drive against the face of the locknut to relieve the thread pressure. Retighten the locknut and repeat. Periodically measure the bearing clearance until the correct reduction is obtained.

c. Bend a tang of the lockwasher down into one of the locknut slots. Use the slot which is most nearly lined up with a tang moving the locknut in the direction of tightening until the tang is aligned.

METHOD NO. 2

a. Tighten the locknut until there is a line-to-line fit between the adapter bore and shaft. At this point, no internal clearance has been removed and any advancement of the locknut will result in a reduction of internal clearance due to interference between the bearing bore and tapered seat.

b. Mark a suitable lockwasher tang and the mating area of the locknut. Count in the direction of tightening eight (8) tangs and mark the eighth tang. Using a soft steel bar and hammer, drive against the face of the locknut to relieve the thread pressure. Retighten the locknut and repeat until the marked area on the locknut is in line with the marked eighth tang.

c. Bend a tang of the lockwasher down into one of the locknut slots. Use the slot which is most nearly lined up with a tang moving the locknut in the direction of tightening until the tang is aligned.

7. Install cover and draw bolts up snugly, but do not final tighten.

8. If the BS223616 unit is to be applied as an expansion unit, the spacer ring must be removed from the housing. While the bearing is still removed from the housing a depth measurement should be made and the bore or the shaft marked with a scratch so that the bearing may be installed in the approximate center of its expansion range.

9. With shaft in position install bearing-housing assembly into frame and follow the procedure outlined in steps 4, 5, 6 and 7.

10. Tighten all cover bolts to a torque of 45 to 50 foot-pounds.

11. While the mounting bolts are still snug check alignment and freedom of rotation. The housing and shaft clearance at the seals is small and can be visually checked for uniformity all the way around. Align by shimming or shifting and tighten all mounting bolts to a torque of 65 - 75 foot-pounds.

12. Grease lubrication is recommended with this unit for the reported maximum operating speed of 2600 RPM. A multi-purpose roller bearing grease of NLGI Grades 1 or 2 with rust inhibitors and anti-oxidant additives and a suggested minimum oil viscosity of 400 SSU at 100°F should be used. The unit should be filled approximately 75 percent (12.2 ounces) full of the selected grease after assembly by adding it through the fitting.

13. Relubrication of the unit should be through the fitting with approximately 1 ounce of grease. For operation at 2600 RPM the unit should be relubricated on an approximate 2 month interval.

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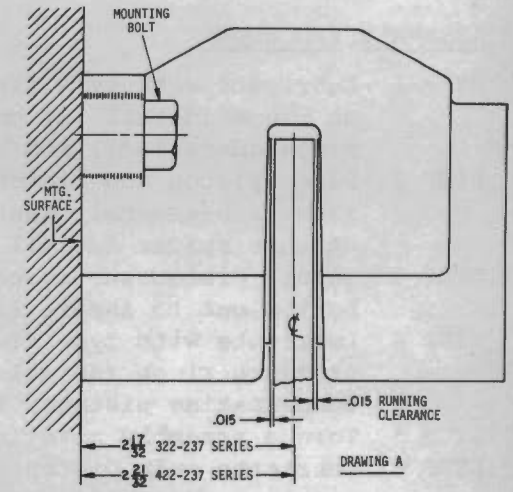
MICO CALIPER DISC BRAKE INSTRUCTIONS

322-237 SERIES & 422-237 SERIES

MODEL NO's.	MODEL NO.
02-520-121	02-520-125
03-520-061	
03-520-062	
03-520-063	



DRAWING A

INSTALLATION PROCEDURE

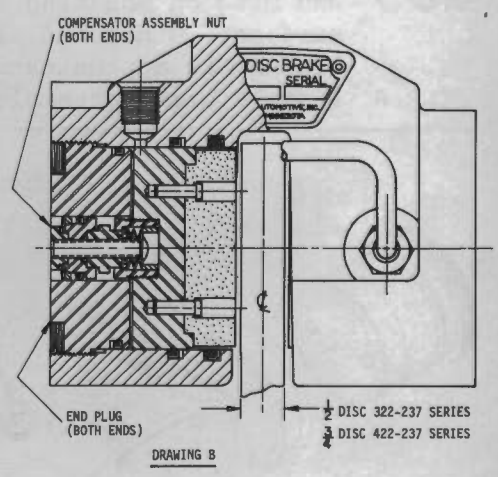
When installing the MICO Model 322-237 it is of utmost importance that the caliper be centered evenly and squarely over the disc. This is to provide even and equal piston travel and contact of the lining assemblies. The MICO Model 322-237 has a mounting face to disc centerline distance of 2-17/32", (see Drawing A). When planning or designing an installation of this brake on a vehicle, this dimension should be closely held. A .015 inch variance (greater or lesser) from this 2-17/32" dimension will eliminate the disc running clearance. Proper shims must be inserted between the disc brake mounting face and the vehicle mounting surface (see Drawing A). Torque mounting bolts to approximately 80 foot pounds. Bleed according to standard procedure.

The MICO Model 322-237 Disc Brake is designed to be used with a 1/2" thick disc. A disc of greater thickness cannot be used. If a disc of lesser thickness is used, the same centerline must be maintained and the initial disc to puck clearance will be greater; however, after an initial brake application the linings will contact the disc, then upon pressure release, the Mico-Jeffries retractor-compensator will provide the proper running clearance of .015 inch per side.

CAUTION: Minimum allowable disc thickness for use with this caliper assembly is 7/16". If a thinner disc is used, a loss of fluid may occur at the time of complete lining wear.

Uneven lining wear may occur if the caliper is not mounted squarely over the disc, or, if the pucks are not parallel to the disc surface. Reduced 'O' ring seal life may also be evident.

It should not be necessary to change the position or setting of either the end plugs or the compensator assembly nut (see Drawing B) during the life of the lining. After the linings have worn to the point of replacement they then may be replaced with Lining Kit #20-060-003. Assembly, Disassembly, and Adjustment Instructions are included with this Replacement Kit.



DRAWING B

DISASSEMBLY PROCEDURE

STEP 1 Remove brake from vehicle by disconnecting necessary fluid lines and removing mounting bolts. (Drain fluid from brake before disassembling.)

STEP 2 Remove (2) end plug assemblies (detail 1) from housing (detail 4) with 1-1/4" wrench.

STEP 3 Loosen and remove assembly nuts (detail 21) with 1/2" socket wrench while holding end plug (detail 16) with 1-1/4" wrench. Then separate the pistons and end plugs by pulling apart.

STEP 4 Remove loading springs (detail 20), wedges (detail 19), pressure rings (detail 18), and 'O' rings (detail 7) from end plugs (detail 16).

STEP 5 Remove 'O' rings (detail 14), back-up rings (detail 15) from end plugs (detail 16) and 'O' rings (detail 2), back-up rings (detail 3), and seals (detail 25), from housing (detail 4).

STEP 6 Remove compensator sub-assembly (detail 13) from main piston (detail 10) with 11/16" socket wrench. Piston must be held in vise or collet. Spacer (detail 12) not necessary to remove from(detail 13).

CHANGE LININGS PROCEDURE

STEP 1 and STEP 2 same as Disassembly Procedure (above).

STEP 3 Remove linings (detail 7) from pistons (detail 10) with thin blade screwdriver or similar means.

STEP 4 Insert clips (detail 9) into piston (detail 10) and drive with a hammer until clip edge makes contact with piston. Do not strike repeatedly after seated.

STEP 5 Insert new linings (detail 7) into piston pockets and install rivets (detail 6) with hammer and flat head punch or similar means.

STEP 6 Reassemble using Steps 7 thru 10 of Assembly Procedure.

(continued) MICO CALIPER DISC BRAKE INSTRUCTIONS for Series 322-237 & 422-237

ASSEMBLY PROCEDURE

STEP 1 Lubricate with type fluid used in system. Install 'O' rings (detail 14), back-up rings (detail 15) on end plugs (detail 16) and 'O' rings (detail 2), back-up rings (detail 3), and seals (detail 25), in housing (detail 4).

STEP 2 Place piston and lining sub-assembly in collet or vise and install new compensator sub-assembly (detail 13) using an 11/16" socket wrench over the retainer. Be sure spacer (detail 12) is in proper position.

STEP 3 Insert piston sub-assemblies in bore of end plugs (detail 16) until they bottom out to assure lining to disc clearance on vehicle.

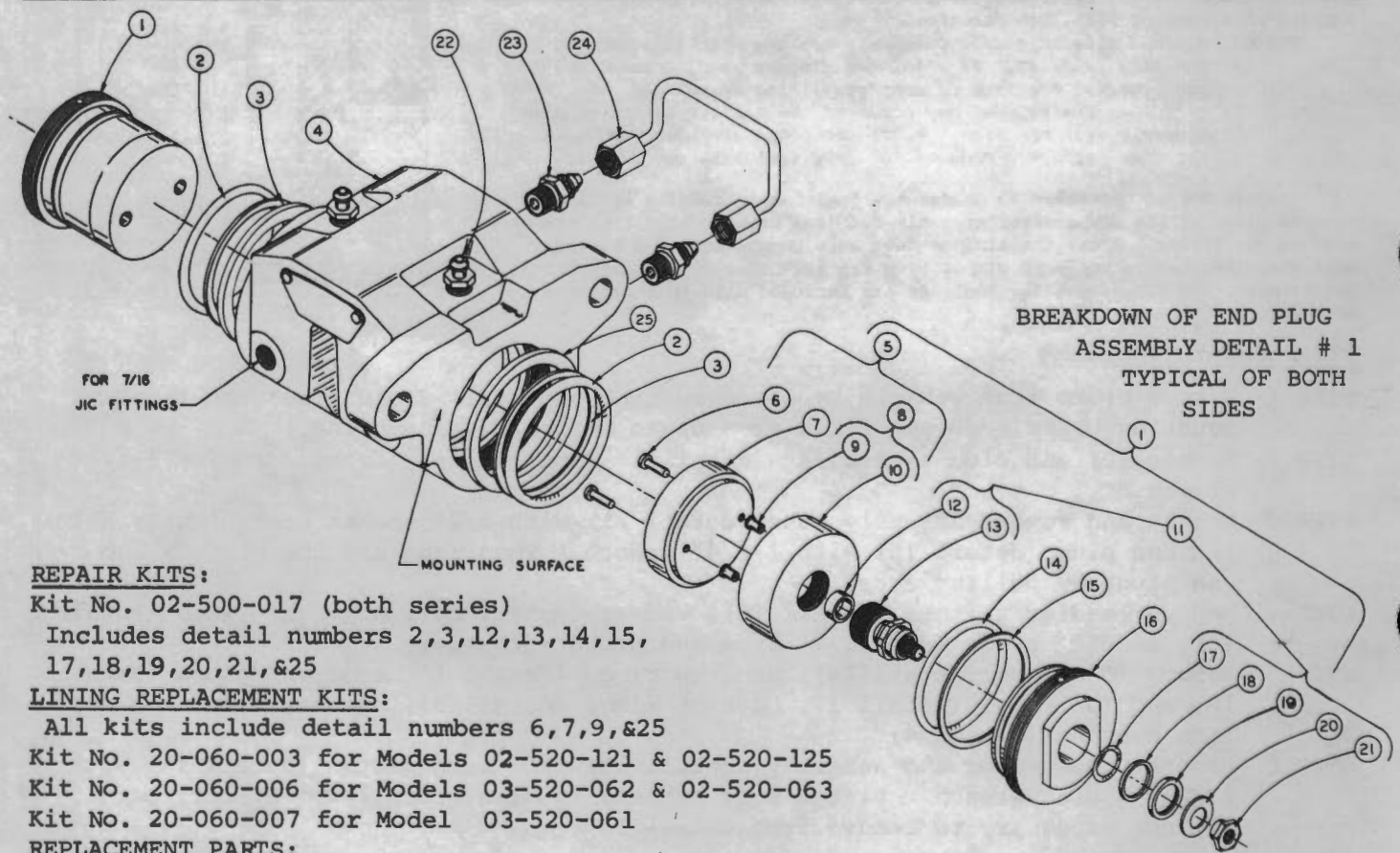
STEP 4 Lubricate with type fluid used in system and install 'O' rings (detail 17), pressure rings (detail 18), wedges (detail 19), with tapers to match that of compensating pistons, loading springs (detail 20) and assembly nuts (detail 21).

STEP 5 Torque assembly nuts (detail 21) to approximately 10 foot pounds.

STEP 6 Lubricate main piston (detail 10) with type fluid used in system and install complete assemblies (detail 1) into housing (detail 4) using 1-1/4" wrench.

STEP 7 End plug on mounting surface side must be screwed in until flush with mounting surface. Other end plug must be screwed in until the distance between the linings is approximately 5/8".

STEP 8 Install brake assembly, refer to Installation Procedure.



BREAKDOWN OF END PLUG ASSEMBLY DETAIL # 1 TYPICAL OF BOTH SIDES

REPAIR KITS:
Kit No. 02-500-017 (both series)
Includes detail numbers 2,3,12,13,14,15, 17,18,19,20,21,&25

LINING REPLACEMENT KITS:
All kits include detail numbers 6,7,9,&25
Kit No. 20-060-003 for Models 02-520-121 & 02-520-125
Kit No. 20-060-006 for Models 03-520-062 & 02-520-063
Kit No. 20-060-007 for Model 03-520-061

REPLACEMENT PARTS:
No. 32-560-004 Tubing Assembly (Detail No. 24)
No. 34-150-024 Connector (Detail No. 23)
No. 30-010-056 Piston (Detail No. 10)

MINNESOTA AUTOMOTIVE INC
BOX 2074 / 1911 LEE BLVD.
NORTH MANKATO, MINN. 56001
PHONE: 507 345-4593

WESTERN STATES AFFILIATE
ALMICO INC.
1075 Hamilton Road
Duarte, Calif. 91010
Phone: 213 358-2523

FORM NO. 81-520-003 / 8-73 *Printed In U. S. A.*

GENERAL INFORMATION

Strandberg Indicating Tachometers employ conventional d-c generators and d-c microammeters calibrated in terms of rotational speed, surface speed, or any other desired units, such as gallons or pieces per minute or second. Connection between the generator and the large, easy-to-read indicator is made by any two-conductor cable. Any length up to 500 feet may be used. A twenty-foot length of cable is supplied with the instrument unless otherwise specified. Since the d-c generated voltage is directly proportional to speed, no power is required. Since the output voltage per revolution is high enough for low speed applications, no tubes or transistors are required.

INSTALLATION -- GENERATOR

Three types of generators are available and are as follows:

1. Type R12-A is a shaft-driven device with a 1/4-inch diameter 5/8-inch long shaft. A three-inch flexible shaft is included as standard equipment. A six-inch flexible shaft is optional and will be supplied in lieu of the three-inch chaft, if requested (See Dwg. No. 1958).

2. Type R12-B is a shaft-driven device similar to the R12-A except it is supplied with factory installed fork coupling (See Dwg. No. 1959).

A base mount for either type R12-A or Type R12-B should be located 1-1/8 inches below the shaft center line. Complete mounting dimensions are shown on the above referenced drawings.

All generators are factory calibrated for clockwise rotation, unless otherwise specified. Mounting should be made at the end of the shaft which will permit the generator shaft to turn in the direction specified as the calibrated rotational direction. If it becomes necessary to reverse the mounting, recalibration of the tachometer will be required (See Calibration section).

3. Type R12-C is a surface-driven device. Mounting should be such that the drive wheels make firm contact with the web. For yarn and fabric applications, the wheels should contact the web directly above a guide or driven roll. For complete mounting dimensions see Dwg. No. 1971.

INDICATING TACHOMETERS TECHNICAL DATA	ORIGINAL DATE 28 SEPT 66	STRANDBERG ENGINEERING LABS, INC GREENSBORO, NORTH CAROLINA	
	DRAWN RCS		
	CHECKED RCS	A	DRAWING NUMBER 1973
	APPROVED WEP		SHEET 1 OF 2

PROJECT: PT-2

INSTALLATION -- INDICATOR

Standard indicators have 4-1/2 and 7-inch scale lengths. Cutout templates are supplied with the tachometer for panel mounting. See Dwg. Nos. 1970 and 1972 for additional information.

WIRING

No external power source is required. A 20-foot 2-conductor cable is supplied. However, any cable length up to 500 feet and wire size no smaller than AWG22 can be used. Polarity must be observed.

CALIBRATION -- ZERO

With the shaft idle, the indicating pointer can be set to zero by adjusting the meter set screw in the front center of the meter housing. This is a mechanical adjustment. It is factory pre-set and should not require frequent field adjustment.

CALIBRATION -- RPM TACHOMETERS

Tachometers calibrated in Revolutions per Minute (or other units of time) are factory calibrated. They can, however, be calibrated on the job against other tachometers or stroboscopes by turning the screw-driver adjustment located on the indicator rear terminal plate. For upscale adjustment, turn adjusting screw (Cal. Pot.) in a clockwise direction when facing rear of unit (See Dwg. No. 1970).

CALIBRATION -- SURFACE SPEED TACHOMETERS

Tachometers calibrated in terms of surface speed, such as feet or yards per minute, are factory calibrated when the drive roll diameter is given. They can also be field calibrated in the manner described for RPM tachometers.

MAINTENANCE

No preventive maintenance is recommended. However, occasional calibration checks should be made at intervals depending upon the accuracy requirement. In the event of failure, the generator brushes should be checked and replaced if necessary. Terminal connections to the indicator should be checked. Replacement generators and indicators are available. In the event any part is replaced, the instrument should be recalibrated.

INDICATING TACHOMETERS TECHNICAL DATA	ORIGINAL DATE 28 SEPT 66	STRANDBERG ENGINEERING LABS, INC GREENSBORO, NORTH CAROLINA	
	DRAWN RCS		
	CHECKED RCS	A	DRAWING NUMBER 1973
	APPROVED WEP		SHEET 2 OF 2

PROJECT: PT-2

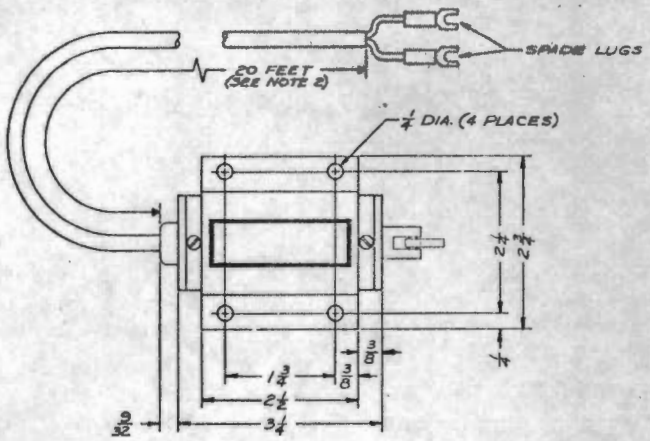
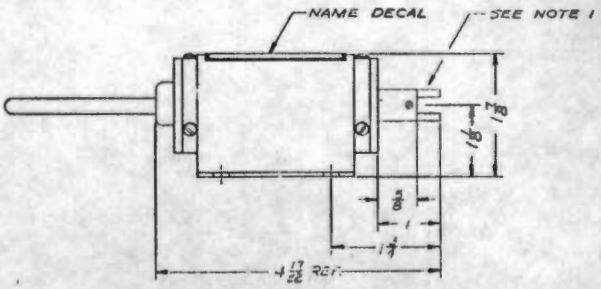
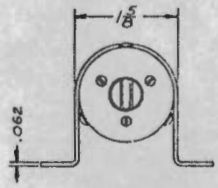


FIG. 1

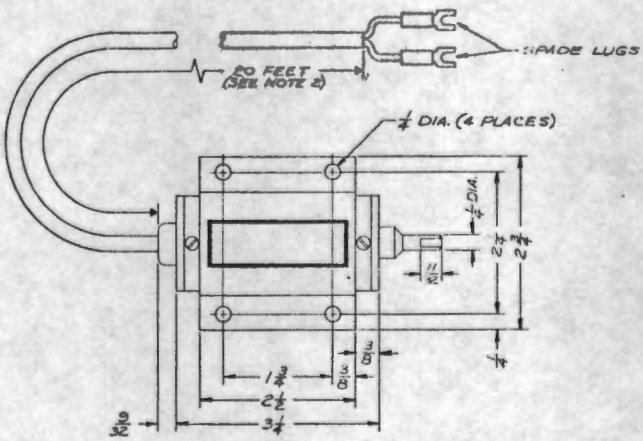
NOTES:
1. LOCATE HOLES IN SHAFT PER FIG. 1 FOR FORKED COUPLING.
2. STANDARD CABLE LENGTH - 20 FEET. AVAILABLE IN OTHER LENGTHS AS REQD.





MATERIAL	PINION	HEAT TREAT	
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED: FRAC ± 1/64, DEC ± .005, ANG ± 30	TITLE: MOUNTING DIMENSIONS TACHOMETER GENERATOR TYPE RI2-1	WEIGHT	STANDARD ENGINEERING LABS, INC. GREENSBORO, NORTH CAROLINA
SCALE 1/1	NO REQD	DRAWN R.C.S. DATE 7-6-56	DRAWING NUMBER 1959
NEXT ASSY		CHECKED DATE	
		APPROVED DATE	

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL



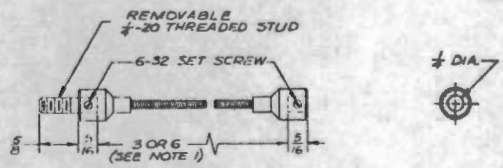
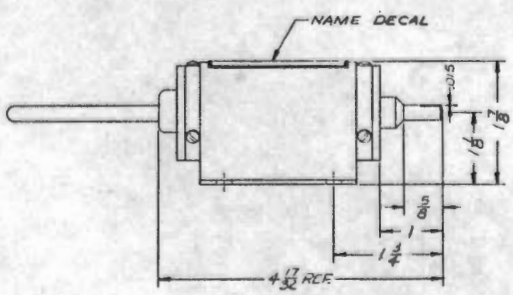
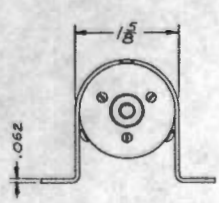


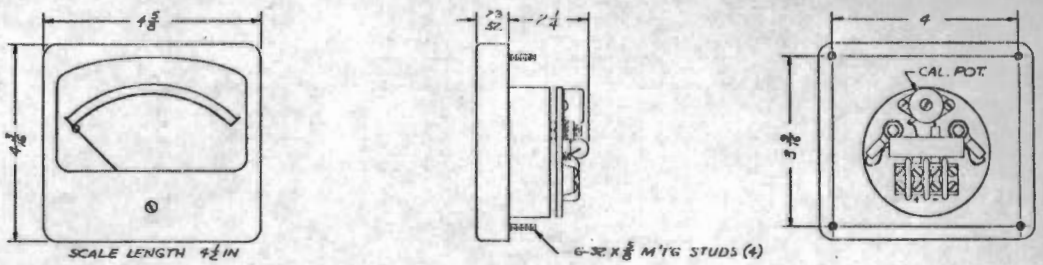
FIG. 1

NOTES:
1. 3-INCH FLEXIBLE SHAFT SUPPLIED AS STANDARD EQUIPMENT. 6-INCH FLEXIBLE SHAFT WILL BE SUPPLIED IN LIEU OF 3-INCH IF REQUESTED.
2. STANDARD CABLE LENGTH - 20 FEET. AVAILABLE IN OTHER LENGTHS AS REQD.

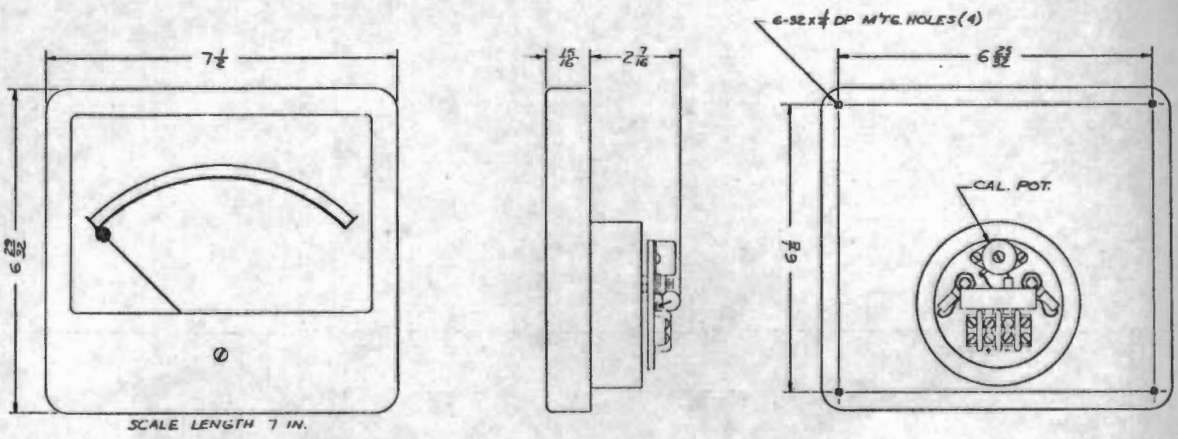




MATERIAL	PINION	HEAT TREAT	
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED: FRAC ± 1/64, DEC ± .005, ANG ± 30	TITLE: MOUNTING DIMENSIONS ALTERNATOR TYPE RI2-4	WEIGHT	STANDARD ENGINEERING LABS, INC. GREENSBORO, NORTH CAROLINA
SCALE 1/1	NO REQD	DRAWN DATE	DRAWING NUMBER 1958
NEXT ASSY		CHECKED DATE	
		APPROVED DATE	



4½ INCH TACHOMETER METER UNIT

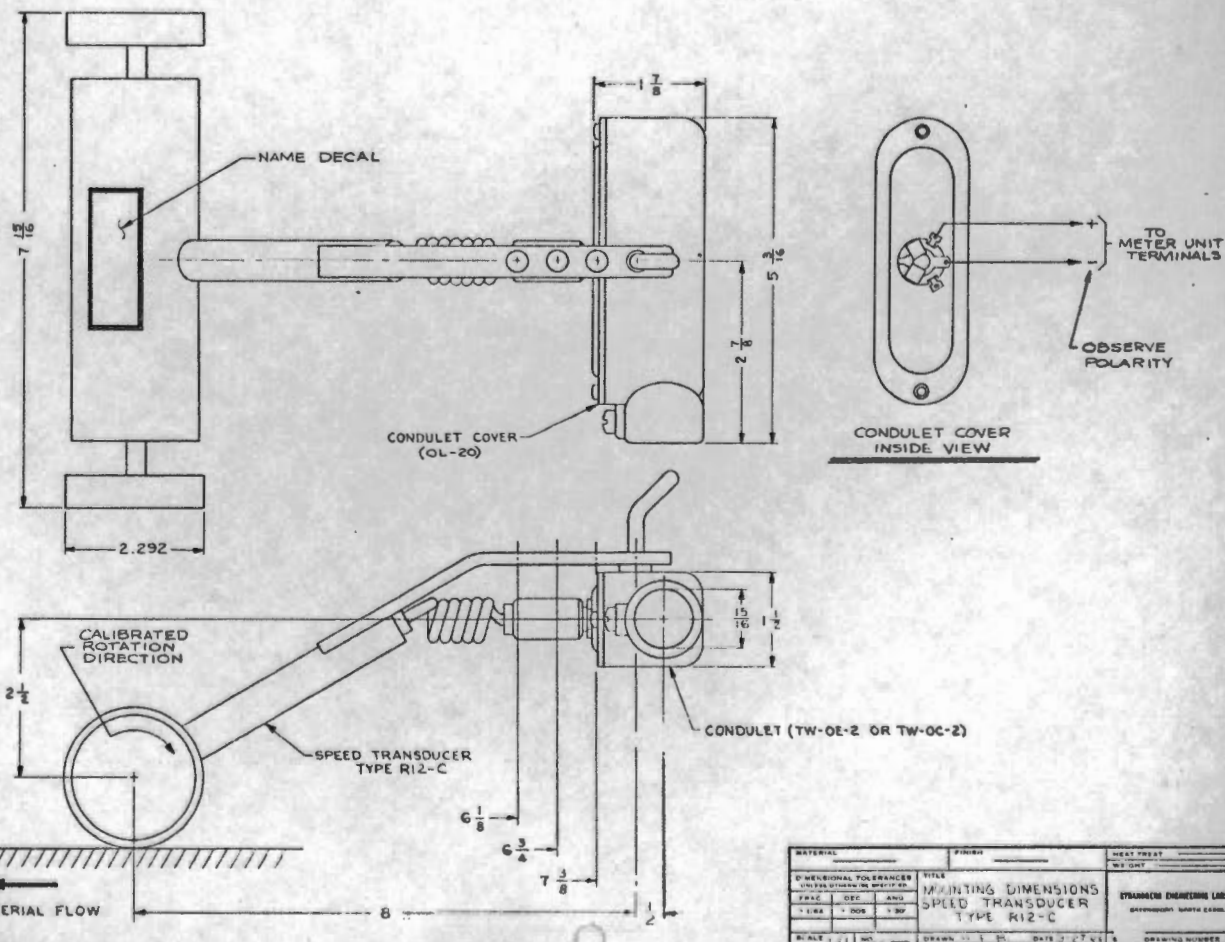


7 INCH TACHOMETER METER UNIT

NOTES:
1. THIS DWG. SUPERSEDES DWG NOS. 1377 & 1378.
2. FOR MOUNTING CUT-OUT DIMENSIONS SEE DWG. NO. 1972.

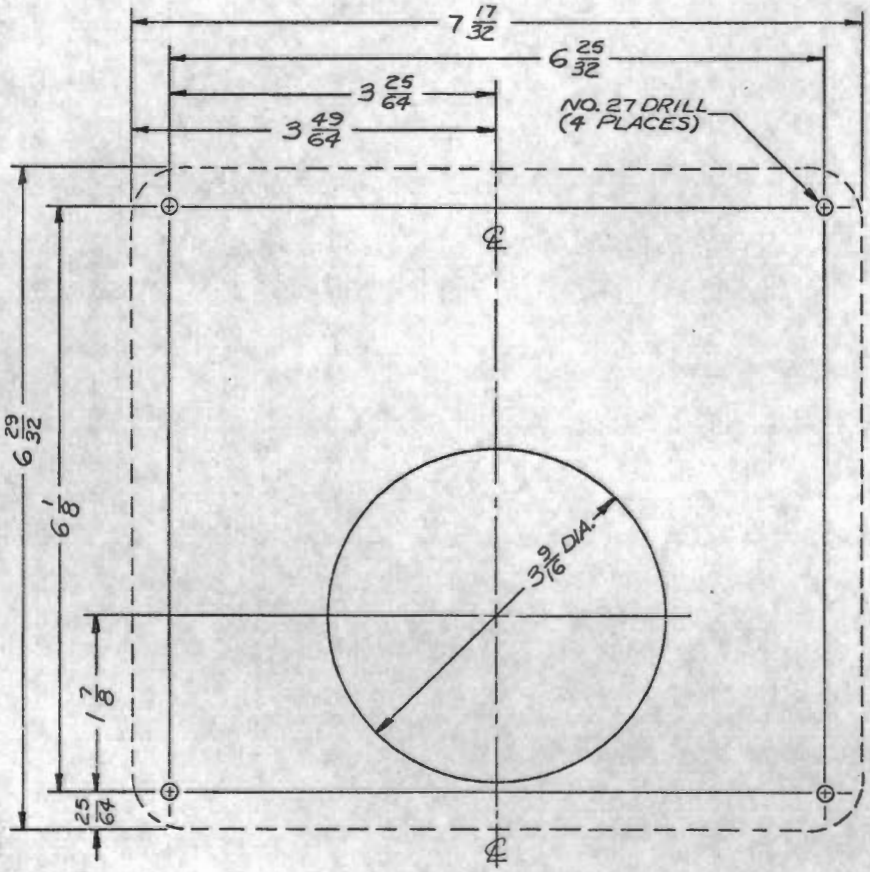
MATERIAL		FINISH	
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	FRAC ± 1/64	DEC ± .005	ANG ± 30'
SCALE 3/4	NO. REQ'D		
NEXT ASSY			
TITLE	OUTLINE DIMENSIONS 4½ INCH & 7 INCH TACHOMETER MULTI-UNITS		
DRAWN		DATE	
CHECKED		DATE	
APPROVED		DATE	
HEAT TREAT			
WEIGHT			
STEARNS ENGINEERING LABS, INC.			
DRAWING NUMBER	1970		

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL

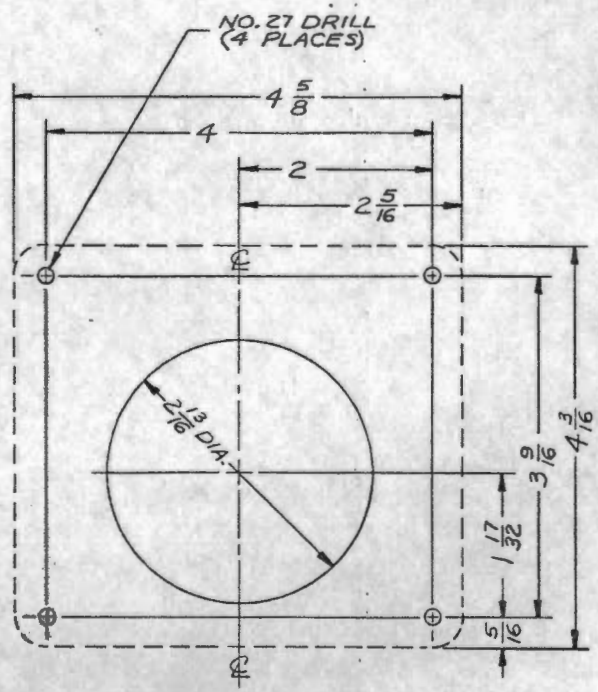


MATERIAL		FINISH	
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	FRAC ± 1/64	DEC ± .005	ANG ± 30'
SCALE 1/1	NO. REQ'D		
NEXT ASSY			
TITLE	MOUNTING DIMENSIONS SPEED TRANSDUCER TYPE R12-C		
DRAWN		DATE	
CHK'D		DATE	
APPR'D		DATE	
HEAT TREAT			
WT. UNIT			
STEARNS ENGINEERING LABS, INC.			
DRAWING NUMBER	1971		

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL



7 INCH METER



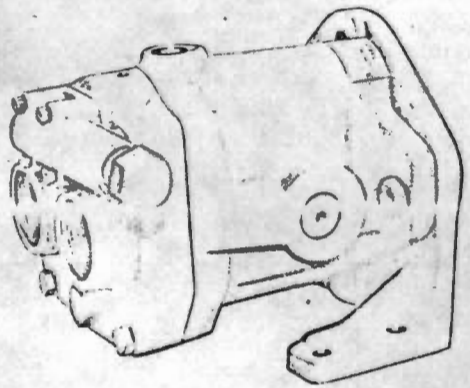
4 1/2 INCH METER

MATERIAL	FINISH	HEAT TREAT / WEIGHT
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED: FRAC. ± 1/64; DEC. ± .005; ANG. ± 30'	TITLE: MOUNTING DIMENSIONS 4 1/2 INCH & 7 INCH TACHOMETER METER UNITS	STRANDBERG ENGINEERING LABS, INC. GREENSBORO, NORTH CAROLINA
SCALE 1/1 NO. REQ'D —	DRAWN R.C.S. DATE 2-28-66	DRAWING NUMBER / ISSUE

SPERRY RAND

VICKERS

10 AND 15 GPM VARIABLE IN-LINE PISTON UNITS



SERVICE PARTS INFORMATION

PVB10-(F)(Y)-30-*(*)(L)-1***
PVB15-(F)(Y)-30-*(*)(L)-1***
MVB10-(F)UD(Y)-30-*-10

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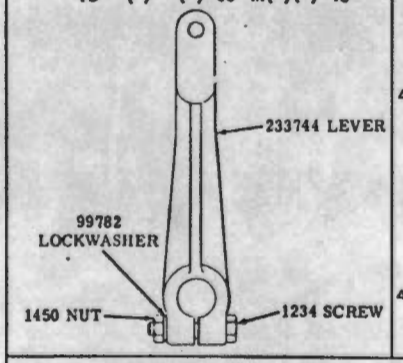
MODEL CODE BREAKDOWN

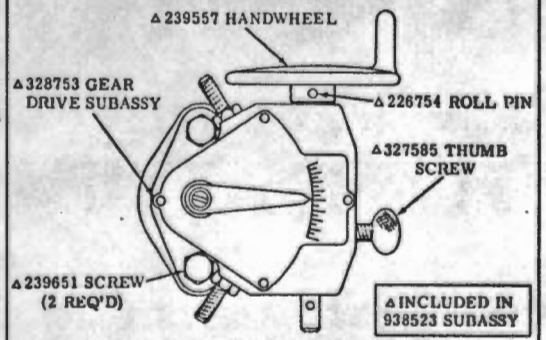
*V B * - (*) * * (*) - 30 - * (*) (L) - 1*

- P - PUMP / M - MOTOR
- VARIABLE DISPLACEMENT
- IN-LINE PISTON UNIT
- FLOW RATING AT 1800 RPM: 10 - 10 GPM; 15 - 15 GPM
- MOUNTING: F - FOOT BRACKET (OMIT FOR FLANGE MOUNT)
- ROTATION, VIEWING SHAFT END: R - RIGHT HAND (CW); L - LEFT HAND (CCW); U - EITHER DIRECTION (MOTORS ONLY)
- SWASH PLATE MOVEMENT: D - BOTH SIDES OF CENTER; S - ONE SIDE OF CENTER
- SHAFT: Y - LONG SHAFT (STANDARD) (OMIT FOR SHORT SHAFT)
- PUMP DESIGN NUMBER
- CONTROL TYPE: C - PRESSURE COMPENSATED (350-3000 PSI) 10 GPM UNITS (350-2000 PSI) 15 GPM UNITS; CM - PRESSURE COMPENSATED (INTERMEDIATE RANGE) (350-1500 PSI) 1* GPM UNITS; H - HANDWHEEL; M - LEVER; V - NO CONTROL
- COMPENSATOR VARIATIONS: D - DUAL RANGE (ELECTRIC CONTROL - 115 VOLTS, 60 CYCLE); DH - DUAL RANGE (HYD. CONTROL); E - START-UP VALVE; C - ADJUSTABLE MAXIMUM STOP
- CONTROL OPTIONS: L - LEFT HAND LOCATION VIEWING SHAFT END (OMIT FOR RIGHT HAND LOCATION)
- CONTROL DESIGN NUMBER

MANUAL LEVER CONTROL MODEL
VB-(*)**(*)-30-M(*)(*)-10



HANDWHEEL CONTROL MODEL
VB-(*)**(*)-30-H(*)(*)-10



To insure sustained efficiency and maximum trouble-free life of this precision equipment, initial and continuous filtration of the fluid medium to 25 microns or less is essential. (For information pertaining to Vickers economical 10 micron filters, see installation drawing I & M 229847.)

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NOTE
COMPENSATOR S/A PARTS SHOWN WITHIN THIS AREA.

PRESSURE RANGE (PSI)	COMPENSATOR SUBASSY	SPRING
(C)350-3000 (10) 350-2000 (15)	942158	●239371
CMI 350-1500	942159	●265693

■ INCLUDED IN START-UP VALVE (E) SUBASSY 942157

MODEL	●INCLUDED IN VALVE PLATE S/A
PVB10-RDY(*)-30-H M-10	942160
PVB10-LDY(*)-30-H M-10	942161
MVB10-UDY(*)-30-H M-10	942162
PVB15-RDY(*)-30-H M-10	942163
PVB15-LDY(*)-30-H M-10	942164
PVB10-RS(Y)-30-C(*)-11	942165
PVB10-LS(Y)-30-C(*)-11	942166
PVB15-RS(Y)-30-C(*)-11	942167
PVB15-LS(Y)-30-C(*)-11	942168

YOKE	HOUSING	MODEL	●SCREW (2 REQ'D)	●ROTATION PLATE
342744	306327	PVB1*-*DY(*)-30-H M-10	227401	195060
342743	357652	PVB1*-*SY(*)-30-C(*)-11		266399
342744	306327	MVB10-*DY(*)-30-H M-10		

MODEL	SHAFT	KEY
VB-***-30	261478	22971
VB-***Y-30	270369	58303

IMPORTANT: COMPENSATOR AND START-UP VALVE SHOWN FOR L. H. SHAFT ROTATION. FOR R.H. ROTATION UNITS, ROTATE BOTH VALVES 180°.

MODELS	SNAP RING	WASHER	SPRING	THRUST WASHER	CYLINDER BLOCK	PINS (3 REQ'D)	BACK-UP WASHER	SPHERICAL WASHER	SHOE PLATE	PISTON S A-KIT	SWASH PLATE	ROTATING GROUP
	THESE PARTS INCLUDED IN											
PVB10-**(Y)-30-**-1*	93509	245223	247294	241954	321703	248812	261476	261477	275961	942047	239077	936276
MVB10-**(Y)-30-**-1*					260860					941887		936273
PVB15-**(Y)-30-**-1*												

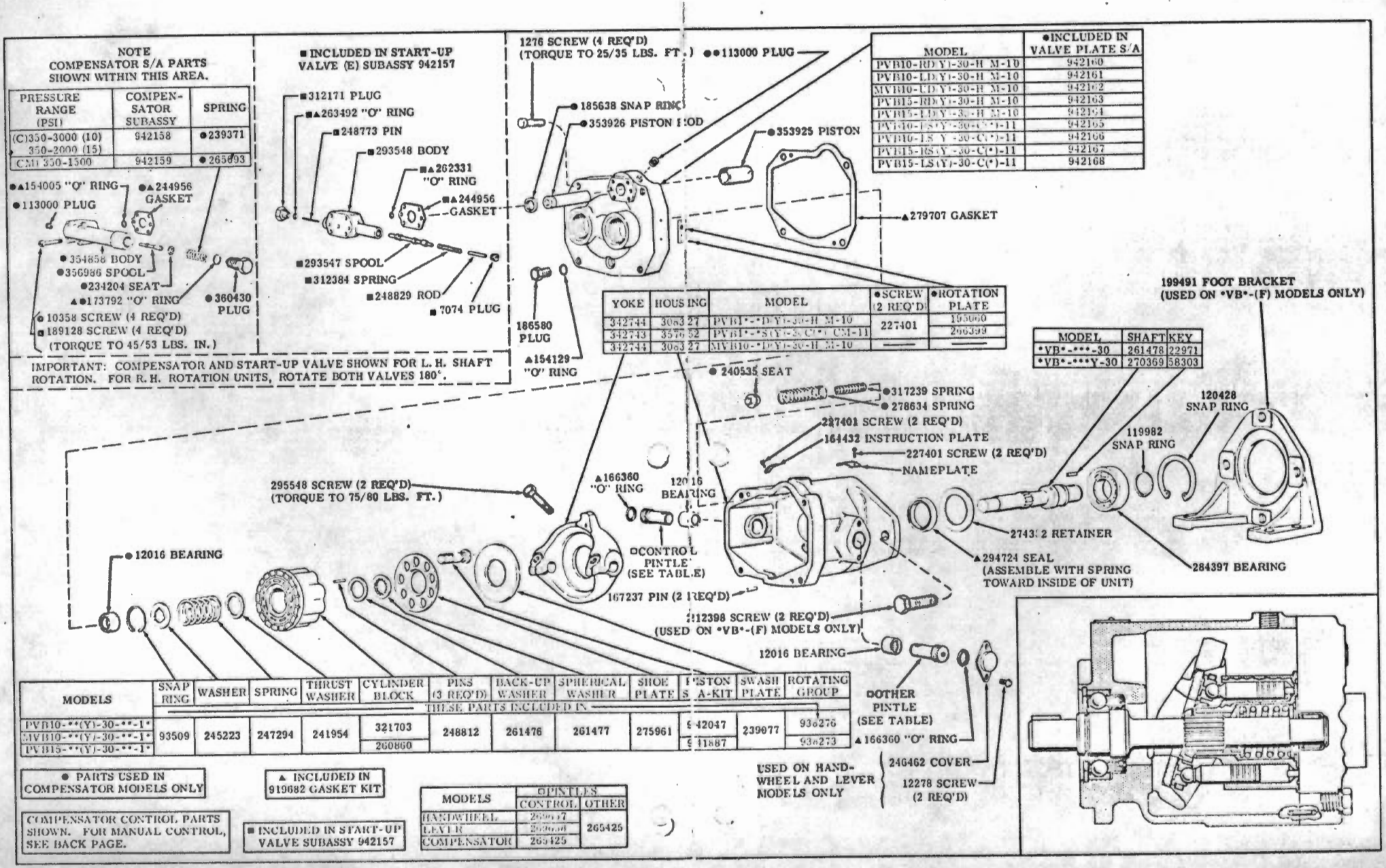
● PARTS USED IN COMPENSATOR MODELS ONLY

▲ INCLUDED IN 919682 GASKET KIT

COMPENSATOR CONTROL PARTS SHOWN. FOR MANUAL CONTROL, SEE BACK PAGE.

■ INCLUDED IN START-UP VALVE SUBASSY 942157

MODELS	□PINTLES	
	CONTROL	OTHER
HANDWHEEL	265427	265425
LEVER	265426	
COMPENSATOR	265425	



SERVICE PARTS INFORMATION

DUAL RANGE AND ADJUSTABLE MAXIMUM STOP COMPENSATOR MODELS

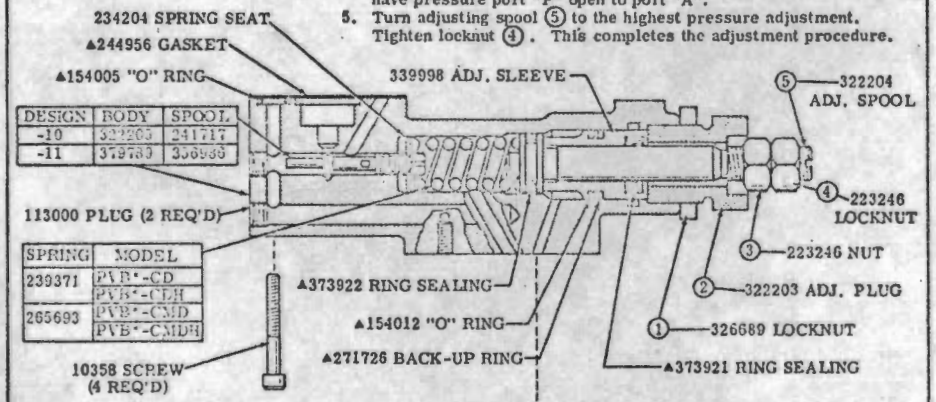
SPERRY RAND

VICKERS

CD, CMD, CDH, CMDH, CONTROL ADJUSTMENT PROCEDURE

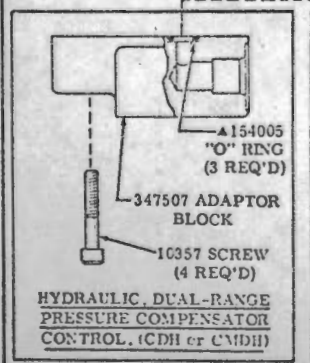
PVB*-(F)*S(F)(*)(Y)-*-C(M)D-10/11
PVB*-(F)*S(F)(*)(Y)-*-C(M)DH-10/11

1. Loosen locknuts ① and ④.
2. Turn adjusting spool ⑤ until nut ③ is bottomed against adjusting plug ②. Adjusting spool threads will be full extended.
3. With the directional valve de-energized; or in the Hydraulic System having the pressure port "P" blocked and port "A" open to port "T", adjust the lowest pressure setting by turning adjusting plug ②. Tighten locknut ① after adjustment is completed.
4. Energize the directional valve; or in the Hydraulic System, have pressure port "P" open to port "A".
5. Turn adjusting spool ⑤ to the highest pressure adjustment. Tighten locknut ④. This completes the adjustment procedure.

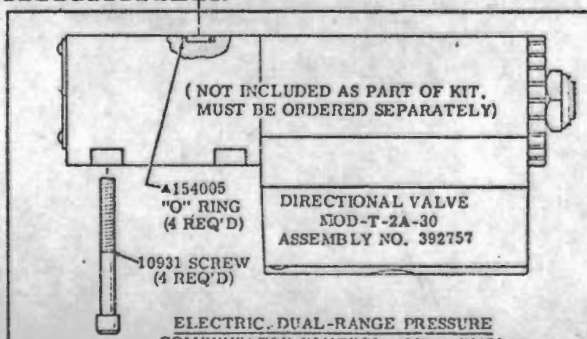


DESIGN	BODY	SPOOL
-10	322205	241717
-11	379789	356966

SPRING	MODEL
239371	PVB*-CD
	PVB*-CDH
265693	PVB*-CMD
	PVB*-CMDH



HYDRAULIC, DUAL-RANGE PRESSURE COMPENSATOR CONTROL, (CDH or CMDH)



ELECTRIC, DUAL-RANGE PRESSURE COMPENSATOR CONTROL, (CD or CMD)

▲INCLUDED IN 919621 GASKET KIT

NOTE-COMPENSATOR S/A KITS INCLUDE ALL PARTS SHOWN EXCEPT DIR. VALVE.

-11 DESIGN COMPENSATOR S/A KITS	
CMD-942092	CMDH-942114
CD-942093	CDH-942115

Revised 3-1-72

I-3260-S

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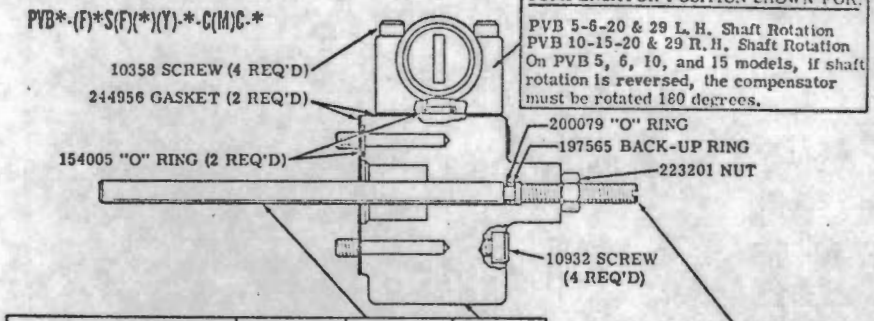
PVB*-(F)*S(F)(*)(Y)-*-C(M)C-*



COMPENSATOR POSITION SHOWN FOR:
PVB 5-6-20 & 29 L. H. Shaft Rotation
PVB 10-15-20 & 29 R. H. Shaft Rotation
On PVB 5, 6, 10, and 15 models, if shaft rotation is reversed, the compensator must be rotated 180 degrees.

MODEL	MAX. STOP S/A NO.	ADJUSTING ROD	ADAPTER BLOCK
PVB5-*LS*-11-C(M)C-1*	942188	354573	354578
PVB6-*LS*-11-C(M)C-1*			
PVB5-*RS*-11-C(M)C-1*	942189		354579
PVB6-*RS*-11-C(M)C-1*			
PVB1*-*LS*-20-C(M)C-1*	942190	354574	
PVB1*-*RS*-20-C(M)C-1*	942191		354578
PVB2*-*LS*-10-C(M)C-1*	942192	354575	
PVB2*-*RS*-10-C(M)C-1*			

NOTE

To assist initial priming, manual adjustment control setting must be at least 40% of maximum flow position. Maximum flow position occurs when rod is fully extended.

MODEL CODE BREAKDOWN

P V B * - (*) * S (*) (*) (*) - * - * (*) (*) - *

- PUMP
- VARIABLE DISPLACEMENT
- IN-LINE DESIGN
- GPM-RATING AT 1800 RPM 5, 6, 10, 15, 20, 29
- FOOT BRACKET (F)
- ROTATION R - RIGHT L - LEFT
- SINGLE SIDE OF CENTER DISPLACEMENT (S)
- SIDE PORT FLANGED CONNECTIONS ON 20 AND 29. GPM MODELS (F)
- OPTIONAL SIDE PORTS (W) (NOTE: (X) THRU SHAFT MODELS ARE NOT AVAILABLE WITH DUAL RANGE COMP. AND MAX. STOP FEATURES ON PVB 20/29 UNITS.)
- STANDARD SHAFT (Y)
- CURRENT PUMP DESIGN -20 (5 and 6)- -20 (20 and 29) -30 (10 and 15)
- ADJUSTABLE MAX. STOP (C)
- COMPENSATOR SPRING (C) 250-3000 PSI (CM) 150-1500 PSI (FOR RECOMMENDED PSI LIMITS, REFER TO INSTALLATION DWG.)
- DUAL ELECTRIC COMPENSATOR (D)
- DUAL HYDRAULIC COMPENSATOR (DH)
- CURRENT CONTROL DESIGN

To insure sustained efficiency and maximum trouble-free life of this precision equipment, initial and continuous filtration of the fluid medium to 25 microns or less is essential. (For information pertaining to Vickers economical 10 micron filters, see installation drawing I & M 229847.)

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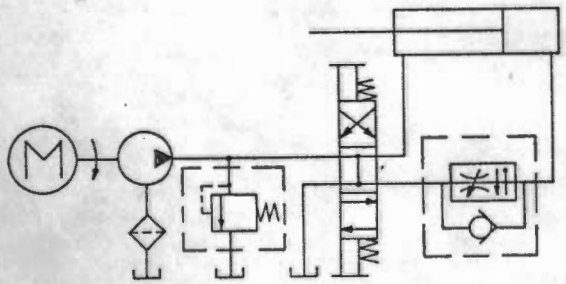
SPERRY RAND

VICKERS

TROUBLE-SHOOTING GUIDE AND MAINTENANCE HINTS



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SECTION I - INTRODUCTION

1-1. GENERAL. The trouble shooting charts and maintenance hints that follow are of a general system nature but should provide an intuitive feeling for a specific system. The more general information is covered in the immediately following paragraphs. Effect and probable cause charts appear in Section II.

1-2. SYSTEM DESIGN. There is, of course, little point in discussing the design of a system which has been operating satisfactorily for a period of time. However, a seemingly uncomplicated procedure such as relocating a system or changing a component part can cause problems. Because of this, the following points should be considered:

A. Each component in the system must be compatible with and form an integral part of the system. For example, an inadequate size filter on the inlet of a pump can cause cavitation and subsequent damage to the pump.

B. All lines must be of proper size and free of restrictive bends. Undersize or restricted line results in a pressure drop in the line itself.

C. Some components must be mounted in a specific position with respect to other components or the lines. The housing of an in-line pump, for example, must remain filled with fluid to provide lubrication.

D. The inclusion of adequate test points for pressure readings, although not essential for operation, will expedite trouble-shooting.

1-3. KNOWING THE SYSTEM. Probably the greatest aid to trouble-shooting is the confidence of knowing the system. Every component has a purpose in the system. The construction and operating characteristics of each one should be understood. For example, knowing that a solenoid controlled directional valve can be manually actuated will save considerable time in isolating a defective solenoid. Some additional practices which will increase your ability and also the useful life of the system follow:

A. Know the capabilities of the system. Each component in the system has a maximum rated speed, torque, or pressure. Loading the system beyond the specifications simply increases the possibility of failure.

B. Know the correct operating pressures. Always set and check pressures with a gauge. How else can you know if the operating pressure is above the maximum rating of the components? The question may arise as to what the correct operating pressure is. If it isn't correctly specified on the hydraulic schematic, the following rule should be applied:

The correct operating pressure is the lowest pressure which will allow adequate performance of the system function and still remain below the maximum rating of the components and machine.

Once the correct pressures have been established, note them on the hydraulic schematic for future reference.

C. Know the proper signal levels, feedback levels, and dither and gain settings in servo control systems. If they aren't specified, check them when the system is functioning correctly and mark them on the schematic for future reference.

1-4. DEVELOPING SYSTEMATIC PROCEDURES. Analyze the system and develop a logical sequence for setting valves, mechanical stops, interlocks, and electrical controls. Tracing of flow paths can often be accomplished by listening for flow in the lines or feeling them for warmth. Develop a cause and effect troubleshooting guide similar to the charts appearing in Section II. The initial time spent on such a project could save hours of system down-time.

1-5. RECOGNIZING TROUBLE INDICATIONS. The ability to recognize trouble indications in a specific system is usually acquired with experience. However, a few general trouble indications can be discussed.

A. Excessive heat means trouble. A mis-aligned coupling places an excessive load on bearings and can be readily identified by the heat generated. A warmer than normal tank return line on a relief valve indicates operation at relief valve setting. Hydraulic fluids which have a low viscosity will increase the internal leakage of components resulting in a heat rise. Cavitation and slippage in a pump will also generate heat.

B. Excessive noise means wear, mis-alignment, cavitation or air in the fluid. Contaminated fluid can cause a relief valve to stick and chatter. These noises may be the result of dirty filters, or fluid, high fluid viscosity, excessive drive speed, low reservoir level, loose intake lines, or worn couplings.

1-6. MAINTENANCE. Three simple maintenance procedures have the greatest effect on hydraulic system performance, efficiency, and life. Yet, the very simplicity of them may be the reason they are so often overlooked. What are they? Simply these:

A. Maintaining a clean sufficient quantity of hydraulic fluid of the proper type and viscosity.

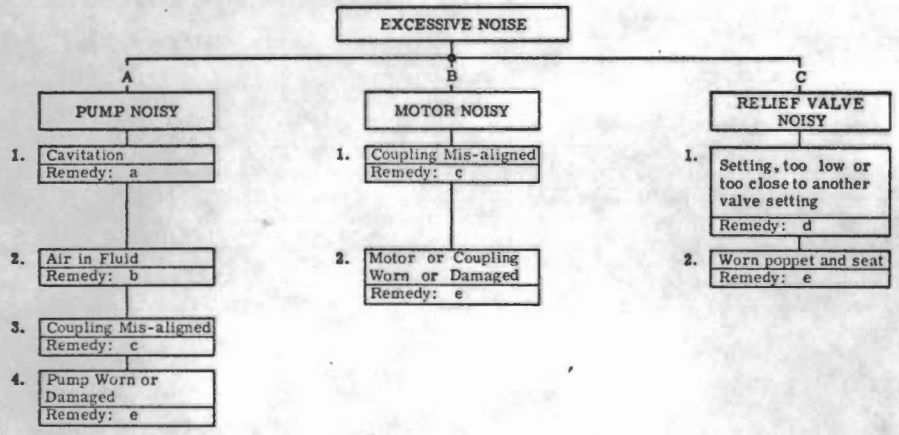
B. Changing filters and cleaning strainers.

C. Keeping all connections tight, but not to the point of distortion, so that air is excluded from the system.

SECTION II - TROUBLE-SHOOTING GUIDES

2-1. The following charts are arranged in five main categories. The heading of each one is an effect which indicates a malfunction in the system. For example; if a pump is exceptionally noisy, refer to Chart I titled EXCESSIVE NOISE. The noisy pump appears in Column A under the main heading. In Column A there are four probable causes for a noisy pump. The causes are sequenced according to the likelihood of happening or the ease of checking it. The first cause is cavitation and the remedy is "a". If the first cause does not exist, check for cause number 2, etc.

I



REMEDIES:

a. Any or all of the following: Replace dirty filters - Wash strainers in solvent compatible with system fluid - Clean clogged inlet line - Clean reservoir breather vent - Change system fluid - Change to proper pump drive motor speed - Overhaul or replace supercharge pump - Fluid may be too cold

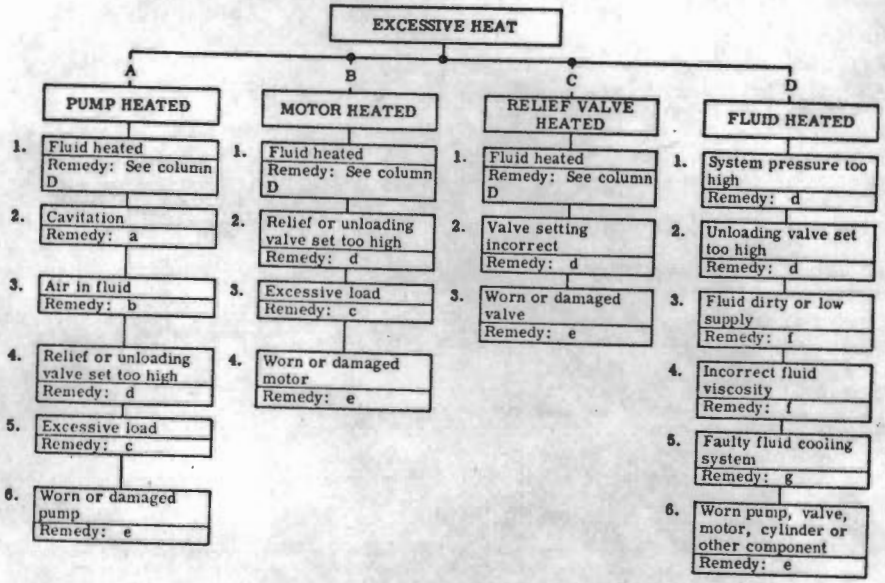
b. Any or all of the following: Tighten leaky inlet connections - Fill reservoir to proper level (with rare exception all return lines should be below fluid level in reservoir) - Bleed air from system - Replace pump shaft seal (and shaft if worn at seal journal)

c. Align unit and check condition of seals, bearings and coupling

d. Install pressure gauge and adjust to correct pressure

e. Overhaul or replace

II



REMEDIES:

a. Any or all of the following: Replace dirty filters - Clean clogged inlet line - Clean reservoir breather vent - Change system fluid - Change to proper pump drive motor speed - Overhaul or replace supercharge pump

b. Any or all of the following: Tighten leaky inlet connections - Fill reservoir to proper level (with rare exception all return lines should be below fluid level in reservoir) - Bleed air from system - Replace pump shaft seal (and shaft if worn at seal journal)

c. Align unit and check condition of seals and bearings - Locate and correct mechanical binding - Check for work load in excess of circuit design

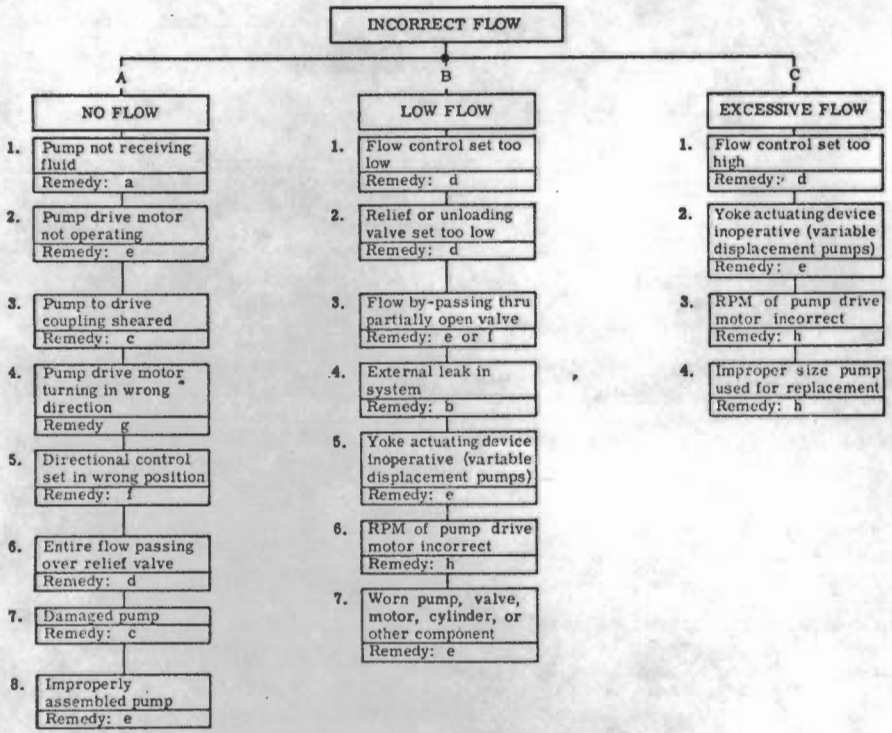
d. Install pressure gauge and adjust to correct pressure (Keep at least 125 PSI difference between valve settings)

e. Overhaul or replace

f. Change filters and also system fluid if of improper viscosity - Fill reservoir to proper level

g. Clean cooler and/or cooler strainer - Replace cooler control valve - Repair or replace cooler

III



REMEDIES:

a. Any or all of the following: Replace dirty filters - Clean clogged inlet line - Clean reservoir breather vent - Fill reservoir to proper level - Overhaul or replace supercharge pump

b. Tighten leaky connections - Bleed air from system

c. Check for damaged pump or pump drive - replace and align coupling

d. Adjust

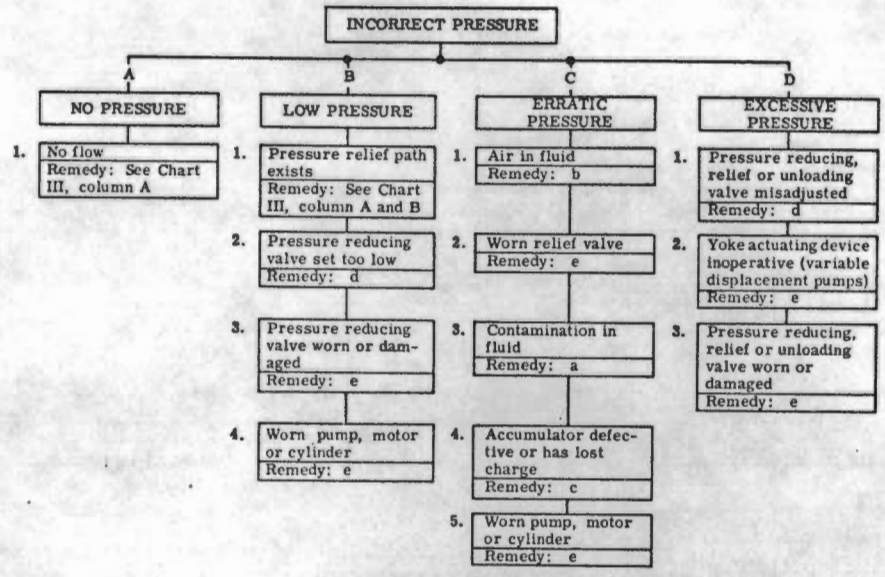
e. Overhaul or replace

f. Check position of manually operated controls - Check electrical circuit on solenoid operated controls - Repair or replace pilot pressure pump

g. Reverse rotation

h. Replace with correct unit

IV



REMEDIES:

a. Replace dirty filters and system fluid

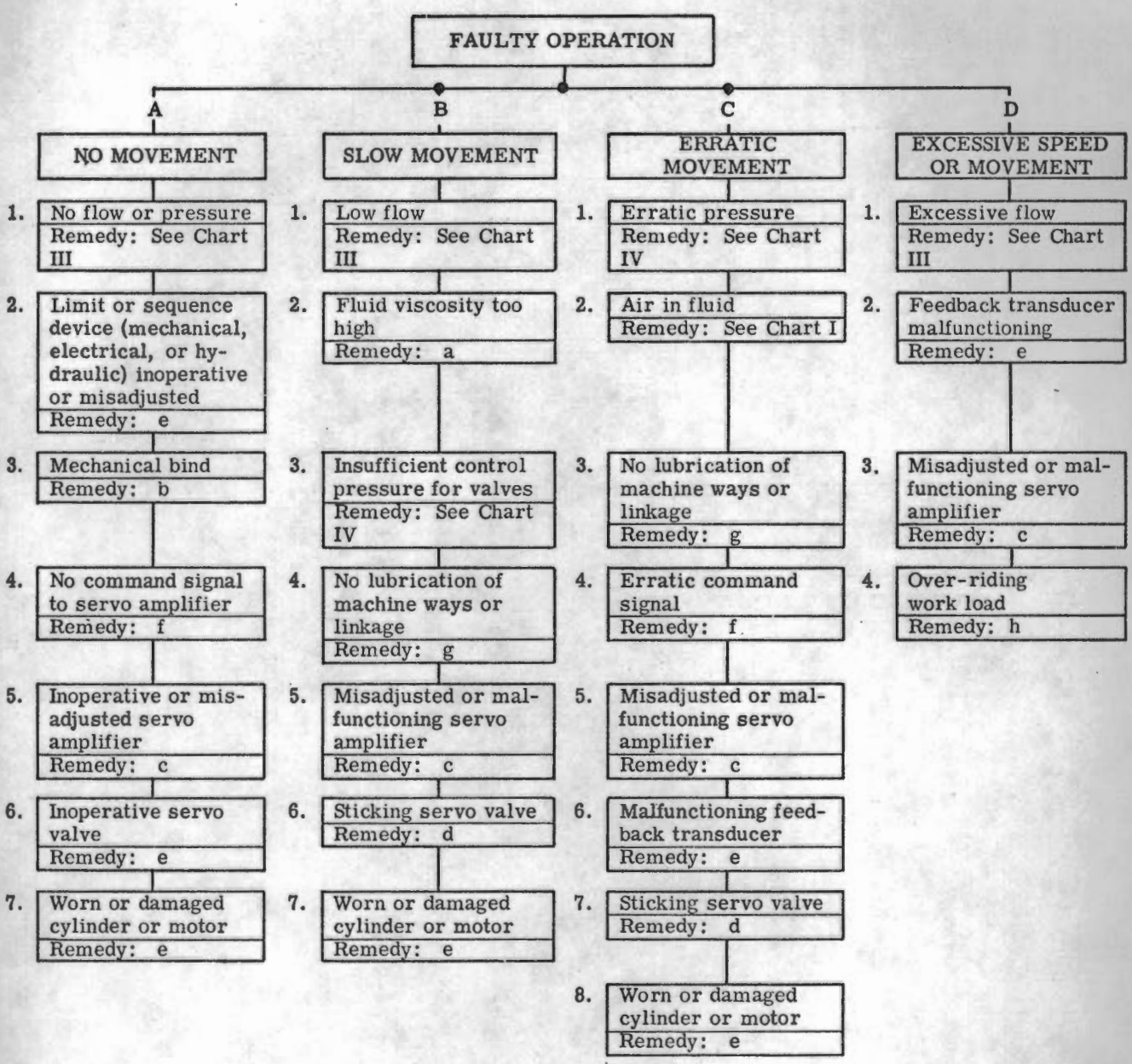
b. Tighten leaky connections (fill reservoir to proper level and bleed air from system)

c. Check gas valve for leakage - Charge to correct pressure - Overhaul if defective

d. Adjust

e. Overhaul or replace

V



REMEDIES:

a. Fluid may be too cold or should be changed to clean fluid of correct viscosity

b. Locate bind and repair

c. Adjust, repair, or replace

d. Clean and adjust or replace - Check condition of system fluid and filters

e. Overhaul or replace

f. Repair command console or interconnecting wires

g. Lubricate

h. Adjust, repair, or replace counterbalance valve.

PART LIST			
REVISION REFERENCE			
ITEM NO	DESCRIPTION	PART NO	QTY REQ'D
1	SHAFT	MC677289	1
2	KEY	22 x 106	1
3	BEARING	MA677292	1
4	RETAINING RING	56 x 327	1
5	SPACER	MB677286	1
6	O-RING	SEE CHART 'B'	1
7	RETAINING RING	56 X 241	1
8	OIL SEAL	SEE CHART B	1
9	ADAPTER (FLG'D)	MD677298	1
10	ADAPTER (SCR'D)	MD677291	1
11	COVER (FLG'D)	MC677301	1
12	COVER (SCR'D)	MC677300	1
13	HEX HD CAP SCREW	116 x 128	4
14	BALL	49 x 12	1
15	O-RING	SEE CHART B	1
16	CARTRIDGE	SEE CHART A	1

CHART A		
CARTRIDGE KITS		
CODE	TORQUE	CARTRIDGE KIT PART NO
A	10 IN-LB / 100 PSI	58CAAA
B	16 IN-LB / 100 PSI	58CBAA
E	26 IN-LB / 100 PSI	58CEAA
F	35 IN-LB / 100 PSI	58CFAA

CAM RINGS
ONLY DIFFERENCE

CHART B		
OIL SEALS		
	CODE A	CODE D
DESCRIPTION	BUNA N / NITRILE	EPM
OIL SEAL	MA677149	MA677150
O RING ITEM 6	2-20N219-7	2-20E515-8
O RING ITEM 15	2-243N219-7	2-243E515-8
REPAIR KIT SEALS & RINGS	545FIAA	545FIDA

NOTES

1 RPM
MAXIMUM ___ 3000 RPM
MINIMUM WILL VARY FROM 50 TO 100 RPM DEPENDING ON CHARACTERISTICS OF DRIVEN LOAD

2 FOR SAE FLANGE DETAILS SEE PG 266, DWG 203-C-1372 & DWG 203-C-1373

3 PORTS:
BOTH SHAFT AND HEAD END PORTS MAY BE INDIVIDUALLY ROTATED TO LEFT, RIGHT, UP OR DOWN POSITIONS

4 STARTING TORQUE
85% OF 100 RPM TORQUE

5 FILTRATION
25 MICRON RECOMMENDED

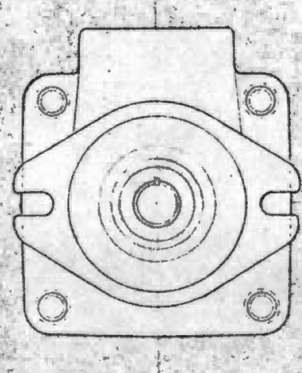
6 LOADS
OVERRUNNING: REPLENISHING INLET IS RECOMMENDED TO REDUCE BRAKING PRESSURES
FREEWHEELING: 65 PSI ON OUTLET REQUIRED

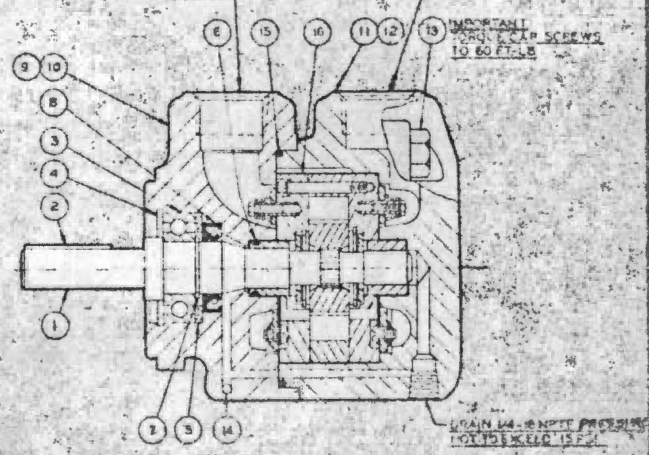
7 MAXIMUM PRESSURE ____ 2500 PSI CONTINUOUS

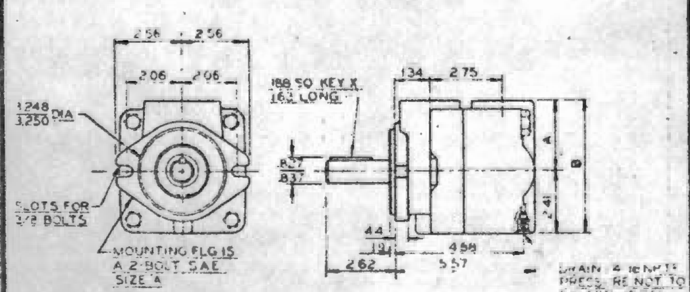
8 DRY SHIPPING WT ___ 25 LBS

ROTATION CHART		
VIEWED FROM SHAFT END		
ROTATION	PORT A	PORT B
CLOCKWISE	OUTLET	INLET
CTRCLOCKWISE	INLET	OUTLET

203-D-443

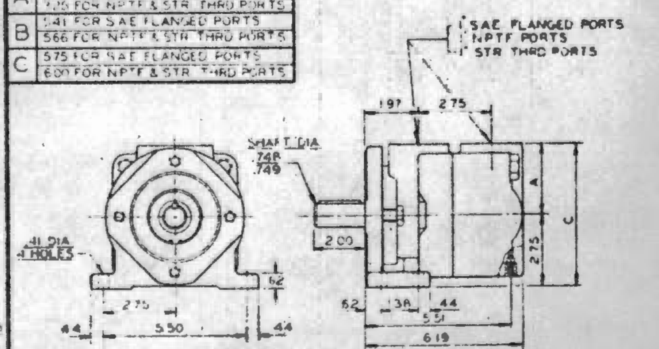






FLANGE MOUNTED MOTOR

DIMENSION	
A	300 FOR SAE FLANGED PORTS
	225 FOR NPTF & STR THRD PORTS
B	541 FOR SAE FLANGED PORTS
	566 FOR NPTF & STR THRD PORTS
C	575 FOR SAE FLANGED PORTS
	600 FOR NPTF & STR THRD PORTS



FOOT MOUNTED MOTOR

DRAWN BY MAC	DATE [illegible]	MANATROL DIVISION PARKER HANNIFIN ELYRIA, OHIO, U.S.A.	TITLE ASSY: DUAL VANE HYDRAULIC MOTOR, CONSTANT TORQUE, VARIABLE HORSEPOWER
CHECKED BY	DATE		B10 SERIES
SCALE			DRAWING NO 203-D-1443 —