Westinghouse Variable Voltage Planer Controller

INSTRUCTIONS

EQUIPMENT REQUIRED

Reversing Planer Motor
Unit Type Motor Generator Set
Magnetic Controller
Rototrol (Part of Unit Motor Generator Set)
Duplex Type Cut and Return Rheostat
Reversing Stroke Limit Switch
Slow Down Stroke Limit Switches
Pendant Pushbutton Station
Multi-conductor Cable for Pendant Station
Starter for Motor Generator Set
Safety Disconnecting Switch

DESCRIPTION OF CONTROLLER

The control panel on which are mounted all the necessary contactors, relays, etc., is enclosed in a substantial steel cabinet. The cabinet is thoroughly ventilated and is provided with a single door in the front and a removable back so that all the apparatus is accessible.

The resistors are mounted inside the cabinet at the top so that the rear of the panel is unobstructed and the heat dissipated does not affect the contactors and relays. The resistors are accessible both from the front and the rear of the cabinet.

The cabinet is open at the bottom so that it may be placed directly over the conduits passing through the floor. The connections to the panel are made to terminal boards located at the rear of the panel.

STARTING AND ADJUSTING EQUIPMENT

The wiring to all apparatus should be checked very carefully to make certain it agrees with the wiring diagram.

With the power off, the contactors, relays, and interlocks should be operated by hand to insure that they operate freely without friction and make good contact.

Should the planer operate in the reverse direction from that indicated by the marking on the pushbutton, reverse the connections to the planer motor shunt field leads marked MF1 and MF2.

The relays are adjusted carefully on the test floor before shipment and should not be changed unless it is evident the adjustment has been disturbed during shipment.

Should the relays require adjustment, open the motor armature circuit to prevent the motor from operating. Open the circuit to the coils AR, TR and FWR connected inside the reversing contactors C and R. The relays AR, TR and FWR can be energized now only by the coils connected across the generator armature. Press one of the automatic buttons and adjust the rheostat to obtain the voltages given below for adjustment. The voltages given are measured across the generator armature.

The AR relay should be adjusted to pick up at 230 volts and to drop out at 190 volts.

The FWR relay should be adjusted to pick up at 285 volts and to drop out at 220 volts.

The TR relay should be adjusted to pick up at 170 volts and to drop out at 85 volts.

It should be noted that the values given are approximate only and the operation of the planer can be further improved by adjusting the relays while observing the movement of the platen or table. The motor armature and relay coils should be reconnected.

Should the table tend to drift when the inch buttons are released, or when the stop lever is deflected, adjust relay TR to drop out at a higher voltage If the table tends to bounce back, or reverse, when the stop lever is deflected, it is an indication that the TR relay has been adjusted to drop out at too high a voltage.

Should the speed of the table seem to level off momentarily before reaching the maximum speed, adjust the field weakening relay FWR to pick up at a lower voltage. If the speed of the motor overshoots when set for maximum speed then the FWR relay is adjusted to pick up at too low a voltage. Most tachometers will overshoot so it is important not to mistake the overshoot of the tachometer for that of the motor.

Should the AR relay be adjusted to drop out at too high a voltage, it may cause severe arcing at the C and R contacts resulting in excessive maintenance. The operation of the AR relay should be checked over the entire speed range in order to make sure that it closes at all speed settings of the rheostat.

OPERATION OF THE CONTROLLER

The magnetic controller consists of two contactors marked C and R for reversing the main generator shunt fields, one control relay marked CR for selecting either automatic or inching operation, one field weakening contactor marked FW for weakening the planer motor shunt field, one field weakening relay to operate the FW contactor, one automatic relay marked AR for forcing

Westinghouse Variable Voltage Planer Controller—Continued

INSTRUCTIONS—Continued

the deceleration and acceleration at the end and beginning of each stroke, one a-c. voltage relay marked VR, and two relays marked TR and BR for connecting the main generator differential field to the main generator armature to prevent the residual voltage in the main generator from building up and causing the planer to creep.

The scheme of control as shown on Figure 1 makes use of a rototrol, which is driven at a constant speed by the a-c. motor of the unit motor generator set. This rototrol functions to maintain a constant speed on the planer motor for a given setting of the rheostat, regardless of load and other variables. The rototrol also tends to provide uniform acceleration and deceleration of the planer motor. This action, combined with the small time constant of the main generator shunt field circuit, provides a very fast equipment and insures accurate and consistent reversals of the table.

It will be noted that there are three sets of rototrol field windings, shown on Figure 1. The rototrol shunt field windings are connected in series with the main generator shunt field windings in a balanced Wheatstone bridge circuit. The shunt field windings measure the current, determined by the rheostat setting, going through the main generator shunt fields. This current is intended to cause the planer motor to run at some definite speed. The rototrol differential field windings are connected across the planer motor armature and measure the terminal voltage of the planer motor, which roughly represents speed. The terminal voltage of the planer motor, however, is the sum of the counter electromotive force (which is directly proportional to speed) and the voltage or IR drop due to the internal resistance of the armature. The voltage or IR drop varies with the load or armature current. It is, therefore, necessary to use the rototrol series fields to compensate for this voltage drop. Part of the load current is shunted around the series field windings to protect them from overheating and also as a means to adjust the speed regulation of the planer motor.

When the speed of the planer motor at no load is correct for the setting of the rheostat, the three sets of rototrol fields balance each other and the voltage across its armature is zero. Should the motor speed attempt to change, the rototrol fields become unbalanced and the rototrol generates a voltage causing current to flow through the Wheatstone bridge circuit in the direction required to hold the planer motor speed constant and in accordance with rheostat setting.

Because the main generator is separately excited, variable voltage is easily obtained by means of a rheostat in series with the main generator shunt field circuits. Part of the speed range is obtained by varying the main generator voltage and maintaining full field on the planer motor. The rest of the speed range is obtained by weakening the planer motor shunt field and maintaining full voltage on the main generator.

On power failure there is sufficient stored energy in the main motor generator set to stop the planer motor.

The apparatus is shown on Figure 1 in the de-energized position. Starting the main motor generator set in the correct direction will cause the exciter voltage to build up to approximately 230 volts. This will energize the planer motor shunt field and the coil of relay, BR. Relay contact, BR, closes, connecting the main generator differential field, GS to GS4, across the main generator armature, preventing the main generator from building up a voltage on residual magnetism, which would cause the planer motor to creep. The a-c. voltage relay coil, VR, is energized through the a-c. starter. The controller is now ready to operate.

Inching Operation

The inching operation is independent of the setting of the limit switches and rheostats.

Pressing the "Inch Cut" button energizes contactor coil C. The contacts of contactor C close, energizing the main generator shunt fields. The TR relay contacts open, de-energizing the relay coil BR. Relay contact BR opens, disconnecting the main generator differential field. The main generator builds up a voltage causing the planer motor to operate in the cut direction. The planer motor will continue to run until the "Inch Cut" button is released.

Releasing the "Inch Cut" button de-energizes relay coil C. The contacts of contactor C open, de-energizing the main generator shunt fields. The main generator voltage decreases rapidly and the planer motor comes to rest. The TR relay contacts close and energize the relay coil BR. The BR relay contact closes, connecting the main generator differential field across the main generator armature.

Pressing the "Inch Return" button causes the same sequence of operation except the R relay coil is energized instead of the C relay coil.

Automatic Operation

The initial direction of the table can be selected at the pendant station provided the table is between the limits of travel.

Pressing the "Auto-Cut" button energizes the control relay coil CR. The CR contacts on closing energizes the coil of contactor C. The contacts of contactor C close, energizing the main generator shunt fields. The TR relay contacts open immediately, de-energizing the relay coil BR. Relay contact BR opens, disconnecting the main generator differential

Westinghouse Variable Voltage Planer Controller—Continued

INSTRUCTIONS—Continued

field. The main generator voltage builds up to a value determined by the setting of the generator rheostat and the planer motor accelerates smoothly and rapidly with the main generator voltage. When the main generator voltage reaches approximately 200 volts, the planer motor field weakening contactor FW opens, inserting the motor rheostat in series with the planer motor field, causing the planer motor to accelerate to the speed determined by the rheostat setting. The planer motor runs in the cut direction at the speed set by the cut rheostat.

Near the end of the cut stroke, the cut slow-down limit switch is operated by the dog on the table. The field weakening contactor coil FW, is de-energized and the contacts of FW close, shorting out the planer motor field rheostat. The planer motor shunt field builds up to full field strength, and the motor slows down to the full field speed. The same dog now operates the cut stroke limit switch. The relay coil C is de-energized and the relay coil, R, is energized. The C relay contacts open and the R relay contacts close, reversing the voltage on the main generator shunt fields and causing the main generator voltage to decline rapidly, pass through zero, and build up in the opposite direction. The planer motor follows the main generator voltage and is quickly decelerated, reversed, and accelerated in the return direction. The planer motor runs in the return direction at the speed set by the return rheostat.

At the end of the return stroke, the return slowdown and stroke limit switches are operated by the dog on the table. The planer motor is thus decelerated, reversed, and accelerated in the cut direction in the same manner as at the end of the cut stroke. This automatic reversing sequence continues until either the stop lever or the "Inch" buttons are operated.

The AR relay contact is held closed by the holding coil until the main generator voltage drops to approximately 190 volts. The AR relay contact on opening changes the resistance value of the bridge circuit forcing the main generator shunt fields at the end and beginning of each stroke.

Automatic operation can be started initially in the return direction by pressing the "Return" button.

Deflecting the pendant station stop lever will immediately de-energize the control relay coil CR and relay coil C (or R). The C (or R) relay contacts on opening de-energize the main generator shunt fields. The main generator voltage declines rapidly and the planer motor is brought to rest. Relay TR is adjusted to drop out at approximately 85 volts to energize relay BR. The BR relay contact closes connecting the main generator differential field across the main generator armature. This prevents the main generator from building up a residual voltage which would cause the planer motor to creep.

INSPECTION AND MAINTENANCE

Inspection should be made at relatively frequent intervals as often as feasible on the basis of the amount the equipment is used.

Inspection should consist of the examination of all working parts. The apparatus should be cleaned and all badly worn parts replaced.

Remove all dust and other foreign matter from the controller, limit switches, pendant station, and rheostat.

Inspect all contactors, relays, and interlocks to make sure they operate freely and without friction.

All bolts and screws in the main and control wiring must always be tightly drawn. A complete check should be made occasionally.

Inspect the arc horns, arc boxes, contacts and shunts.

Contacts and arc boxes which are badly burned should be cleaned or replaced. The contacts may be cleaned with a cloth moistened in gasoline.

Contacts should not be filed merely to brighten a dull surface, but should be filed only when they are badly burned or pitted. If filing is necessary, care should be taken to see that the contacts are properly aligned after the filing is completed.

The contacts should never be greased.

Special attention should be given to the reversing and slow-down limit switches to keep them free from oil and metal dust.

Westinghouse Variable Voltage Planer Controller—Continued

INSTRUCTIONS—Continued

ELEMENTARY CONTROLLER DIAGRAM

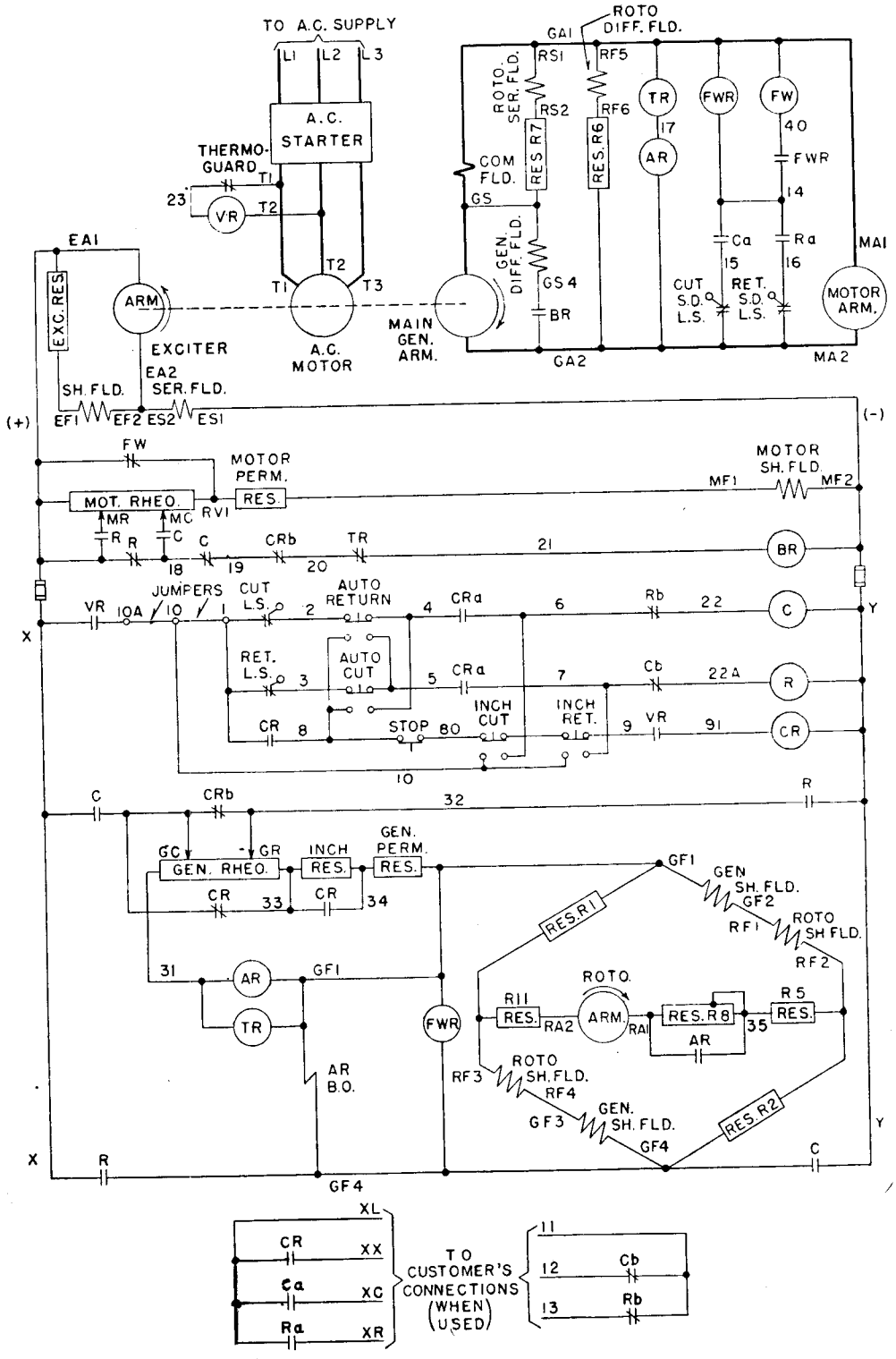


FIG. 1—ELEMENTARY DIAGRAM

Westinghouse Variable Voltage Planer Controller—Continued

RESISTOR TABLE

H.P.	Cycles	R1	R2	R6	R7	R5 + R11	R8	Gen. Rheo.	Inch	Gen. Perm.	Motor Rheo.	Motor Perm.	Exciter Field
15	60	40	40	365	0.94	3.4	120	3050	200	17	65	25.5	
20	60	40	40	365	0.94	3.4	120	3050	200	17	65	25.5	
25	60	40	40	365	0.94	3.4	120	3050	200	17	65	25.5	
35	60	30	30	275	1.2	11.5	120	1650	150	12	45	19.5	
50	60	22	22	585	1.1	5.0	120	1800	150	14	36	15.7	See
75	60	18.3	18.3	510	1.15	11.0	20	1375	100	12.8	56	14.6	
15	50	40	40	280	0.7	0.0	120	2300	150	5.5	70	25.5	Note
20	50	40	40	280	0.7	0.0	120	2300	150	5.5	70	25.5	
25	50	40	40	280	0.7	0.0	120	2300	150	5.5	70	25.5	No. 8
35	50	30	30	200	1.0	3.9	120	1200	126	3.5	60	19.5	
50	50	22	22	465	0.8	0.0	120	1500	126	12.0	55	15.7	
75	50	18.3	18.3	400	1.0	3.2	31	750	100	14.0	78	14.6	

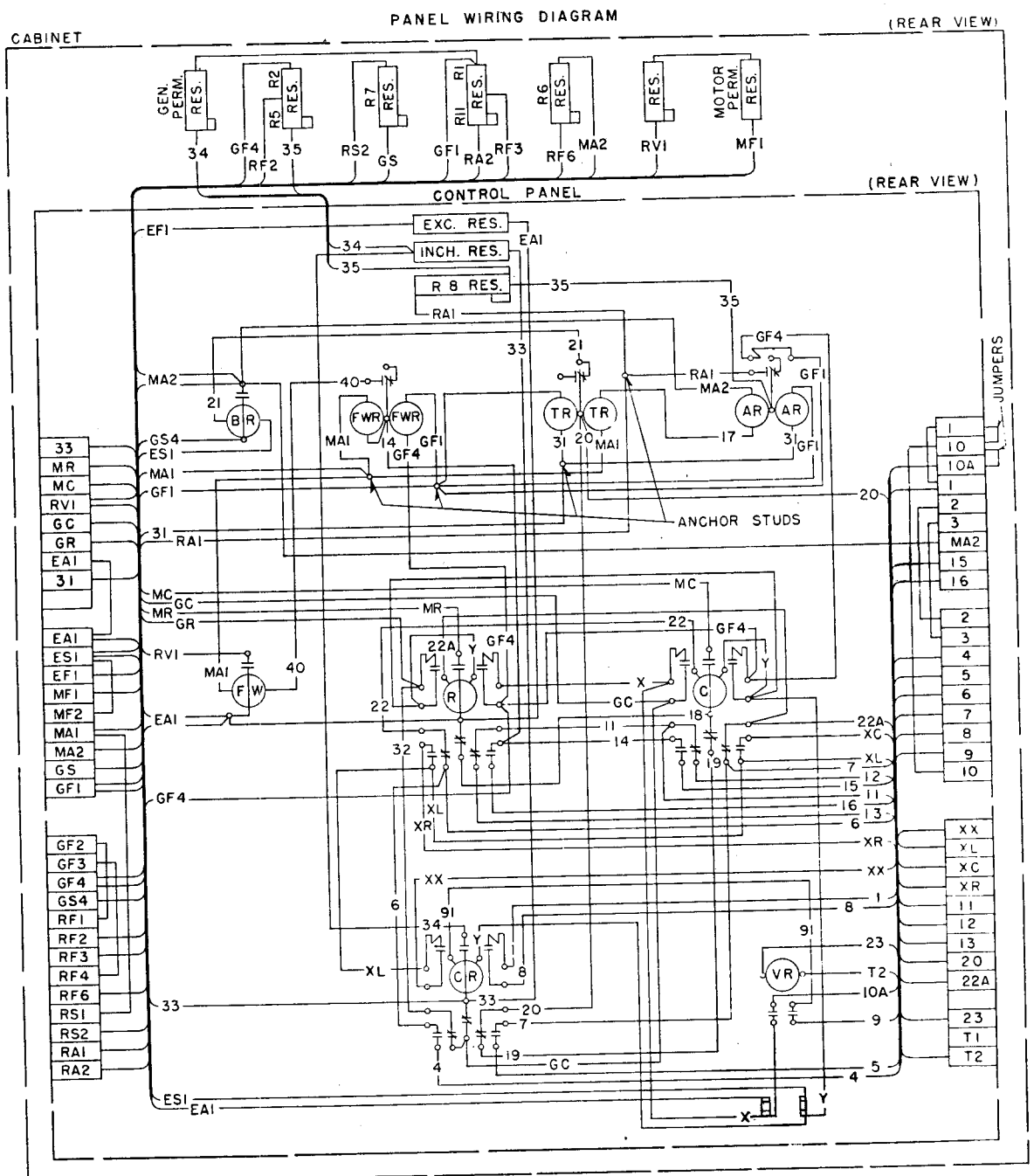
SEQUENCE TABLE

Contactors or Relays	Off	INCH		AUTOMATIC OPERATION							
				CUT				RETURN			
		Cut	Return	Start Stroke	Generator Builds Up To Approx. 190 Volts	Hit Slow Down L.S.	Hit Stroke L.S.	Start Stroke	Generator Builds Up To Approx. 190 Volts	Hit Slow Down L.S.	Hit Stroke L.S.
C		△		△	△	△					
R			△					△	△	△	
CR				△	△	△	△	△	△	△	△
AR		△	△	△	△	△	△	△	△	△	△
TR	●						●				●
BR	△										
FWR	●	●	●	●		●	●	●		●	●
FW	●	●	●	●		●	●	●		●	●
VR	△	△	△	△	△	△	△	△	△	△	△

● Indicates Spring Closed.
△ Indicates Magnet Closed.

FIG. 2—RESISTOR AND SEQUENCE TABLE

Westinghouse Variable Voltage Planer Controller—Continued



NOTE NO. 1: PLAN VIEW OF LIMIT SWITCHES WHERE MOUNTED ON THE RIGHT SIDE OF BED PLATE FACING THE FRONT OF THE PLANER. DIMENSION "A" EQUALS 120 INCHES DIVIDED BY THE NUMBER OF MOTOR REVOLUTIONS PER FOOT OF TABLE TRAVEL.

NOTE NO 2: LEADS MARKED WITH "△" SHOULD NOT BE SMALLER THAN NO. 6 WIRE OR EQUIVALENT CABLE RESISTOR CONNECTIONS ARE NO 10 WIRE.

NOTE NO. 3: THE FWR, TR & AR COILS SHOULD BE CONNECTED TO ADD.

NOTE NO. 5: ◯ THE ARROW INDICATES THE DIRECTION OF ROTATION OF THE ARMATURE WHEN LOOKING AT THE COMMUTATOR END OF THE MACHINE

NOTE NO. 6: CONNECT ONLY THE WIRES SHOWN IN CONDUITS TO TERMINAL BLOCKS.

NOTE NO. 7: LIMIT SWITCHES ARE IN POSITION SHOWN WHEN THE LIMIT SWITCHES ARE MIDWAY BETWEEN THE DOGS.

NOTE NO. 8: ADJUST EXCITER RESISTOR TO GIVE 250 V. NO LOAD, COLD ON EXCITER ARMATURE

FIG. 3—PANEL WIRING DIAGRAM

Westinghouse Variable Voltage Planer Controller—Continued

EXTERNAL CONNECTION DIAGRAM

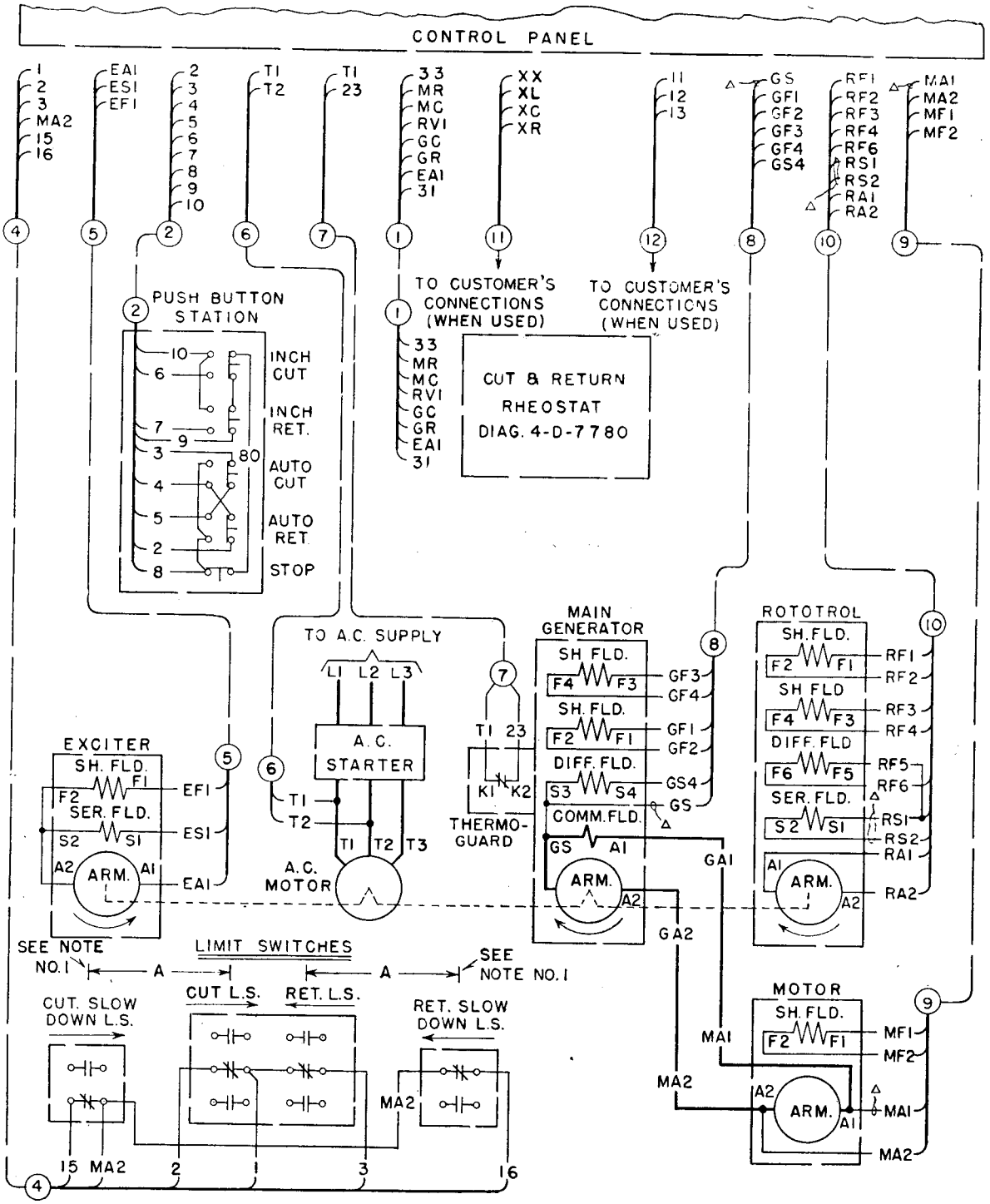
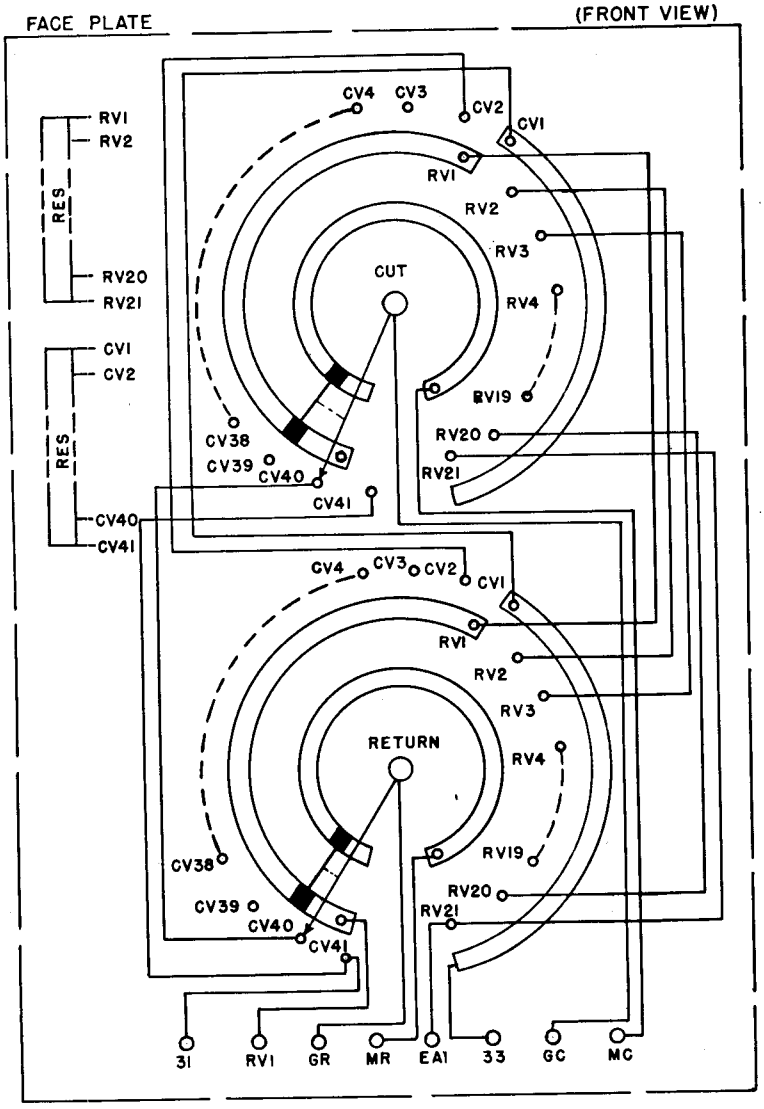


FIG. 4—EXTERNAL CONNECTION DIAGRAM

Westinghouse Variable Voltage Planer Controller—Continued



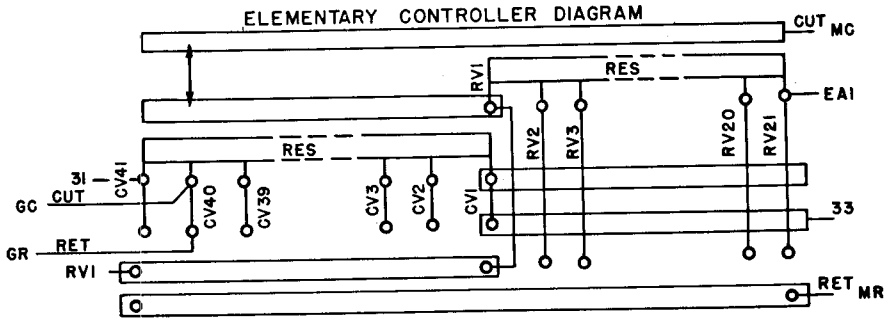


FIG. 5—RHEOSTAT DIAGRAM

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INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

ADJUSTABLE VOLTAGE PLANER CONTROLLER

This instruction leaflet covers the electrical equipment used to drive a metal-working planer.

The control consists of the following apparatus:

1. Controller (in floor-mounted enclosure)
2. Reversing Limit Switch
3. Pendant Pushbutton Station
4. Dual Type Rheostat
5. Motor-Generator Set Starter
6. Planer Drive Motor
7. Motor-Generator Set

These instructions apply only to the style numbers given in Table No. 1.

TABLE NO. 1
Style Numbers and Drawing References

Controller, 220/440 Volts, 50/60 Cycles, 40 to 1200 RPM					
CONTROLLER STYLE NO.	HP	PANEL DWG.	DIAGRAM	RES. DWG.	O.L. DWG.
1622 571	15	23B7698	36A3585	22D8059	24D2242
1622 572	20	23B7698	36A3585	22D8059	24D2242
1622 573	25	23B7698	36A3585	22D8059	24D2242
1622 574	35	23B7698	36A3585	22D8060	24D2242
1622 575	50	23B7698	36A3585	22D8061	24D2242
1622 576	75	23B7698	36A3585	22D8062	24D2242
RHEOSTAT STYLE NO.	**HP**		**DIAGRAM**	**RES. DWG.**	**O.L. DWG.**
1620 366	15, 20, 25	.....	24D1888	15C4732	3D1144
1620 367	35	.....	24D1888	15C4733	3D1144
1620 368	50	.....	24D1888	15C4734	3D1144
1620 369	75	.....	24D1888	15C4735	3D1144
Style No. 707 924, Type D, 5-Button Pendant Pushbutton Station					
Style No. 1228 658, Type S-26, Reversing Limit Switch					

MACHINE IDENTIFICATION AND REFERENCE DATA

In order to have a record of each machine it is suggested that the purchaser check all nameplate readings and make an office record of them. The calculated field data is listed herein for the adjustable speed shunt machines. It may be necessary to refer to these values for field current and speed calculations. It must be remembered that this is calculated data, and test data may vary from this slightly.

TABLE NO. 2

3-Kw Exciter, Fr. 43-SK, 230 V., 13 A., L-451805					
				AMPERES	
CIRCUIT	TERM.	RES. 75°C	TURNS/ COIL	1450 RPM	1750 RPM
Sh. Fld.	F1-F2	385	3900	.63	.63
Sh. Fld.	F3-F4	385	3900	.44	.25
Ser. Fld.	S1-S2	.071	25	..	..
Comm. Fld.	....	.120	55	..	..
Arm.	....	.306	105 X 3	..	..

1750 RPM		1450 RPM	
AT/PR POLES	NO LOAD VOLTS	AT/PR POLES	NO LOAD VOLTS
1900	160	1975	140
2450	200	2700	180
2950	230	3350	210
3550	260	3900	230
4250	290	4550	250
5250	320	5450	270

TABLE NO. 3

5-Kw Exciter, Fr. 53 SK, L-453143					
				AMPERES	
CIRCUIT	TERM.	RES. 75°C	TURNS/ COIL	1450 RPM	1750 RPM
Sh. Fld.	F1-F2	419	4500	.55	.55
Sh. Fld.	F3-F4	419	4500	.39	.195
Ser. Fld.	S1-S2	.02	....	..	..
Arm.	....	.26	....	..	..
Comm. Fld.	....	.08	....	..	..

TABLE NO. 4

Rototrol, Fr. 254-E, L-455276			
CIRCUIT	TERM. MARKING	RES. 75°C	TURNS/COIL
Pattern Fld.	AF1-AF2	227.5	1380
Pattern Fld.	BF1-BF2	227.5	1380
Voltage Fld.	F3-F4	12.56	700*
A. H. Fld.	F7-F8	31.6	408
Comm. Fld.	.....	2.07	195
Arm.	.....	10.2	125 X 10

*Fields Connected in Parallel

AT/PR POLES		NO LOAD VOLTS	
25 & 75 HP SET	35 & 50 HP SET	1750 RPM	1450 RPM
750	920	250	207
1075	1275	350	290
1400	1700	450	373
1825	2175	550	456
2400	2825	650	538
M.B. = 5.84375	M.B.= 5.875		

TABLE NO. 5

25-Hp Motor, Fr. 91.5-SK, L-372436				
CIRCUIT	TERM.	RES. 75°C	TURNS/COIL	AMP.
Sh. Fld.	F1-F2	14	545	7.45
Comm. Fld.	....	.0237	22	...
Arm.	....	.0649	147 X 1	...
25-Kw. Generator, Fr. 113-7.5, L-515514				
CIRCUIT	TERM.	RES. 75°C	TURNS/COIL	AMP.
Sh. Fld.	F1-F2	12.4	550	...
Diff. Fld.	S3-S4	.54	48	...
Comm. Fld.	....	.0134	22	...
Arm.	....	.035	137 X 1	...

1750 RPM		1450 RPM	
AT/PR POLES	NO LOAD VOLTS	AT/PR POLES	NO LOAD VOLTS
2375	150	2900	150
3250	200	3950	200
4200	250	5250	250
5250	300	6950	300
6600	350	8250	325
8550	400	11900	375

TABLE NO. 6

35-Hp. Motor, Fr. 111.6-SK, L-498490				
CIRCUIT	TERM.	RES. 75°C	TURNS/COIL	AMP.
Sh. Fld.	F1-F2	21.45	725	7.0
Comm. Fld.	....	.0147	19	...
Arm.	....	.0446	123 X 1	...
35-Kw Generator, Fr. 123-7.5, L-498489				
CIRCUIT	TERM.	RES. 75°C	TURNS/COIL	AMP.
Sh. Fld.	F1-F2	16.2	700	...
Diff. Fld.	S3-S4	.613	45	...
Comm. Fld.	....	.008	21	...
Arm.	....	.0235	123 X 1	...

1750 RPM		1450 RPM	
AT/PR POLES	NO LOAD VOLTS	AT/PR POLES	NO LOAD VOLTS
3550	200	2900	140
4525	260	4325	200
5700	300	6050	260
6550	330	7700	300
7250	350	....	...
8100	376	9600	330
9650	400	....	...
11900	430	11250	350

TABLE NO. 7

50-Hp. Motor, Fr. 121.4-SK, L-381135				
CIRCUIT	TERM.	RES. 75°C	TURNS/COIL	AMP.
Sh. Fld.	F1-F2	11.2	554	9.0
Comm. Fld.	....	.0071	13	...
Arm.	....	.025	...	...
50-Kw Generator, Fr. 123.10-SK, L-381300				
CIRCUIT	TERM.	RES. 75°C	TURNS/COIL	AMP.
Sh. Fld.	F1-F2	11.9	1308	...
Diff. Fld.	S3-S4	.853	48	...
Comm. Fld.	....	.0038	12	...
Arm.	....	.016	162 X 1	...

1750 RPM		1450 RPM	
AT/PR POLES	NO LOAD VOLTS	AT/PR POLES	NO LOAD VOLTS
2675	150	2150	100
3650	200	3300	150
4700	250	4600	200
6025	300	6250	250
8000	350	9000	300
11450	400	11350	325

TABLE NO. 8

75-Hp Motor, Fr. 133.22-SK, L-501872				
CIRCUIT	TERM.	RES. 75°C	TURNS/COIL	AMP.
Sh. Fld.	F1-F2	13.9	571 + 1	...
Comm. Fld.	....	.007	13	...
Arm.	....	.0261	162 X 1	...
75-Kw Generator, Fr. 143.9-SK, L-515981				
CIRCUIT	TERM.	RES. 75°C	TURNS/COIL	AMP.
Sh. Fld.	F1-F2	107	598	...
Diff. Fld.	S3-S4	.542	60	...
Comm. Fld.	....	.0041	13	...
Arm.	....	.011	162 X 1	...

1750 RPM		1450 RPM	
AT/PR POLES	NO LOAD VOLTS	AT/PR POLES	NO LOAD VOLTS
3100	200	3100	166
4000	250	4000	207
5000	300	5000	249
6200	350	6200	290
8200	400	8200	332
9400	420	9400	350
11900	450	11940	373

SAFETY FOR PERSONNEL

To insure maximum safety for personnel, it is suggested that recommendations of the National Electric Code, National Safety Code, and all applicable local safety regulations be fully conformed with in the installation and operation of this equipment. The following precautions will also be helpful, if carefully observed, in insuring safety for personnel.

1. *Make* certain the apparatus is properly connected before any attempt is made to operate the equipment.

2. *Do Not* operate the equipment without first completing individual tests and adjustments noted elsewhere in these instructions.

3. *Never* operate contactors or relays by hand unless all power is completely disconnected.

POWER AND CONTROL CONNECTIONS

Power connections should be installed in accordance with such code regulations as apply, and as shown on wiring diagram furnished with the controller.

All control and auxiliary power connections shown on diagrams should be completed. In general, all control connections should be no smaller than No. 12 wire.

FIELD TESTS

Mechanical Conditions

1. Open all manually-operated switches.

2. Check all contactors, relays and rheostats for any binding action by moving them by hand. M-G sets must not be running. Observe whether relays or instruments have any blocking.

3. Check M-G sets for mechanical operation by turning them by hand. Watch for any foreign matter or binding action. Observe lubrication; see that oil rings are free to turn.

4. Inspect control panel for any tools or bars that may be across bus bars or terminal studs.

5. Check operation of ventilating equipment.

M-G Set Rotation. Check all sets to see that rotation agrees with outline drawings or interconnection diagrams.

Polarities

1. *Field Polarities.* The polarity of the various fields should be correct when the control equipment leaves the factory and all connections correct when they agree with the latest subs of the diagrams. The resistors have been set to calculated values and may require some field adjustments. All armature and field polarities should be checked.

2. *Test of Field Polarity.* Tag the leads to the terminal block before opening any circuits, then open one side of each field circuit and start the motor-generator set. Test the Rototrol fields for proper polarity with a 6-volt battery. The polarities should agree with the following rule.

The fields are marked so that for clockwise rotation (facing the commutator end) A2 terminal is positive with plus excitation connected to the odd numbered terminal of any one field. For counterclockwise rotation, A2 terminal is negative with plus excitation connected to the odd numbered terminal of any one field.

Rototrol. The Rototrol has four sets of field windings, two pattern fields, one voltage field and one anti-hunt field. The cut direction pattern field is marked RAF1-RAF2; the return direction pattern field is marked RBF1-RBF2; the voltage field is marked RF3-RF4; and the anti-hunt field is marked RF7-RF8. The Rototrol does not have a self-exciting field. The pattern fields provide the Rototrol excitation ampere-turns. The voltage field is connected in a bridge circuit to measure the c e m f, or speed, of the motor.

The planer motor speed is adjusted by changing the rheostat resistance in series with the pattern and voltage fields of the Rototrol. The motor shunt field is weakened in one step. At minimum operating speed, the full rheostat resistance is in series with the pattern field and all out in the voltage field. The motor speed is increased by first shorting out the rheostat resistance in series with the pattern field and then by inserting resistance in series with the voltage field until the motor full field speed is reached. At this point on the rheostat, an interlock operates causing the FR and FW relays to operate to weaken the motor shunt field and reinsert rheostat resistance in series with the pattern field. This recalibrates the Rototrol so that the motor speed is approximately the same immediately before and after the rheostat interlock operates. The motor speed is further increased to maximum speed by shorting out the rheostat resistance reinserted in series with the pattern field.

Resistor Adjustments. The resistors are adjusted to the values listed in the resistor table. (See Table No. 9). These adjustments were selected after combination tests on several drives to determine the average settings to provide the best operation under normal operating conditions allowing for variations in commercial machines. If necessary, the resistors may be adjusted in the field to provide the correct machine voltages and speeds as follows:

The exciter voltage should be adjusted to 260 volts cold. It should be checked after the exciter has been running and readjusted to 230 volts no load. The no load voltage should not be less than 230 volts.

The Rototrol pattern field permanent resistor RP may be adjusted to obtain the maximum generator voltage as shown on the generator nameplate. When making this adjustment, the rheostat should be in the full clockwise, or high speed, position.

The planer drive motor maximum speed, 1200 rpm, is obtained by adjusting the motor field weakening resistor MF. Before making this adjustment, be sure the maximum generator voltage is correct.

The inching speed is set at approximately 200 rpm. This setting may be changed by adjusting resistor IN.

TABLE NO. 9
Resistor Settings

RES.	STYLE NO.	MARKING	OMS 15-20-25 HP	OMS 35 HP	OMS 50 HP	OMS 75 HP
AH	828 058	RF7-24	0	0	48	0
		RF7-23	149	222	86	156
		23-22	128	122	183	87
E-1	1460 358	FF3-26	595	595	595	710
		26-27	290	290	290	327
IN	1038 104	32-33	923	505	605	405
M	1038 099	RA1-GF2	Total	Total	Total	Total
RC	1460 538	36-39	1047	1295	731	970
RP	874 977	33-34	116	45	25	66
		34-N	22	93	87	37
SL	.....	36-32	Total	2350	Total	Total
MF	.....	EA1-30	3.3	1.55	5	8
		30-31	44.4	31.67	42.2	35
MP	.....	31-MF1	16	13.75	15.2	9.1
R1	.....	GA2-FR4	75	62.5	66	63.5
R2	.....	RF4-GS	13	28.65	23	23

The minimum cut and return operating speeds are determined by the resistance in the pattern field rheostat. The minimum operating speed can be changed only by adjusting resistor taps on the rheostat.

The recalibrating speed for 60-cycle operation can be adjusted only by adjusting the resistor taps between tap TC and 36 on the pattern field rheostat. The recalibrating speed for 50-cycle operation can be adjusted by changing the slider on resistor RC.

It should be noted that the operating speeds, currents and voltages listed in the tables under test data, will vary for different machines due to commercial tolerances permitted in manufacturing and also due to temperature changes in the machines.

Relay Settings. Relay FR is adjusted to pick up at 225 to 250 volts on the generator. The coil wired 3-11 is connected to add with the coil wired GA2-40 in the cut direction. Coils wired 6-12 and GA2-40 are connected to add in the return direction. The relay must drop out whenever either coil being used is open circuited.

If the platen accelerates, levels off and then re-accelerates, when the rheostat is set for maximum speed, it is an indication that the FR relay is adjusted to pick up at too high a voltage. Readjust the FR relay to pick up at a lower voltage so that the platen accelerates continuously to the speed set by the rheostat.

Relay CR is adjusted to pick up on the coil in the exciter circuit, 3 to N, alone in the cut direction and 6 to N in the return direction. The relay is adjusted to be held in by the coil, GA2 to P, until the generator voltage drops to approximately 100 volts with the coils, 3 to N and 6 to N, de-energized.

OPERATION OF CONTROL

Starting the M-G set causes the exciter voltage to build up and the blower motor to start. After the exciter voltage builds up, relay DF should pick up connecting the generator differential field GS3-GS4 across the generator armature to kill the generator residual voltage to prevent the motor from creeping. The control equipment is now ready to operate. (See wiring diagram, Fig. 1).

Pressing the Auto-Cut button picks up relays C, CR, AR, SD and M. Relay CR drops out relay DF and AR seals itself in the closed position. Relay C excites the Rototrol cut pattern field through the rheostat and pattern field resistor RP. Relay M con-

TABLE NO. 10

Test Data, 15-20-25 Hp, No Load

MOTOR RPM	MOTOR Arm. Amps.	MOTOR Fld. Amps.	GENERATOR Arm. Volts	GENERATOR Fld. Amps.	EXC. Volts	ROTOTROL Pat. Fld.	ROTOTROL Vol. Fld.	ROTOTROL A. H. Fld.	ROTOTROL Arm. Volts
60 CYCLES									
1265	4.5	3.2	390	7.10	236	.645	1.46	.449	82.0
885	5.7	8.0	380	6.80	234	.630	1.41	.431	80.0
262	3.0	7.6	114	1.48	228	.241	.75	.098	17.0
110	2.7	7.8	47.5	.56	230	.097	.30	.035	6.5
50	1.5	8.3	22.5	.23	243	.044	.15	.015	2.5
50 CYCLES									
1172	4.5	2.95	345	8.0	233	.660	1.30	.325	101
825	4.5	7.7	350	8.4	233	.672	1.32	.329	102
263	3.0	7.75	115	1.83	234	.254	.75	.07	21
107	3.0	7.9	41	.70	238	.10	.30	.025	8
52	1.5	8.0	22.5	.31	239	.043	.15	.011	4

TABLE NO. 11

Test Data, 35 Hp, No Load

MOTOR RPM	MOTOR Arm. Amps.	MOTOR Fld. Amps.	GENERATOR Arm. Volts	GENERATOR Fld. Amps.	EXC. Volts	ROTOTROL Pat. Fld.	ROTOTROL Vol. Fld.	ROTOTROL A. H. Fld.	ROTOTROL Arm. Volts
60 CYCLES									
1173	6.6	3.55	350	5.25	228	.630	1.43	.308	78.5
790	6.6	6.80	349	5.20	230	.641	1.50	.300	77.0
250	5.0	6.80	114	1.40	230	.376	1.17	.075	19.1
104	4.5	6.80	46	.56	231	.152	.47	.030	7.6
55	4.5	6.95	25.5	.30	232.5	.080	.26	.020	4.5
50 CYCLES									
1200	6.6	3.45	352	8.1	230.5	.830	1.45	.340	130
810	7.5	6.80	356	8.4	230.5	.852	1.54	.340	130
245	5.0	6.80	110	1.54	232	.370	1.14	.060	22
114	4.5	6.80	50	.72	232	.170	.53	.029	10
55	2.5	6.90	25	.34	234	.080	.26	.011	5

TABLE NO. 12

Test Data, 50 Hp, No Load									
60 CYCLES									
	MOTOR		GENERATOR		EXC.	ROTOTROL			
RPM	Arm. Amps.	Fld. Amps.	Arm. Volts	Fld. Amps.	Volts	Pat. Fld.	Vol. Fld.	A. H. Fld.	Arm. Volts
1230	12	3.4	355	6.00	234	.770	1.80	.521	62.0
825	14	9.0	360	6.20	235	.780	1.85	.540	64.0
255	9	8.8	112	1.30	233	.334	1.05	.119	15.5
111	7	8.9	49	.56	234	.141	.45	.049	6.0
57	7	9.0	25	.28	234	.070	.25	.023	3.0
50 CYCLES									
1235	13	3.25	342	9.70	238	.920	1.75	.352	108.0
780	14	9.00	341	9.60	238	.913	1.75	.340	106.0
255	12	9.10	113	1.60	240	.332	1.05	.052	16.0
117	9	9.20	51	.76	240	.152	.47	.025	7.5
54	7	9.20	24	.34	240	.070	.22	.011	3.5

TABLE NO. 13

Test Data, 75 Hp, No Load									
60 CYCLES									
	MOTOR		GENERATOR		EXC.	ROTOTROL			
RPM	Arm. Amps.	Fld. Amps.	Arm. Volts	Fld. Amps.	Volts	Pat. Fld.	Vol. Fld.	A. H. Fld.	Arm. Volts
1225	12	4.0	406	6.80	238	.740	1.95	.340	64.0
768	12	9.8	410	7.00	238	.750	1.98	.345	65.0
253	8	9.6	136	1.62	236	.392	1.30	.080	15.0
110	5	9.6	60	.72	236	.172	.58	.035	7.0
53	4	9.7	28	.34	237	.080	.27	.020	3.5
50 CYCLES									
1235	12	3.5	365	8.20	235	.777	1.75	.291	81.8
697	11	9.8	373	8.80	236	.800	1.78	.309	85.5
263	8	9.4	141	2.00	234	.409	1.33	.070	19.0
111	5	9.6	60	.86	236	.175	.57	.030	8.0
52	5	9.7	28	.40	237	.080	.26	.015	4.0

nects the generator shunt field to the Rototrol armature. The Rototrol voltage builds up exciting the generator shunt field causing the generator voltage to build up and the motor accelerates in the cut direction. If the rheostat is set for some speed above the motor full field speed, the FR relay will pick up dropping out the FW relay at a set generator voltage and weaken the motor shunt field. The motor continues to accelerate until it reaches the speed selected by the rheostat.

The motor continues to run in the cut direction until the cut limit switch operates. The cut limit switch drops out relays C and FR and picks up relay R. Relay FR picks up relay FW applying full field to the motor. The Rototrol cut pattern field is de-energized and the return field excited. Relay CR drops out since the two coils now energized are bucking each other. Relay CR picks up as the generator voltage approaches zero. The return pattern field forces the Rototrol voltage down and in the return direction which forces the generator voltage down and in the return direction. The motor regeneratively brakes to zero speed and accelerates in the return direction to the speed selected by the rheostat. Relays FR and FW operate as in the cut direction.

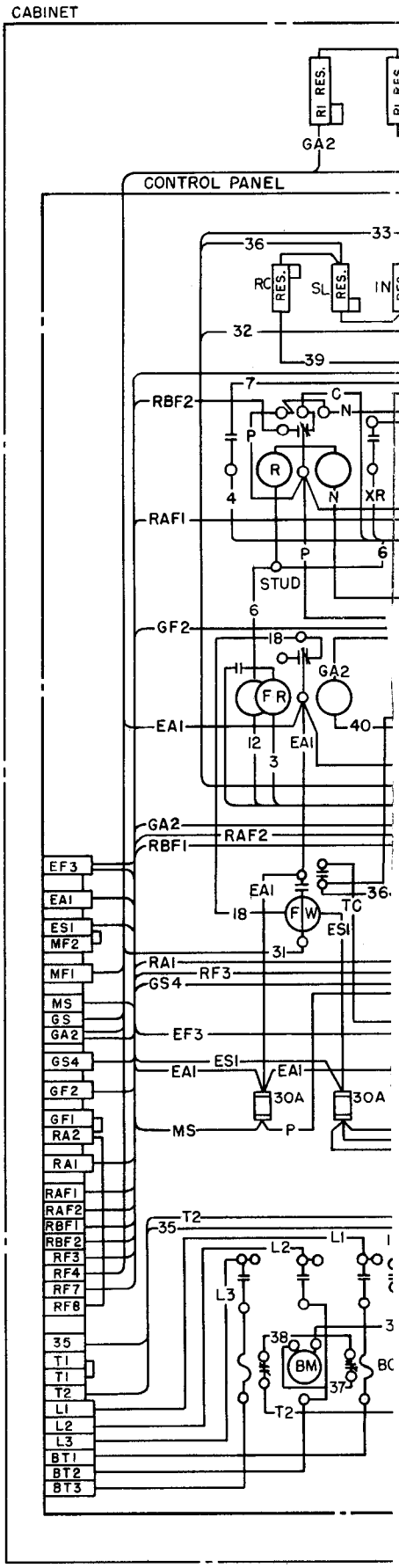
The motor continues to run in the return direction until the return limit switch operates. The return limit switch drops out relays R and FR and picks up relay C. The operation is similar to the foregoing.

Operating the Stop lever drops out relays AR and SD. Relay AR drops out relays C, or R, and FR. Relay C, or R, de-energizes the Rototrol pattern field. Relay SD shorts the voltage field rheostat. Relay FR picks up relay FW to apply full field to the motor. The Rototrol voltage is now forced down by the voltage field. The generator voltage is forced down by the Rototrol and the motor regeneratively brakes to rest. As the generator voltage approaches zero, relay CR drops out and in turn drops out relay M and picks up relay DF. Relay DF connects the generator differential field to the generator armature to kill the generator residual voltage to prevent the motor from creeping.

Pressing the Inch Cut or Inch Return button picks up relays CR, and C, or R. Relay CR drops out relay DF and picks up relay M. Relay C, or R excites the Rototrol pattern field through the inch resistor IN and the permanent resistor RP. The Rototrol voltage and generator voltage build up and the motor accelerates to the inching speed. Releasing the Inch button drops out relay C, or R, de-energizing the pattern field. As the generator voltage drops, the motor decelerates and relay CR drops out picking up relay DF and dropping out relay M.

SHORT STROKE SELECTOR SWITCH

As the name implies the "short stroke" selector switch should be used only for short strokes with the dogs set close together. The maximum number of short strokes will be obtained with both the cut and return rheostats adjusted for the same speed, approximately 350 to 400 rpm on the motor. When turned to the "On" position, the selector switch inserts additional resistance in series with the Rototrol anti-hunt field and short circuits the rheostat resistance in series with the Rototrol voltage field. If the selector switch is left in the "On" position for medium and long strokes, the operation may be unstable.


CABINET
CONTROL PANEL
RI RES.
GA2
RC RES.
SL RES.
IN
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33
32
39
7
C
N
P
4
R
N
XR
RBF2
RAFI
P
6
STUD
6
GF2
18
11
GA2
F R
EAI
12
EAI
3
40
GA2
RAF2
RBFI
EF3
EAI
ESI
MF2
MFI
MS
GS
GA2
GS4
GF2
GFI
RA2
RAI
RAFI
RAF2
RBFI
RBF2
RF3
RF4
RF7
RF8
35
TI
TI
T2
LI
L2
L3
BTI
BT2
BT3
EAI
18
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ESI
31
RAI
RF3
GS4
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BM
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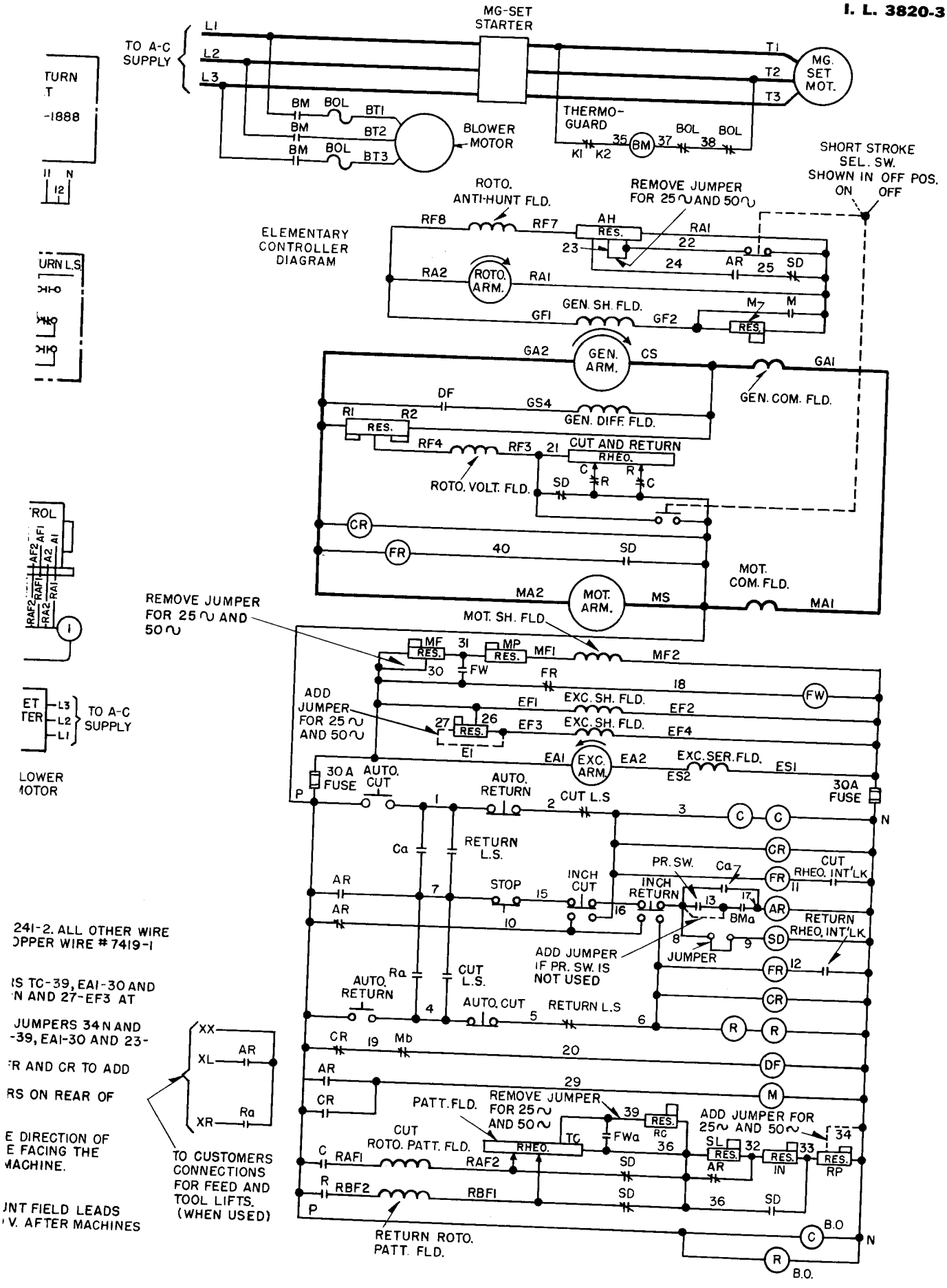
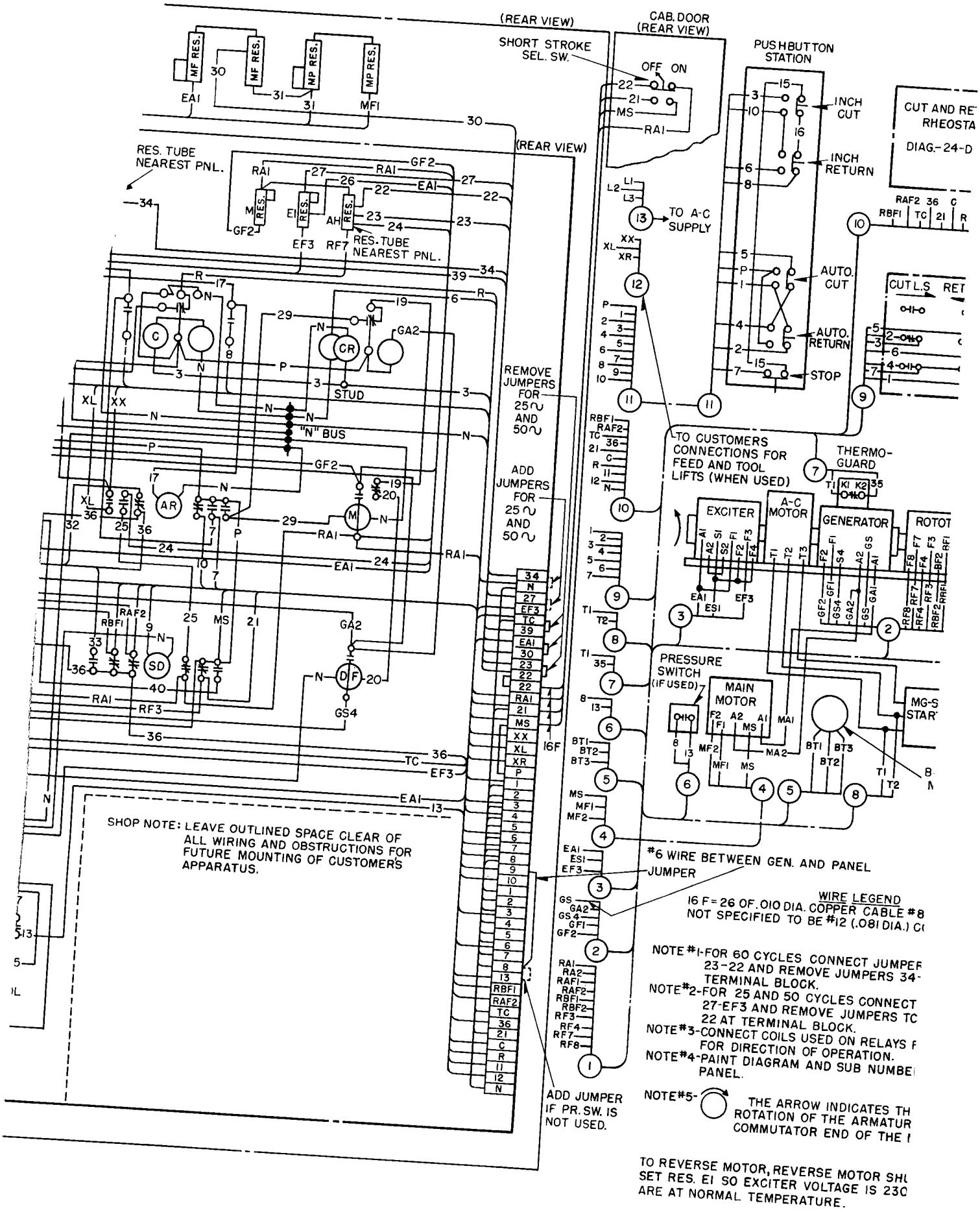


FIG. 1. Adjustable Voltage Planer Controller Wiring Diagram


(REAR VIEW)
SHORT STROKE SEL. SW.
CAB. DOOR (REAR VIEW)
OFF ON
PUSHBUTTON STATION
INCH CUT
INCH RETURN
AUTO. CUT
AUTO. RETURN
STOP
TO A-C SUPPLY
RES. TUBE NEAREST PNL.
RES.-TUBE NEAREST PNL.
REMOVE JUMPERS FOR 25∿ AND 50∿
ADD JUMPERS FOR 25∿ AND 50∿
"N" BUS
STUD
TO CUSTOMERS CONNECTIONS FOR FEED AND TOOL LIFTS (WHEN USED)
THERMO-GUARD
EXCITER
A-C MOTOR
GENERATOR
PRESSURE SWITCH (IF USED)
MAIN MOTOR
SHOP NOTE: LEAVE OUTLINED SPACE CLEAR OF ALL WIRING AND OBSTRUCTIONS FOR FUTURE MOUNTING OF CUSTOMER'S APPARATUS.
#6 WIRE BETWEEN GEN. AND PANEL
JUMPER
ADD JUMPER IF PR. SW. IS NOT USED.
WIRE LEGEND
16 F = 26 OF .010 DIA. COPPER CABLE #8
NOT SPECIFIED TO BE #12 (.081 DIA.) C
NOTE #1-FOR 60 CYCLES CONNECT JUMPER
23-22 AND REMOVE JUMPERS 34-
TERMINAL BLOCK.
NOTE #2-FOR 25 AND 50 CYCLES CONNECT
27-EF3 AND REMOVE JUMPERS TC
22 AT TERMINAL BLOCK.
NOTE #3-CONNECT COILS USED ON RELAYS F
FOR DIRECTION OF OPERATION.
NOTE #4-PAINT DIAGRAM AND SUB NUMBE
PANEL.
NOTE #5-
THE ARROW INDICATES TH
ROTATION OF THE ARMATUR
COMMUTATOR END OF THE
TO REVERSE MOTOR, REVERSE MOTOR SH
SET RES. E1 SO EXCITER VOLTAGE IS 230
ARE AT NORMAL TEMPERATURE.