Buffalo Service
Mr. John Atkinson
Service Mgr. DOP

(105)

Westinghouse

Type DT-3 Speed Regulator

INSTRUCTION BOOK

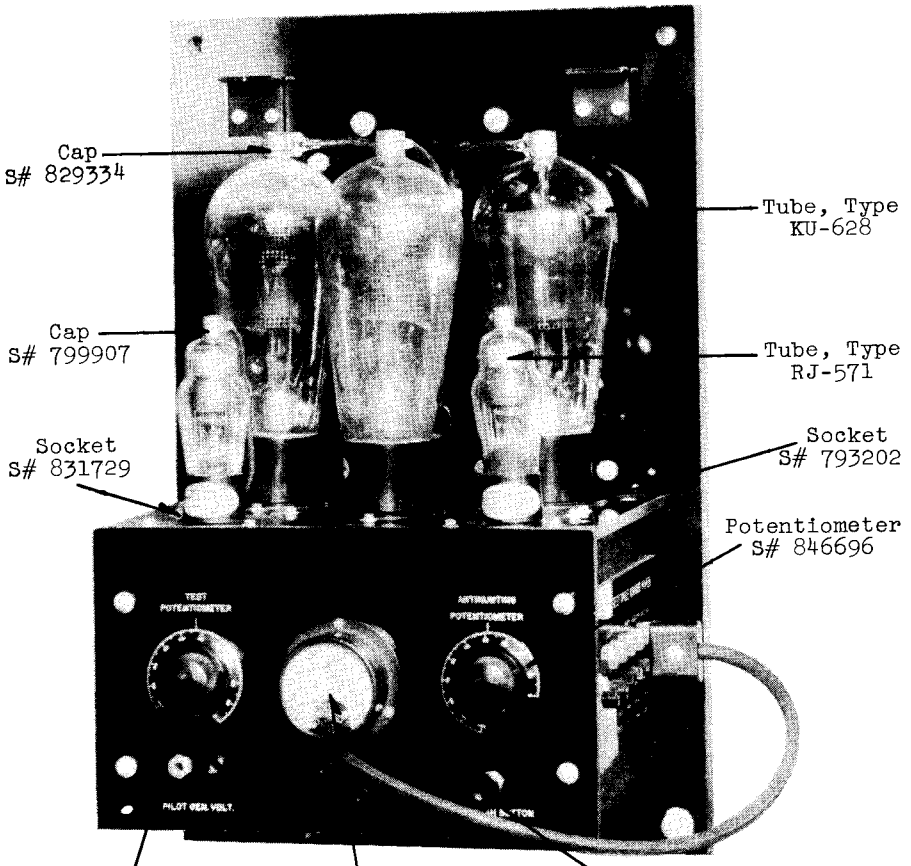

Fig. 1 - Type DT-3 Speed Regulator, Front View
(Top Cover Removed)

Westinghouse Electric & Manufacturing Company

East Pittsburgh Works **East Pittsburgh, Pa.**

I. B. 5670-26-A

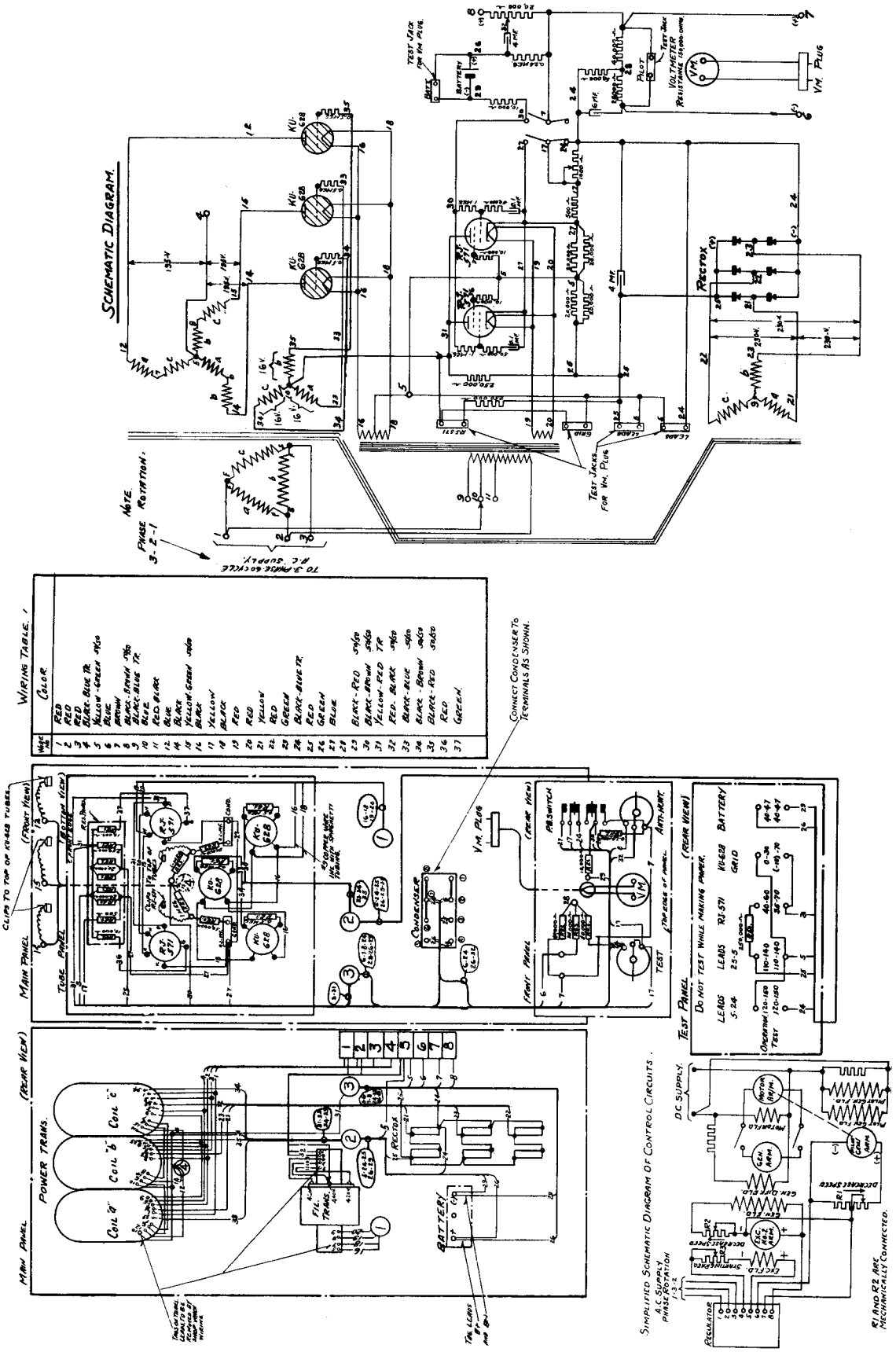

Fig. 2 - Wiring Diagram for Type DT-3 Speed Regulator

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Type DT-3 Speed Regulator

IMPORTANT

ON COLD DAYS START UP THE MOTOR-GENERATOR SET AT LEAST FIVE MINUTES BEFORE STARTING UP THE MOTOR

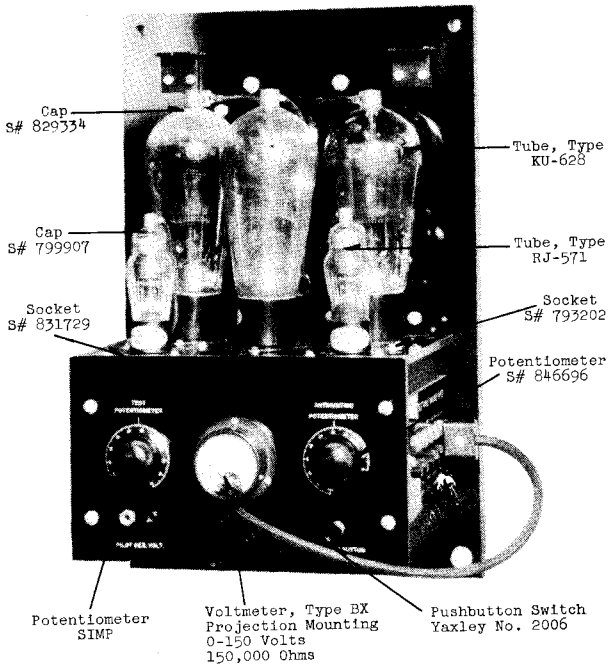

Fig. 3 - Type DT-3 Speed Regulator, Front View
Top Cover Removed Showing Principal Parts)

OPERATION

1 - The Type DT-3 Speed Regulator may be used to control the speed of a motor as shown in the simplified schematic diagram in Fig. 2. A pilot generator is geared to the motor, and the regulator, through exciter No. 2 and the generator, controls the voltage across the motor armature so that the speed of the pilot generator is maintained at a definite value to give a constant voltage across regulator terminals 6 and 7. Since the pilot generator voltage is proportional to the pilot generator speed, the equipment will regulate the speed of the motor at a value determined by the adjustment of rheostat R1.

2 - The DT-3 Regulator as shown in Fig. 2 consists of three KU-628 tubes connected to supply current to the No. 2 exciter field winding, and two RJ-571 tubes which control the KU-628 tubes. The pilot generator is connected to terminals 6 and 7, and a 45-volt battery is connected in the grid circuit of the RJ-571 tubes to oppose the pilot generator voltage so that the RJ-571 grid voltage becomes more negative when the pilot generator voltage is decreased. The RJ-571 tube grid-control circuit may be traced from the cathode 27 of Fig. 1 to 17-24-28-7-26-29-30 grid. The resistor 24-28 in connection with capacitor 24-6 gives quick response action. When the pilot generator voltage 6-7 is changing a charging current is flowing through resistor 24-28 to capacitor 6-24. This charging current produces a voltage drop across resistor 24-28 with a polarity so that the voltage across 24-7 will be higher than voltage 28-7.

3 - Resistor 26-7 and capacitor 26-32 produce the required anti-hunting action. The exciter armature voltage is connected to terminals 7-8, and when the exciter voltage is varying as a result of regulator action, a voltage drop will appear across resistor 26-7. The polarity of this voltage drop is such that the variation in RJ-571 grid voltage which caused the regulator action will be opposed and stable regulator action is therefore obtained.

4 - Assuming that the motor speed is too low, the voltage across 6-7 will be low and the grid voltage between 30 and 27 will become more negative. This increased negative voltage decreases the current through the RJ-571 tubes, and the voltage across resistor 31-25 is decreased. Since the grids of the KU-628 tubes are connected through leads 33-34-35 to the star winding of the transformer and the neutral of the transformer is connected to 5, it is obvious that the KU-628 grid voltage becomes more positive when the voltage across resistor 25-31 is decreased. The No. 2 exciter field winding is connected to terminals 4 and 5, and is therefore supplied with rectified current from the three KU-628 tubes. The exciter field current is increased when the KU-628 grid voltage is made more positive. For this reason, the exciter field current is increased when the voltage across 6-7 is decreased.

5 - The grid control of the KU-628 tubes is obtained as a combination of a-c. and d-c. voltage

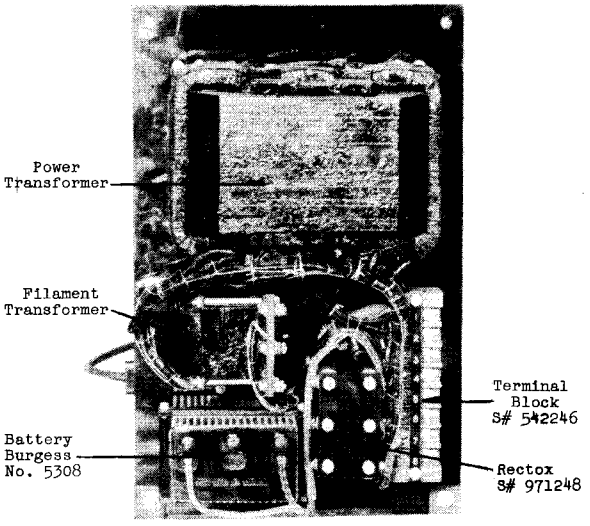

Fig. 4 - Type DT-3 Speed Regulator, Rear View

control. The a-c. grid voltage which is 16 volts, obtained from transformer winding 31 -33, -34, -35 is displaced 90 degrees relative to the KU-628 anode voltage supplied by transformer winding 4-12, -14, -15. The d-c. grid voltage component is obtained from 5-31. By varying this d-c. voltage the point on the a-c. anode voltage wave, at which the KU-628 tubes will break down may be shifted, and the average current through the KU-628 tubes may be varied correspondingly.

6 - Due to the application of three KU-628 tubes and two RJ-571 tubes the regulation will not be affected if one KU-628 tube and one RJ-571 tube should fail.

APPLICATION DATA

7 - A-C. Voltage. The a-c. supply voltage should be within ± 10 per cent of the nameplate marking. Standard designs of this regulator are available for either 220 volts or 440 volts. The a-c. supply current per phase will be approximately 0.2 ampere when the exciter field current is 0.5 ampere. The maximum exciter field current should not exceed 1.5 amperes. The maximum voltage across terminals 4 - 5 is 220 volts with 3 KU-628 tubes and 155 volts with 2 KU-628 tubes. Exciter No. 2 should preferably be a 250-volt machine with a 125-volt field winding.

8 - The resistance between terminals 7 and 8 is 20,000 ohms. The resistance between 6 and 7 is 45,000 ohms when the voltmeter plug is connected in the pilot generator voltage socket.

INSTALLATION

9 - Connect the regulator as shown in Fig. 2 or according to special control diagram, making sure that the phase rotation of the a-c. supply voltage is 3-2-1 and the polarities of 6-7 and 7-8 are as shown in Fig. 2. Connect lead 1 to the terminals of the filament transformer, so that the maximum supply voltage will never exceed the terminal marking. Adjust the anti-hunting potentiometer to position 100 and start up the machines. Turn the anti-hunting potentiometer slowly towards zero until the pilot generator voltage becomes unstable; then turn potentiometer 20 divisions clockwise.

10 - The pilot generator voltage should be approximately 74 volts when the regulator is in operation, provided the battery voltage is 45 volts. If the battery voltage is lower, the pilot generator voltage will be proportionately lower.

11 - Test the various voltages by inserting the test plug in the receptacles on the test panel in the "OPERATION" position. The voltages should be within the specified limits. The test plug should be inserted so that the red spot on the test plug corresponds to the red receptacle. The KU-628 tubes should glow with a fairly steady glow. If the tubes are flickering excessively, the phase rotation of the a-c. supply may not be correct. Incorrect phase rotation will also be indicated by the "GRID" voltage on the test panel which voltage will be higher than 30 volts and will show considerable variations. To reverse the phase rotation reverse leads 1 and 2 externally to the regulator.

12 - Shut down the machines, open the motor line switch and start up the equipment so that the No. 2 exciter field will be energized by the regulator. Depress the test pushbutton on front of the regulator. Turn the test potentiometer from the zero position towards the 100 position until the "GRID" voltage on the test panel is 70 volts. By turning the test potentiometer 25 divisions further clockwise, the "GRID" voltage should reverse and should be at least 10 volts of opposite polarity. In order to read this voltage reverse the test plug. Test the RJ-571 voltage in the same manner. This voltage should decrease from at least 70 to 30 volts or less when the test potentiometer is turned 25 divisions clockwise from the position giving 70 volts. With the test potentiometer in position 50 and the pushbutton depressed, test the voltage of 25-5 and 5-24. These voltages should be between 110 and 140 volts and 120 and 150 volts, respectively. Check the battery voltage. This voltage should be between 42 volts and 47 volts.

13 - With the test potentiometer in the zero position and the test push button depressed there should be no glow in the KU-628 tubes. As the potentiometer is turned slowly clockwise the KU-628 tubes should start to glow when the potentiometer is within the range 40 to 65. By turning the potentiometer two divisions further clockwise there should be a gradual increase in the intensity of the glow discharge in the KU-628 tubes, and a corresponding gradual increase in the armature voltage of exciter No. 2. If this gradual increase does not obtain, but if instead the exciter voltage is suddenly increased from minimum to maximum, the a-c. phase rotation may be reversed and the tests as outlined in paragraph 11, should be carefully repeated.

WEEKLY TESTS

Each week test as follows:

14 - Operation Test - With the motor and pilot generator but not the machine in operation check all voltages of the "OPERATION" receptacles on the test panel. These voltages should be within the limits specified on the test panel. The pilot generator voltage as read on the regulator voltmeter should be as outlined in paragraph 10.

15 - Tube Test - Shut down the machine and open the motor line switch. Start up the equipment so that the No. 2 exciter field will be energized by the regulator.

(a) KU-628 Tube Test - Depress test push button and turn the test potentiometer to the zero position. There should be no glow discharge in any of the KU-628 tubes, and the GRID voltage should be 40 volts or higher when the voltmeter plug is inserted in the GRID receptacle with the red dot up. If there is a glow discharge replace the KU-628 tube. Turn the test potentiometer clockwise until the KU-628 tubes start to glow. The GRID voltage should now be between zero and 30 volts. Turn the test potentiometer further clockwise until the voltage of exciter No. 2 is 250 volts or higher, if a 250-volt machine is used, and observe the position of the test potentiometer dial. All three KU-628 tubes should now glow. Replace any tube which does not glow.

(b) RJ-571 Tube Test - Place the voltmeter plug in the receptacle marked "GRID" with the red dot of the plug upwards. Adjust the test potentiometer clockwise from the zero position, while the test pushbutton is depressed, until the voltmeter reads 70 volts. By turning the test potentiometer 25 divisions further clockwise the grid voltage should change to 10 volts or more of opposite polarity. To read this voltage reverse position of the voltmeter plug so that the red spot is down. Remove the left RJ-571 tube and repeat the above test. Replace the left RJ-571 tube in its socket. Remove the right RJ-571 tube and repeat the above test. Replace the right RJ-571 tube in its socket. Replace any RJ-571 tube which does not give the voltages as specified in above tests.

(c) Plug the voltmeter plug in the receptacle marked RJ-571 with the red spot up. Depress the test pushbutton and adjust the test potentiometer to give 70 volts on the voltmeter. By adjusting the test potentiometer 25 divisions further clockwise the RJ-571 voltage should decrease to 35 volts or less.

(d) Rectox Voltage - With the test potentiometer in the 50 position and the test pushbutton depressed, check the voltage of 25-5 and 5-24. These voltages should be within limits as specified on the test panel.

(e) Battery Test - Replace the battery if the battery voltage is not within 42 volts and 47 volts.

(f) Complete Test - Depress test push button and turn the test potentiometer until the No. 2 exciter armature voltage is between 230 and 250 volts, if a 250-volt exciter is used; and between 120 and 130 volts if a 125-volt exciter is used. Observe the position of the test potentiometer dial. By turning the test potentiometer two divisions counter-clockwise from the observed position the exciter armature voltage should decrease to 50 volts or less.

SPARE TUBES

16 - It is recommended that the following spare tubes be kept in stock:

2 - KU-628 tubes
1 - RJ-571 tube

RENEWAL PARTS

Name of Part	Style
Power Transformer, 440 volts 25 cycle	971 217
Power Transformer, 440 volts 60 cycle	920 770
Power Transformer, 220 volts 60 cycle	967 213
Filament Transformer, 440 volts 25 cycle	971 218
Filament Transformer, 440 volts 60 cycle	920 771
Filament Transformer, 220 volts 60 cycle	967 214
KU-628 Tube Socket	793 202
RJ-571 Tube Socket	831 729
Rectox Rectifier	971 248
Large Capacitor	829 365
KU-628 Grid-Glow Tube	
RJ-571 Amplifier Tube	
Connector Cap for KU-628 Tube	829 334
Connector Cap for RJ-571 Tube	799 907
Resistor 0.5 megohm	860 878
Resistor 0.25 megohm	846 668
Resistor 1.0 megohm	860 003
Resistor 50,000 ohms (1" long)	860 004
Resistor 50,000 ohms (2" long)	846 669
Resistor 40,000 ohms	860 001
Resistor 25,000 ohms	860 875
Resistor 10,000 ohms	799 952
Resistor 20,000 ohms	943 633
Resistor 500 ohms	943 634
Terminal Block	542 246
Potentiometer, 20,000 ohms	846 696
Potentiometer Dial	869 654
Voltmeter Type BX, Projection Mounting, 0-150 volts, 150,000 ohms	
Burgess Battery No. 5308	
Push Button Switch (Yaxley No. 2006)	
Potentiometer, (Yaxley Type SIMP) 1000 ohms	
Capacitor, "Aerovox" Type 250, 0.1 MF	

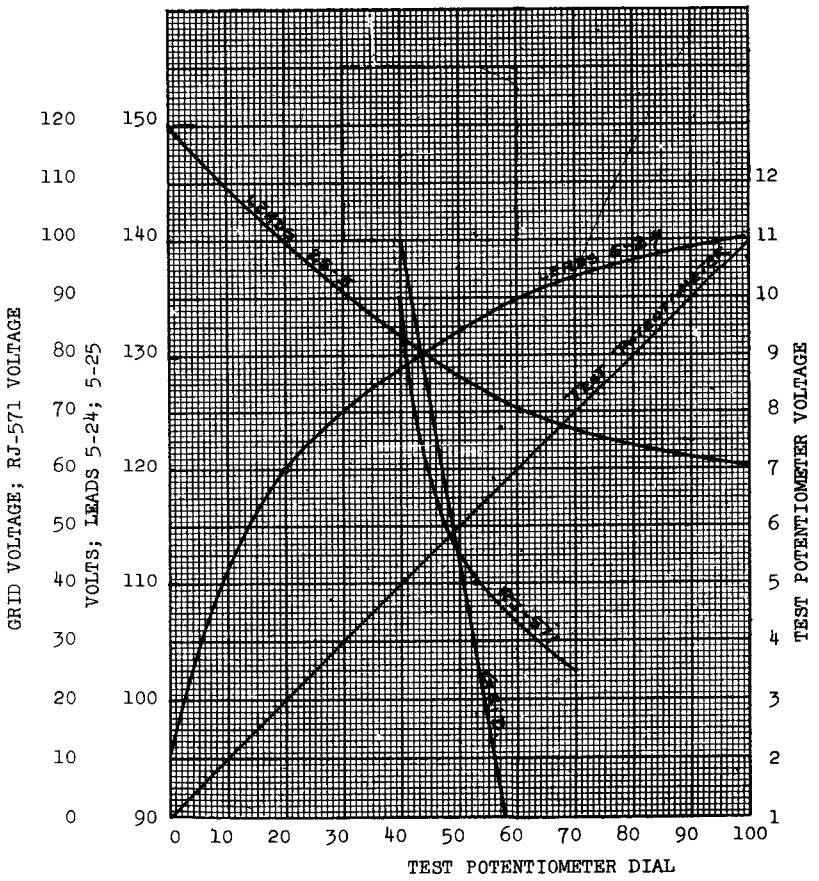

Fig. 5 - Average Test Curves for DT-3 Speed Regulator

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Type DT-3 Speed Regulator

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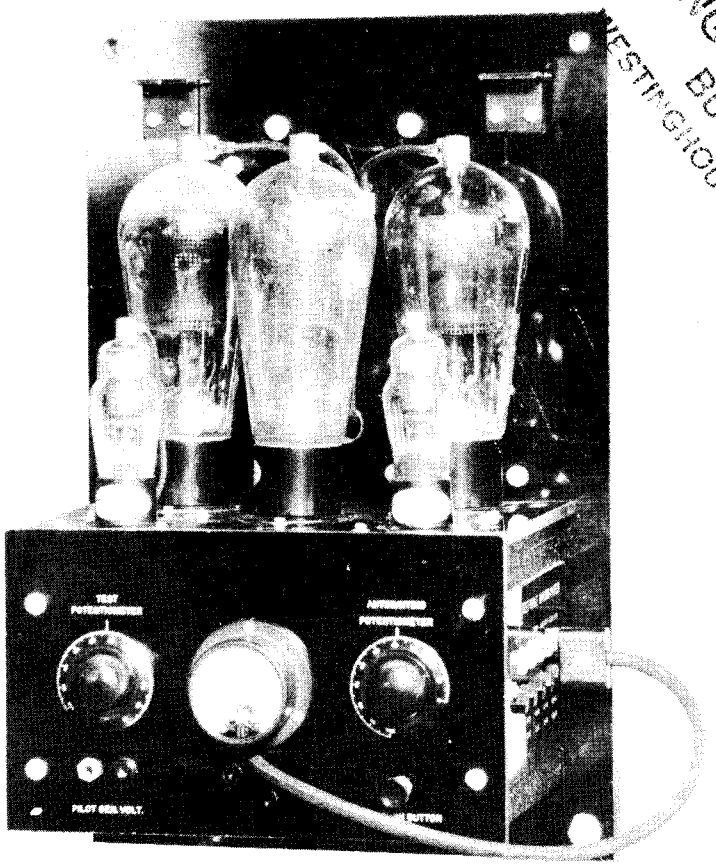

Fig. 1 - Type DT-3 Speed Regulator, Front View (Top Cover Removed)

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Printed in U.S.A. (Rev. 1-38) **I. B. 5670-26-B**

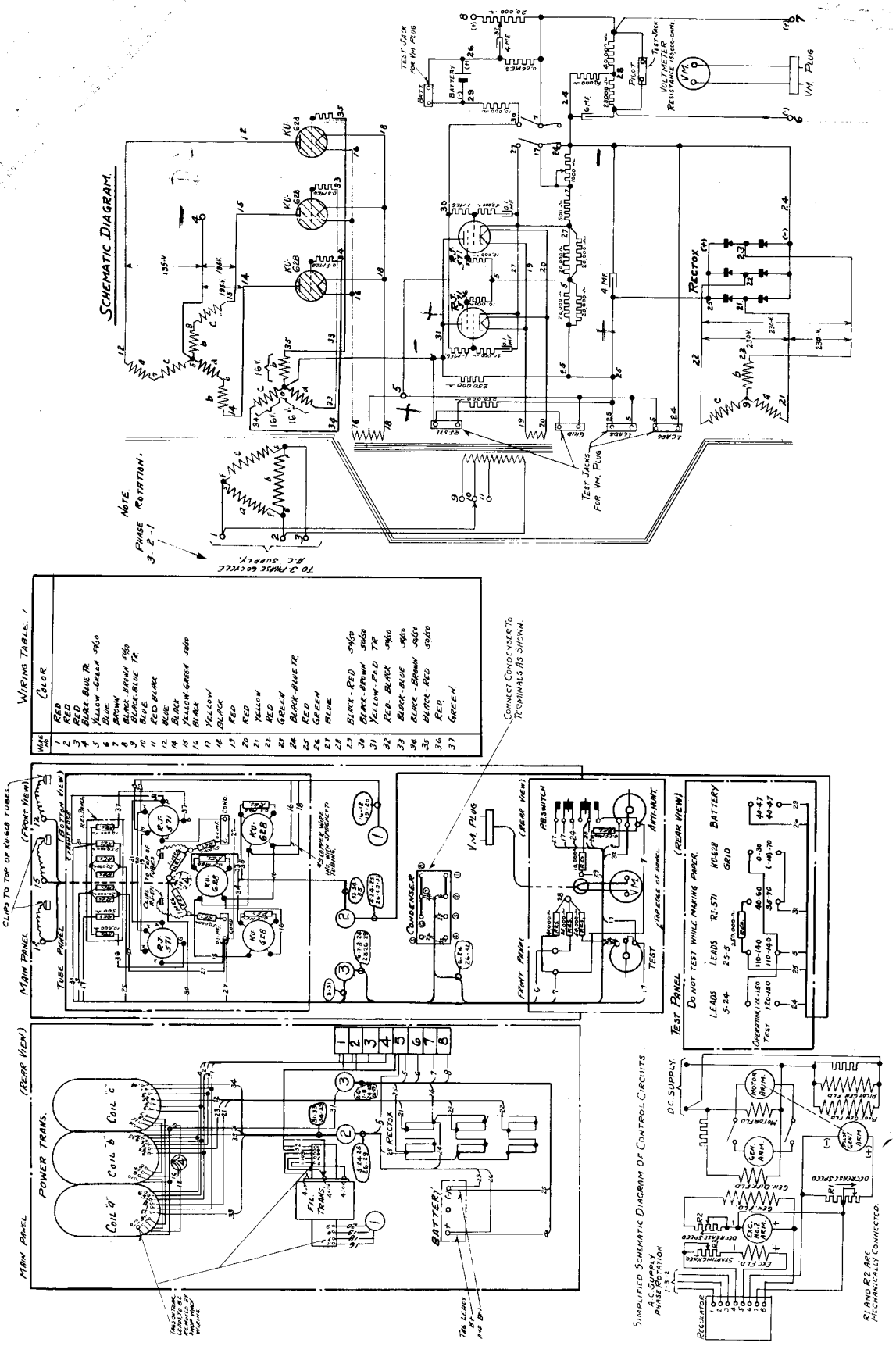

Fig. 2 - Wiring Diagram for Type DT-3 Speed Regulator

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ON COLD DAYS START UP THE MOTOR-GENERATOR SET AT LEAST FIVE MINUTES BEFORE STARTING UP THE MOTOR

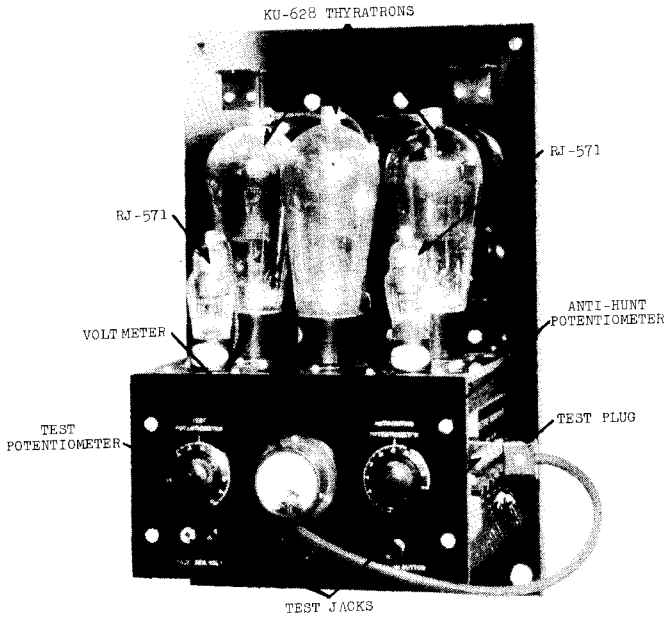

Fig. 3 - Type DT-3 Speed Regulator, Front View Top Cover Removed Showing Principal Parts)

OPERATION

1 - The Type DT-3 Speed Regulator may be used to control the speed of a motor as shown in the simplified schematic diagram in Fig. 2. A pilot generator is geared to the motor, and the regulator, through exciter No. 2 and the generator, controls the voltage across the motor armature so that the speed of the pilot generator is maintained at a definite value to give a constant voltage across regulator terminals 6 and 7. Since the pilot generator voltage is proportional to the pilot generator speed, the equipment will regulate the speed of the motor at a value determined by the adjustment of rheostat R1.

2 - The DT-3 Regulator as shown in Fig. 2 consists of three KU-628 tubes connected to supply current to the No. 2 exciter field winding, and two RJ-571 tubes which control the KU-628 tubes. The pilot generator is connected to terminals 6 and 7, and a 45-volt battery is connected in the grid circuit of the RJ-571 tubes to oppose the pilot generator voltage so that the RJ-571 grid voltage becomes more negative when the pilot generator voltage is decreased. The RJ-571 tube grid-control circuit may be traced from the cathode 27 of Fig. 1 to 17-24-28-7-26-29-30 grid. The resistor 24-28 in connection with capacitor 24-6 gives quick response action. When the pilot generator voltage 6-7 is changing a charging current is flowing through resistor 24-28 to capacitor 6-24. This charging current produces a voltage drop across resistor 24-28 with a polarity so that the voltage across 24-7 will be higher than voltage 28-7.

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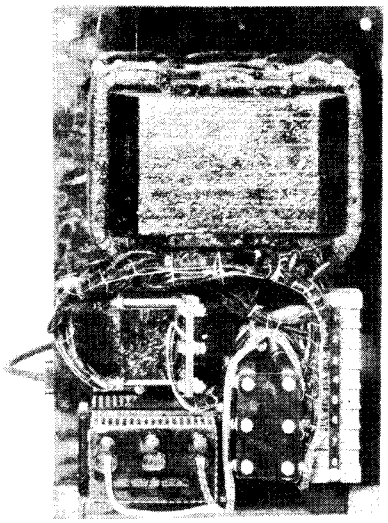

Fig. 4 - Type DT-3 Speed Regulator, Rear View

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12 - Shut down the machines, open the motor line switch and start up the equipment so that the No. 2 exciter field will be energized by the regulator. Depress the test pushbutton on front of the regulator. Turn the test potentiometer from the zero position towards the 100 position until the "GRID" voltage on the test panel is 70 volts. By turning the test potentiometer 25 divisions further clockwise, the "GRID" voltage should reverse and should be at least 10 volts of opposite polarity. In order to read this voltage reverse the test plug. Test the RJ-571 voltage in the same manner. This voltage should decrease from at least 70 to 30 volts or less when the test potentiometer is turned 25 divisions clockwise from the position giving 70 volts. With the test potentiometer in position 50 and the pushbutton depressed, test the voltage of 25-5 and 5-24. These voltages should be between 110 and 140 volts and 120 and 150 volts, respectively. Check the battery voltage. This voltage should be between 42 volts and 47 volts.

13 - With the test potentiometer in the zero position and the test push button depressed there should be no glow in the KU-628 tubes. As the potentiometer is turned slowly clockwise the KU-628 tubes should start to glow when the potentiometer is within the range 40 to 65. By turning the potentiometer two divisions further clockwise there should be a gradual increase in the intensity of the glow discharge in the KU-628 tubes, and a corresponding gradual increase in the armature voltage of exciter No. 2. If this gradual increase does not obtain, but if instead the exciter voltage is suddenly increased from minimum to maximum, the a-c. phase rotation may be reversed and the tests as outlined in paragraph 11, should be carefully repeated.

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(a) KU-628 Tube Test - Depress test push button and turn the test potentiometer to the zero position. There should be no glow discharge in any of the KU-628 tubes, and the GRID voltage should be 40 volts or higher when the voltmeter plug is inserted in the GRID receptacle with the red dot up. If there is a glow discharge replace the KU-628 tube. Turn the test potentiometer clockwise until the KU-628 tubes start to glow. The GRID voltage should now be between zero and 30 volts. Turn the test potentiometer further clock-wise until the voltage of exciter No. 2 is 250 volts or higher, if a 250-volt machine is used, and observe the position of the test potentiometer dial. All three KU-628 tubes should now glow. Replace any tube which does not glow.

(b) RJ-571 Tube Test - Place the voltmeter plug in the receptacle marked "GRID" with the red dot of the plug upwards. Adjust the test potentiometer clockwise from the zero position, while the test pushbutton is depressed, until the voltmeter reads 70 volts. By turning the test potentiometer 25 divisions further clockwise the grid voltage should change to 10 volts or more of opposite polarity. To read this voltage reverse position of the voltmeter plug so that the red spot is down. Remove the left RJ-571 tube and repeat the above test. Replace the left RJ-571 tube in its socket. Remove the right RJ-571 tube and repeat the above test. Replace the right RJ-571 tube in its socket. Replace any RJ-571 tube which does not give the voltages as specified in above tests.

(c) Plug the voltmeter plug in the receptacle marked RJ-571 with the red spot up. Depress the test pushbutton and adjust the test potentiometer to give 70 volts on the voltmeter. By adjusting the test potentiometer 25 divisions further clockwise the RJ-571 voltage should decrease to 35 volts or less.

(d) Rectox Voltage - With the test potentiometer in the 50 position and the test pushbutton depressed, check the voltage of 25-5 and 5-24. These voltages should be within limits as specified on the test panel.

(e) Battery Test - Replace the battery if the battery voltage is not within 42 volts and 47 volts.

(f) Complete Test - Depress test push button and turn the test potentiometer until the No. 2 exciter armature voltage is between 230 and 250 volts, if a 250-volt exciter is used; and between 120 and 130 volts if a 125-volt exciter is used. Observe the position of the test potentiometer dial. By turning the test potentiometer two divisions counter-clockwise from the observed position the exciter armature voltage should decrease to 50 volts or less.

SPARE TUBES

16 - It is recommended that the following spare tubes be kept in stock:

2 - KU-628 tubes
1 - RJ-571 tube

RENEWAL PARTS

Name of Part	Style
Power Transformer, 440 volts 25 cycle	971 217
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Filament Transformer, 440 volts 25 cycle	971 218
Filament Transformer, 440 volts 60 cycle	920 771
Filament Transformer, 220 volts 60 cycle	967 214
KU-628 Tube Socket	793 202
RJ-571 Tube Socket	831 726
Rectox Rectifier	971 248
Large Capacitor	829 365
KU-628 Grid-Glow Tube	
RJ-571 Amplifier Tube	
Connector Cap for KU-628 Tube	829 334
Connector Cap for RJ-571 Tube	799 907
Resistor 0.5 megohm	860 878
Resistor 0.25 megohm	846 668
Resistor 1.0 megohm	860 003
Resistor 50,000 ohms (1" long)	860 004
Resistor 50,000 ohms (2" long)	846 669
Resistor 40,000 ohms	860 001
Resistor 25,000 ohms	860 875
Resistor 10,000 ohms	799 952
Resistor 20,000 ohms	943 633
Resistor 500 ohms	943 634
Terminal Block	542 246
Potentiometer, 20,000 ohms	846 696
Potentiometer Dial	869 654

Voltmeter Type BX, Projection Mounting, 0-150 volts, 150,000 ohms
Burgess Battery No. 5308
Push Button Switch (Yaxley No. 2006)
Potentiometer, (Yaxley Type SIMP) 1000 ohms
Capacitor, "Aerovox" Type 250, 0.1 MF

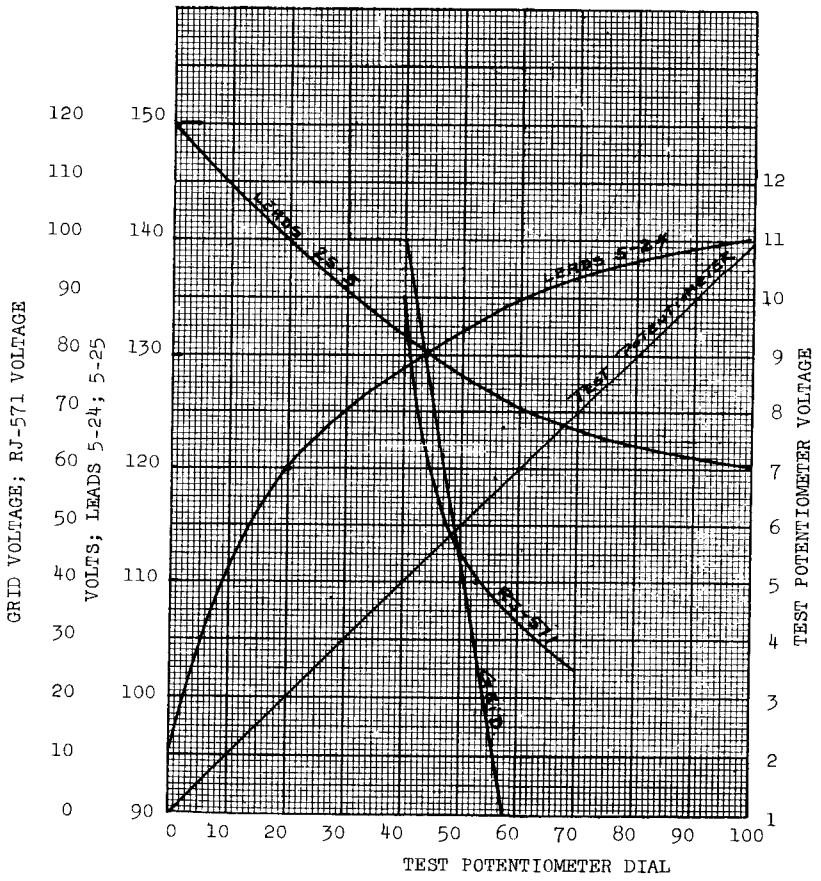

Fig. 5 - Average Test Curves for DT-3 Speed Regulator