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MAINFRAME CONTROLS

Power on :	Turns on power
Range select:	High range for armatures rated 10 amps or more, and low range below 10 amps or small random wound and tool motor armatures.
Mode select:	Automatic mode is used with the H12 armature head. The frequency, power level, and sensitivity of the unit is automatically adjusted to match the armature under test. The manual mode allows independent control of the frequency and power level. This mode of operation is only for very specialized testing and requires detailed knowledge of the armature being tested.
A control:	Allows the user to select any frequency from approximately 100 HZ to 5 KHZ.
B control:	Allows the user to select the desired current being applied to the armature (0 - 2 1/2 amps RMS).
Fuse:	1 amp.

OPERATING INSTRUCTIONS

MODEL H12 ARMATURE HEAD

1. Make certain the POWER switch is in the OFF position. Connect the cable to the mainframe and the armature head making sure that both ends of the cable lock into place (Do not force the connectors. They are keyed and will only fit one way). The cable can be removed by depressing both levers on the connector housing.

2. Select AUTO on the MODE switch.

3. Select either the HIGH or LOW position on the RANGE switch. Use HIGH for armatures with full load current ratings of 10 amps and above, LOW for fewer than 10 amps.

4. Turn the POWER switch ON.

5. Adjust the probes to contact 2 adjacent bars.

6. Place the probes firmly on the com and insure proper contact for steps 7 and 8. A light downward pressure at the probe tips with the thumb will generally suffice.

7. Depress the SET button and release it. (see note 1). The indicator will turn red and the bargraph will scale to an off condition (towards the SHORT legend).

8. When the bargraph scales up to the SET legend (this can take 10 seconds on very high current armatures), and the indicator turns green, (see note 2), the M117 has digitally locked the necessary power level and frequency. You are now ready to proceed with the bar to bar test (see Interpretation of Readings page 5).

Note 1. Pressing the SET button causes the M117 to select and lock a new power and frequency. The SET button needs to be pressed only once for each armature being tested.

Note 2. If the bargraph cannot reach the SET legend or does not indicate at all, the armature is either too large to test or the initial bars selected are shorted. When this condition occurs, repeat steps 6 through 8 on a different set of bars. If SET still can't be obtained, spread the probes to skip 1 bar. This will allow the unit to set on very large armatures.

DIAGNOSTICS & SELF TEST PROCEDURE

1. Select AUTO mode.

2. Select HIGH range.

3. Turn the POWER on.

4. Hold the SELF TEST button in and momentarily depress the SET button. The LED indicator will turn red and the bargraph will scale to the SET legend. The LED indicator will then turn green. Please contact the factory if the self test fails to arrange for repair of the M117 and H12.

5. Place the MODE switch in the MANUAL position.

6. Set the A and B controls at 8. All the bars on the bargraph should be illuminated.

7. Press the tips of the two probes together. The bargraph should decrease to a maximum of 3 bars on. If more than four bars are on, perform the following:

Turn the POWER off. Turn the armature head over and remove the two phillips screws that hold the probes in place. Carefully pull the probes out of the housing and tighten the screw at the rear of each probe. Replace the probes, phillips screws and nylon insulating pad (do not pinch any of the wires). Turn the POWER on and press the probes together. If more than three bars are still on, a faulty cable is present. Cables can be ordered from the factory.

INTERPRETATION OF READINGS

The NORMAL range allows for a +/- 7 1/2% variation. From the SET legend to the OPEN or the SHORT legends represents a change in impedance of 100% Therefore an indication of +3 or -3 equals a 50% change in impedance from the SET condition. The bargraph or display will generally remain in the normal range for most armatures.

When testing any armature it must be kept in mind that the readings obtained will be the same for each bar tested unless there are equalizers. If the armature has equalizers, a pattern will be present that will repeat every so often as you progress from bar to bar. Equalizers will cause the readings to indicate lower than normal. Each low reading will nevertheless still occur in a repetitive pattern. It is extremely important to keep track of the pattern, should one be present, as deviations from this pattern indicate a bad armature.

The possible malfunctions that may occur can range from opens, shorts, partial shorts, crossed turns, shorted risers, single turn shorts in one coil, to an open in a single coil of a two in hand or more group.

CONDITION	INDICATION
Open coil 1 conductor	+5 or more
Riser short	1 bar lit or all bars extinguished
Single turn short in 1 coil	-3 or more

2 or more coils shorted together	A random reading will occur with the shorted coils giving the lowest readings obtained as you progress around the com. i.e. +1, S (SET), -2, -3, +2, -1, etc. The -3 reading is the shorted coil, and the -2 is the coil shorted to it.
Open coil 2 in hand	+2 or +3
Misconnect	Generally will indicate an open but may indicated a very random pattern of + and - readings.
Crossed connection	Will indicate a - reading generally of -2 or more at the crossed coil.

If when using the armature head a random pattern occurs that makes no sense, it is wise to write down the readings on each bar. This may help in the diagnosis of the failure.

The bars selected for the initial set point may sometimes be bars where a failure exists, since initially the condition of this set of bars is unknown. This is why it is extremely important to be aware of and record the pattern that occurs. If you happen to set the unit on a bad segment, you may notice that several sequential bars give the same reading. I.e. +3, +3, +3, Set, -2, Set, +3, +3, etc. If this occurs, reset the unit on any of the sequential readings be they + or -. This will generally give you a valid starting point to redo the test.

INDUCTION ROTOR TESTING THEORY OF OPERATION

This test is performed with the rotor removed and is useful on rotors up to 100Hp. A brief theory of operation follows:

The impulse coil supplied with the HE-7 induces a brief polarized magnetic pulse into the rotor bars. The current that is generated in each rotor bar will essentially be a function of the bar resistance. Therefore, the magnetic field generated around each rotor bar is a function of the current flowing in the bar. Should a bar be cracked or contain a void or other anomaly that causes it's resistance to be greater than normal, the induced current and hence the magnetic field generated by the bar, will be less than that of adjacent bars. The magnetic field is picked up by the FP-V2 probe and displayed on the bargraph. The theory is analogous to applying a voltage to each end of a rotor bar and measuring the current flowing through each bar. Any decrease in the current would imply a cracked or open bar. Unfortunately, it is often not possible to measure the current flowing in each bar since they are buried, and in many cases the slots are closed and the bars cannot be observed. Measuring the intensity of the magnetic field performs the same function as measuring the current.

ROTOR BAR TESTING

1. Place the impulse coil and FP-V2 probe on the rotor (See figure 1).

2. Align the slot on the probe with the indented mark on the impulse coil. Be sure that the coil pole pieces are flat against the rotor and the probe tip is in contact with the rotor. Tighten the nylon screw to lock the probe in this position (do not over tighten). It is very important that the probe tip is in contact with the rotor and the marks are aligned properly. The probe should face one of the end rings about 1 inch from the end of the rotor.

3. Set the switch to the left of the gain control to the Bar position. Turn on the mainframe and adjust the gain control for a 50% reading. DO NOT USE THE SHUNT POSITION ON THE SWITCH AS THE HE7 UNIT MAY INCUR DAMAGE AFTER A PERIOD OF TIME.

4. Holding the edges of the coil assembly slide the assembly and probe slowly around the rotor maintaining the same probe spacing from the end ring. Do not press down on the assembly while moving around the rotor. This may move the probe in the assembly breaking the probe and rotor contact. When the probe tip is directly over a rotor bar, the bargraph will indicate a maximum or peak. When a peak is detected, carefully adjust the gain control until the bargraph indicates approximately 100%. Be careful not to move the assembly. If the assembly happens to move, slide the assembly until the peak is again found.

5. Continue sliding the assembly around the rotor. As each bar is found, the

bargraph will indicate the flux value being generated in that bar. The indicated value in each bar should be about the same. An abrupt variation of -30% or more indicates a possible problem.

6. You will notice that the bargraph will dip to a minimum value between rotor bars. A totally open rotor bar will generally indicate the same or less than this minimum value. A defective end ring will generally indicate less than the minimum value between rotor bars.

7. Once in a while you will notice a gradual variation in the readings as you proceed from bar to bar. A rotor cage that is not centered with respect to the shaft generally causes this. Most of the time this is not a problem but can show up as excessive mechanical vibration when the motor is under load.

8. Keep in mind that the bargraph is indicating the relative quality of each rotor bar. Therefore, the greater the difference between the rotor bars the worse the condition of the bar with the lowest reading.

9. The probe assembly is extremely sensitive and MUST be kept in contact with the rotor surface if valid readings are expected.

10. When the test is completed, TURN OFF THE MAINFRAME.

FIELD COIL TESTING

Various field coils may be tested as follows.

1. Where the individual coil connections for series fields, interpoles or small tool motor fields are available use the inductance test described in procedure A. Procedure A is not recommended for shunt fields.

2. Where only F1, F2, S1, or S2 are available, when testing shunt fields, or when a magnetic flux test is desired, use the magnetic test described by procedure B.

PROCEDURE A.

This test is performed with the H12 armature head as follows:

1. Attach two alligator clip type test leads (not supplied) to the probe tips and to the coil to be tested. This is a comparative test so at least two identical coils (physical and electrical) must be present.

2. Select the LOW range.

3. Select the MAN mode.

4. Set the A control to 10.

5. Set the B control to 0

6. Slowly advance the B control until the bargraph comes up to the SET legend (if the SET point cannot be reached, switch to the HIGH RANGE).

7. Remove one of the coil leads. If all the bargraph segments are on replace the lead just removed and go to step 9. If all the segments are not on replace the lead just removed and go to step 8.

8. Slowly turn the A control counter-clockwise from the 10 position until the bargraph indicates a -1 reading. Turn the B control clockwise until the SET point is reached. Go to step 9.

9. Calibration steps 1-8 have set the power and frequency to be used for comparing the remainder of all similar coils (a set of interpoles, a set of series fields etc.). Connect both of the leads to the next coil to be compared. The reading obtained should be in the NORMAL range. If a lower reading is obtained (-1 or less) the coil has shorted turns. If a higher reading is obtained the coil that you initially selected for steps 1-8 has the shorted turns. If this is the case you should repeat steps 1-8 using the present coil as the reference coil.

10. Repeat step 9 for all remaining coils to be tested.

PROCEDURE B.

This test is performed with the HE7 magnetic head and the FPH2 flux probe.

Field coils may be tested using the normal external F1, F2, and S1, S2 connections,

or if desired, each coil may be tested individually in the machine for polarity and strength prior to internally connecting them.

When testing the series field or interpoles, **DO NOT TOUCH THE SHUNT LEADS**, as a transformer action will take place and **hazardous voltages may be present**.

1. Testing is performed with the two alligator clip leads supplied and the FPH2 flux probe (see figure 2 for flux probe and field pole positioning).

2. **Turn the POWER OFF** Connect the clip leads to the desired connections (F1, F2, or S1, S2). Keep the polarity of the clip leads the same when comparing series and shunt fields. Black clip lead to F2, Red clip lead to F1, or Black to S2 and Red to S1. Keeping this in mind, the polarity of the series field and shunt field will be the same if the leads are tagged correctly.

3. Select either the SERIES or SHUNT position on the selector switch. When using the SHUNT position, the bargraph will indicate a peak with each impulse (approximately 2 impulses/sec.). This peak value is your field strength.

4. Turn on the power.

5. Place the FP-H2 probe on one of the pole piece tips and adjust the gain control for approximately 120% on the bargraph. If the bar graph will not come up to the 120% point move the probe around on the pole piece to find a spot that will give a greater reading (generally near the pole tips see figure 2). If a large enough reading still cannot be found it will be necessary to test each coil individually. It is not necessary to physically break the connections to each coil if they are in series, only

to make contact with each of the individual coil leads. A low reading or indication will most likely be encountered on larger pole pieces (larger than 6 inches across) and higher voltage shunt fields (240v or more).

6. Slowly swing the probe across the pole piece end from tip to tip as shown in figure 2. Record the highest or peak reading obtained. Observe the polarity on the LED indicator. Repeat this step for each pole piece observing the polarity and field strength. Any reduction in field strength is proportional to the percentage of shorted turns a coil may have. For example in a 5 turn series field a single turn short would indicate 20% or more low and a single turn short in a 3 turn coil would give a 33% or more lower reading. Any significant reduction of pole flux indicates a possible bad coil.

When comparing the field strengths at each pole, it is important to take the measurements the same way, either tip to tip or in the same spot if the pole pieces are too small to allow the probe to swing tip to tip.

When a pole piece contains more than one winding (series and shunt coils on the same pole), shorted turns may be indicated in both coils but only one may actually have shorted turns.

SETTING NEUTRAL PLANE

TURN POWER OFF. Neutral plane settings are made with the HE7 magnetic head and the two cables supplied. The cable with the banana plugs and the large clips is connected to the field connections and the cable with the phone plug and small clips is attached to the brushes. Connection polarity of either of the cables is not important.

1. Connect the cable with the banana plugs and large clips to the field leads.

2. Connect the cable with phone plug and small clips to the brushes.

3. Set the gain control to about 5 and select BAR/SERIES on the toggle switch.

4. Turn the POWER on.

5. Adjust the gain setting to obtain a reading of about 100 on the bargraph.

6. Slowly rotate the brush rigging and observe the polarity LED. When neutral plane is crossed the LED will change polarity or color. The LED is can used to obtain an approximate or final setting on large machines.

7. Readjust the gain control as necessary for a reading of about 100

8. The final setting is done by observing the bargraph. The proper neutral plane setting will occur when the bargraph gives a minimum reading. SLOWLY rotate the brush rigging back and forth to obtain the minimum indication on the bargraph. The HE7 unit is quite sensitive and the exact neutral plane setting will be found with very minor movements of the brush rigging.

9. When the correct neutral plane position is found tighten the brush rigging. The process of tightening the bolts will probably cause you to slip off of the exact setting. If you used care in obtaining the setting this small shift should not affect the actual operation of the rotating equipment.

10. **TURN POWER OFF** before disconnecting any of the leads.

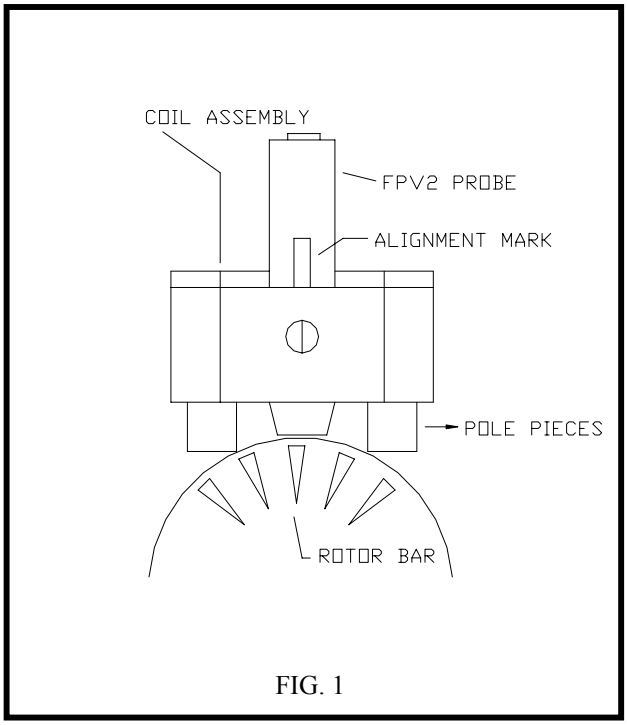
COIL ASSEMBLY
FPV2 PROBE
ALIGNMENT MARK
POLE PIECES
ROTOR BAR

FIG. 1

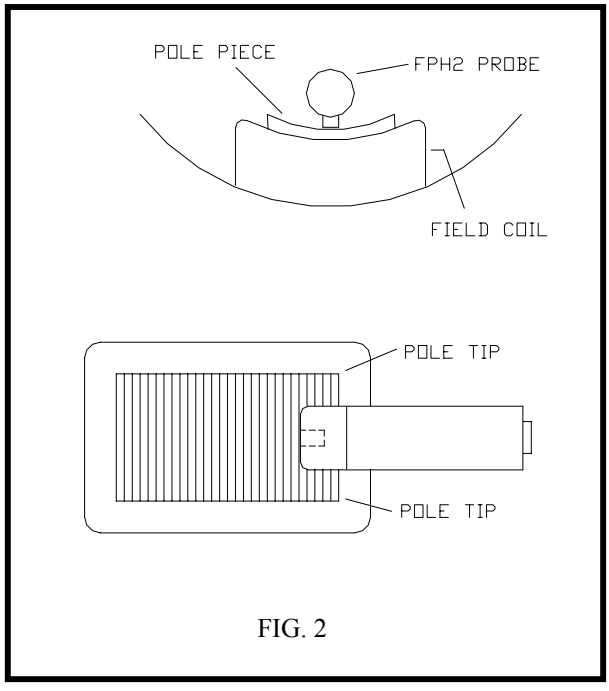
POLE PIECE
FPH2 PROBE
FIELD COIL
POLE TIP
POLE TIP

FIG. 2