INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

MARK 1a DUAL RANGE DEMAND REGISTERS FOR USE ON D-LINE WATTHOUR METERS

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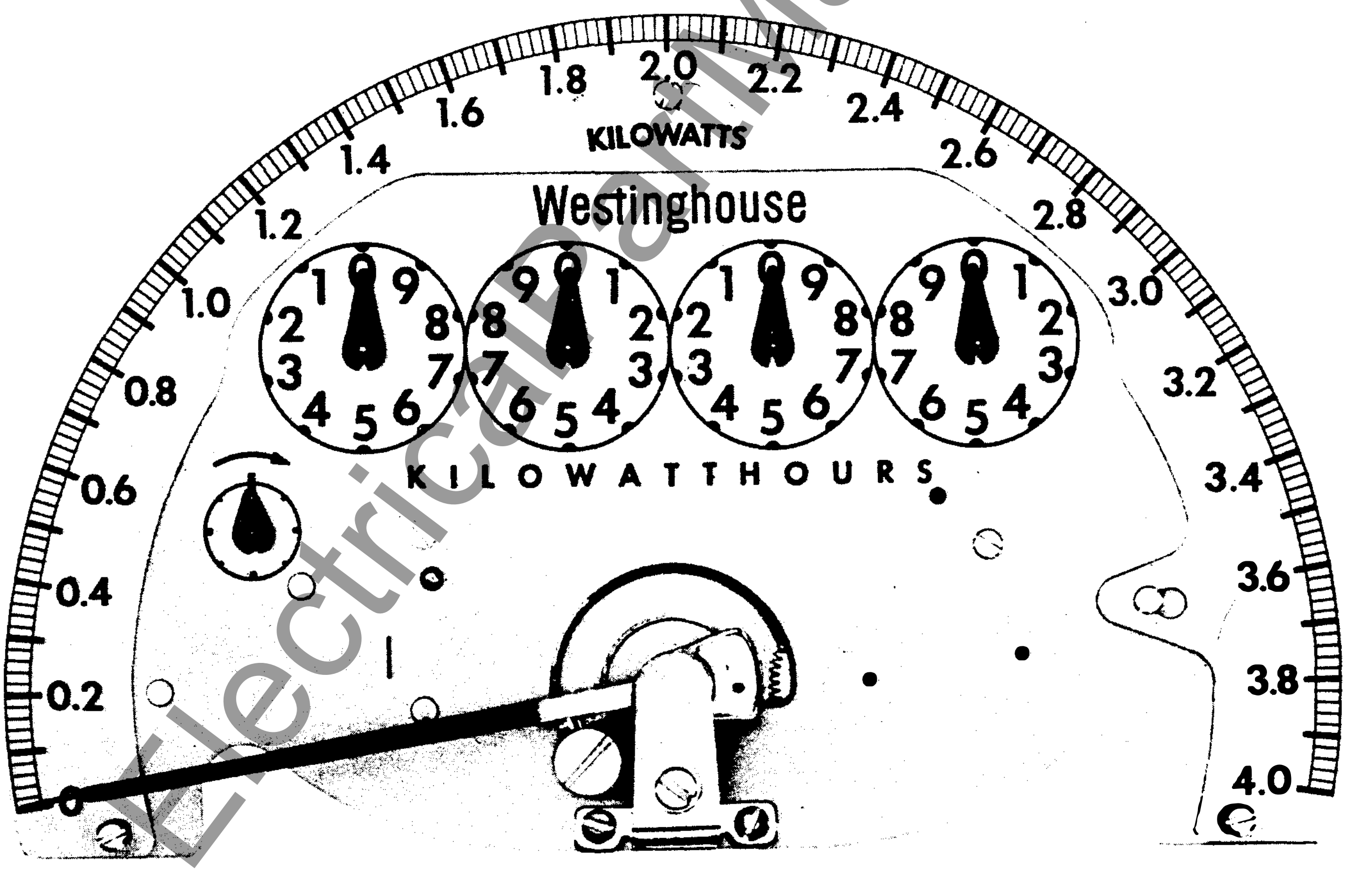

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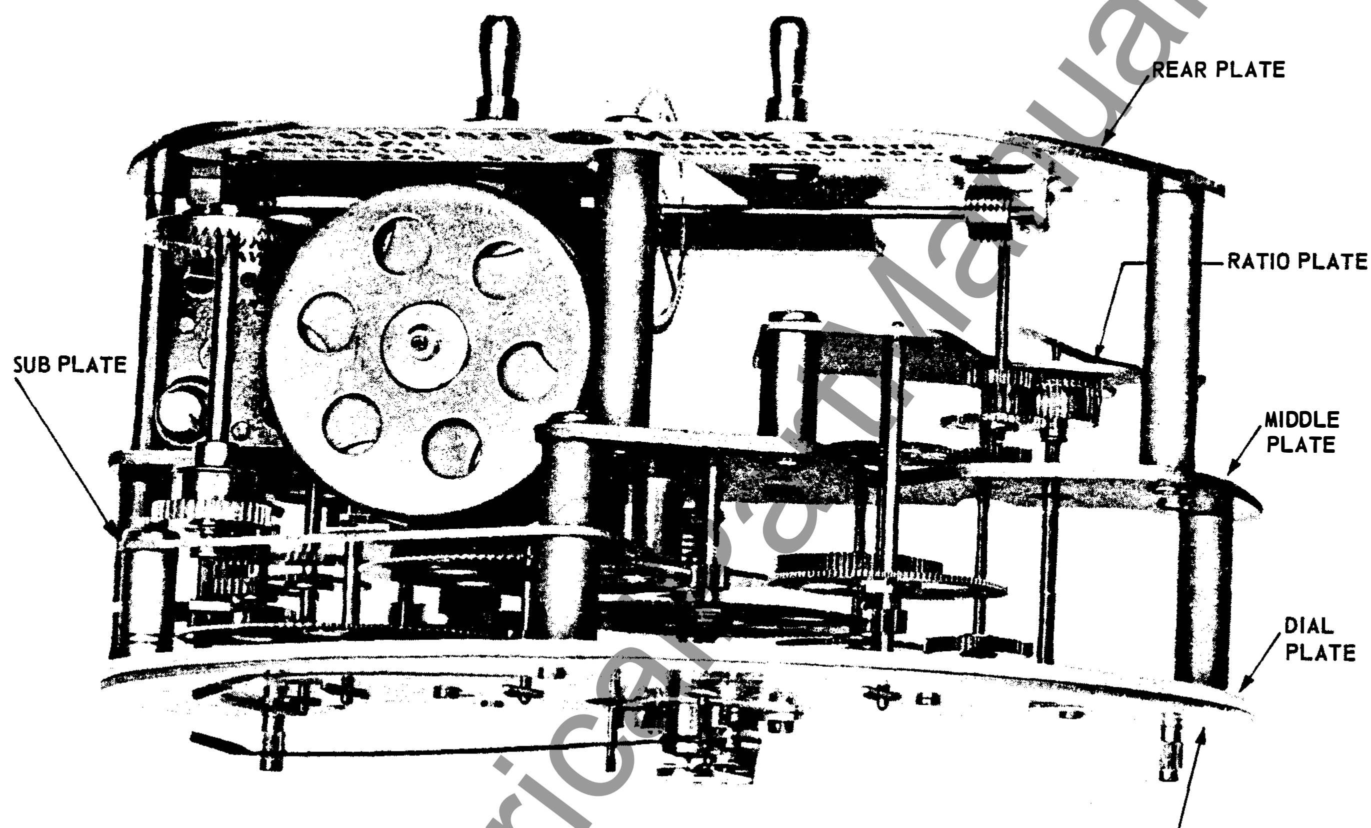

FIG. 1

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INTRODUCTION

The Mark Ia register eliminates the two-pusher design used in the Mark I thereby reducing test time and improving reliability.

The Mark Ia registers convert watthour meters to block interval demand meters. The "watthour demand meters" are identical to watthour meters except for the addition of the demand register and its necessary components: two lead connections for the motor and a glass cover with a mechanical reset. The mechanical demand register gives a combination of the kilowatt hour consumption, just like the standard kilowatt-hour register, and in addition gives the maximum kilowatt demand over a definite time interval by means of a pointer moved over a graduated demand scale.

GENERAL DESCRIPTION

The Mark Ia demand register has a standard kilowatt-hour gear train plus a demand gear train. Both gear trains are driven by the disk shaft.

The interval is accomplished by a synchronous motor and a gear train which turns a cam. The cam pivots an arm which engages a clutch. The clutch when engaged turns a pusher. The pusher contacts a demand pointer. The pointer has enough friction to hold it on any point of the scale to which it is pushed.

During the time interval, the pointer pusher is driven up scale at a rate proportional to the load on the watthour meter. If the demand of the interval exceeds that of the previous interval with the highest demand, the pusher moves the pointer up scale to the point representing the new maximum demand. The pusher is returned to zero at the end of each interval by the action of the cam on a sector gear.

PRINCIPLE OF OPERATION

The following is a description of the operating principle of the Mark Ia demand register (Fig. 2).

The meter disk shaft drives the wormwheel on shaft (1). Shaft (1) turns shaft (2) which turns shaft (10), the kilowatt-hour gear train and the pointer shafts (11) (12) (13) (14) and (15). Shaft (2) also turns shaft (3). Shaft (3) turns the pusher (41) on clutch shaft (6) through shafts (4) and (5).

Both shafts (2) and (3) have two gears and pinions which change mesh when the scale plate is reversed to change class. This gives the dual range feature. As an example to change from Class 2 to Class 6, the scale is reversed and a tab on the scale when placed on the Class 6 side depresses shaft (3) which is then put under spring tension. This action disengages a gear and mating pinion on shafts (2) and (3) and automatically engages a different gear and pinion on these two shafts. This change in ratios corresponds with the scale in use automatically due to the contour of the scale. (Figures 2 and 3).

The time interval is established by the operation of a synchronous motor as it drives thru a gear train to a cam which trips the clutch and returns the pusher to zero by its action on the sector gear (7) and the lever arm (43). The operations are accomplished as follows: crown gear shaft (25) is turned by the output shaft of the synchronous motor. Shaft (25) turns shaft (26), and the driving disk on this shaft turns shaft (27) which turns the time elapsed indicator shaft (30) and also has a driving disk which turns shaft (28). Shaft (28) drives the cam shaft (29). The cam on shaft (29) performs a dual function:

(1) It pivots lever arm (43) which disengages the clutch for the interval reset.

(2) The top outer surface of the cam depresses the spring on the sector gear (7) and drives the pusher (41) on shaft (6) back to zero.

SCALES

The Mark Ia is a dual range register and is available as Class 1 and 2, Class 2 and 6, Class 3 and 5, or Class 4 and 8. The class change is accomplished by reversing the scale which mechanically changes the gear ratios to correspond with the scale in use. (Fig. 3).

A dial multiplier with the words "Multiply all Readings By" is available for meters on which required. A second position is also available on the left hand side of the register for special applications where additional multipliers or information is desired.

In special cases where a customer has standardized on a given demand scale (Example: 0-2.0 KW), the scale plate is not reversed to change the scale class. Instead, a special multiplier tag is reversed which accomplishes the gear shift required and shows the new demand multiplier.

The base speed of the following D-line meters on which these registers are used is either 1000 r.p.h. or 500 r.p.h., and the disk shaft has a single lead worm that meshes with a 100-tooth wormwheel. Listed in the tables (Pg. 7) are some typical register ratios (Rr), watt-hour constants (Kh), and their corresponding demand scales.

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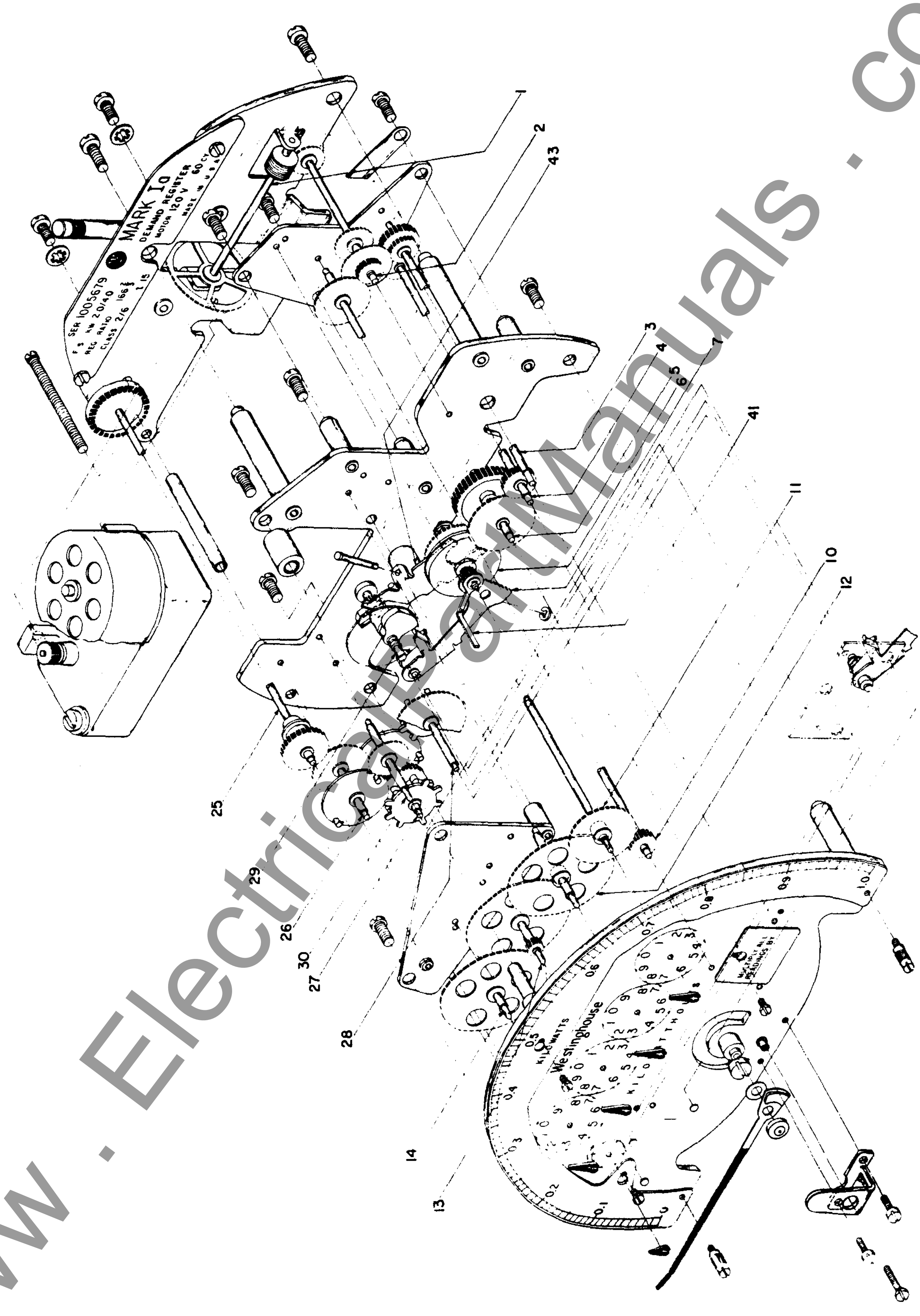

Fig. 2

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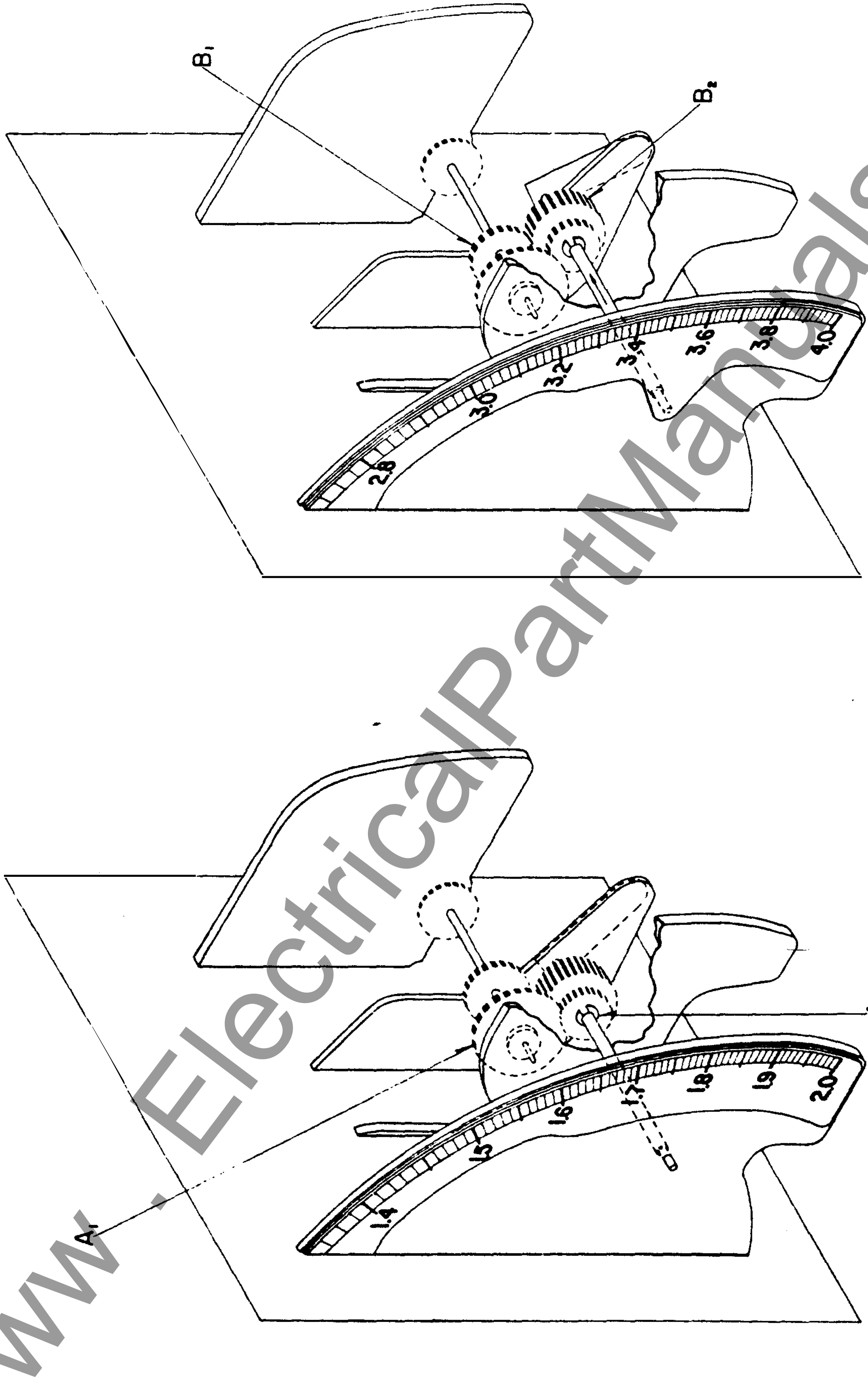

Fig. 3 Dual Range

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For Meters with Base Speed 1000 r.p.h.

Volts	Amperes	Stators	Kh	Rr	Full Scale Reading Kilowatts *			
					Class 2	Class 6	Class 3	Class 5
120	2.5	1	.3	333 1/3	1	2	.75	1.5
120	15	1	1.8	55 5/9	6	12	4.5	9
120	2.5	2	.6	166 2/3	2	4	1.5	3
120	15	2	3.6	27 7/9	12	24	9	18

For Meters with Base Speed 500 r.p.h.

Volts	Amperes	Stators	Kh	Rr	Full Scale Reading Kilowatts *			
					Class 2	Class 6	Class 4	Class 8
120	2.5	2	1.2	83 1/3	2	4	2.4	4.8
120	15	2	7.2	13 8/9	12	24	14.4	28.8
120	2.5	3	1.8	55 5/9	3	6	3.6	7.2
120	15	3	10.8	9 7/27	18	36	21.6	43.2

*The Mark Ia register has 2 classes built into one register depending on the scale used.

UNIVERSAL REGISTER FOR METERS WITH BASE SPEED 16 2/3 RPM TYPES DS-DA-D2S-D3S D2A-DSP-2-5-7-8 DAP-2-5-7-8 D2S-2-5-7-8 D2A-2-5-7-8 D4SM SINGLE-PHASE

In order to provide flexibility in application of registers to meters of any KW capacity, the "Universal" demand register is recommended. For self-contained class 100 and 200 meters this is the R-166 2/3 ratio (direct reading on meters with Kh .6) with a class 2/6 demand scale. This register would have a 2 KW or 4 KW scale depending on the class setting.

The 166 2/3 register ratio is chosen because it provides register dial multipliers that are whole numbers (not fractions) on practically every type and rating of self-contained meter. The proper register multiplier is found as follows:

$$\text{Multiplier} = \frac{\text{Meter Constant (Kh)}}{0.6}$$

In the case of transformer rated class 10 meters, the proper register multiplier is found as follows:

$$\text{Multiplier} = \frac{\text{Meter Constant(Kh)} \times \text{CT ratio} \times \text{PT ratio}}{.6}$$

Since Kh pri = Kh sec X CT ratio X PT ratio, this formula can be used:

$$\text{Multiplier} = \frac{\text{Kh pri}}{.6}$$

UNIVERSAL REGISTERS FOR D4 POLYPHASE METERS WITH BASE SPEED 8 1/3 RPM

With the advent of the D-4 polyphase meters which have a base speed of 500 R.P.H. and a first reduction of 100, a universal register with less gear reduction (twice as fast) should be considered. For self-contained class 200 meters, this is the R_r = 83 1/3 ratio (direct reading on meters with Kh = 1.2) with a full scale of 2 KW or 4 KW depending on the class setting.

The 83 1/3 register ratio is chosen because for the 500 R.P.H. meter it provides register dial multipliers that are whole numbers (not fractions) on practically every type and rating of self-contained meter. The R_r 83 1/3 is direct reading on a meter with a Kh = 1.2. The proper register multiplier is found as follows:

$$\text{Multiplier} = \frac{\text{Meter Constant (Kh)}}{1.2}$$

In the case of the transformer rated class 20 meter, the R_r - 83 1/3 ratio (direct reading on meter with K_h = 1.2) register with a class 4/8 full scale is recommended. This register would have a full scale of 2.4 KW or 4.8 KW depending on the class setting. The proper register multiplier is found as follows:

$$\text{Multiplier} = \frac{\text{Meter Constant(Kh)} \times \text{CT ratio} \times \text{PT ratio}}{1.2}$$

Since Kh pri = Kh sec X CT ratio X PT ratio this formula can be used.

$$\text{Multiplier} = \frac{\text{Kh pri}}{1.2}$$

In all cases the multiplier will apply to both KWH and KW demand readings.

INSTALLATION

These registers are designed for use only on Westinghouse meters. They are designed to be interchangeable with the standard kilowatt-hour register in order to convert from a standard kilowatt-hour meter to a demand meter.

The registers are adjusted and checked for accuracy of registration at the factory and are ready for immediate installation. However, to insure that the register has not been damaged in shipment and that the

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necessary parts have been received for field conversion, the following procedure should be followed:

1. Unpack the register with care.

2. Inspect the register as follows:
   a. Check the nameplate mounted on top of register back plate to insure that the register is correct for the meter with which it is to be used. Check the meter class vs Register Full Scale to verify that register KW full scale corresponds with the thermal capacity of the meter. For instance, a Class 200-240 volt, 2 stator polyphase meter would have a thermal capacity of 200 x 240 x 2 = 96 KW. The correct matching register for this meter should have a full scale of 96 KW.

   b. Check all shaft assemblies for end play and gear mesh.

   c. If it is desired to check the calibration, proceed as outlined under Testing Watthour Demand Meters and Testing Demand Registers.

3. Remove Kilowatt-hour register and attach leads to meter potential terminals. The leads are furnished with the proper connectors so that any disassembly of the meter proper or soldering is eliminated. This is true for all meters except the 3-wire, single-phase meter which is not recommended for field conversion.

4. On 120-volt meters, the Mark Ia is furnished with a 120-volt motor and on 240-volt meters the Mark Ia is furnished with a 240-volt motor. The 240-volt motor will operate between 200 and 300 volts and is adequate for 277-volt application. On 480-volt meters, a 240-volt motor and 240-volt reactor coil are used.

   Wiring drawings for the installation of leads and reactors are shown in Figures 10 through 25. All A-base polyphase meters above Serial No. 53,980,000 are shipped equipped with Demand Motor Leads.

5. In the place of the kilowatt-hour register, install the new Mark Ia register. No changes are necessary in the meter proper.

6. Connect the leads to the motor.

7. Apply rated voltage and see that motor functions correctly.

8. Recheck complete meter on full load and light load adjustment. A slight light load adjustment might be necessary to compensate for the additional friction load of the mechanism. While this adjustment is being made, the demand pointer should be up scale so that it is not being driven when calibrating the meter. This corresponds to actual operating conditions as it is very unlikely that maximum demand will occur when the meter is operating at very low loads.

9. Apply demand type cover. For Mark Ia, check to see that reset wire is the proper length.

10. Install complete meter in service as usual for watthour meters.

ADJUSTMENTS AND MAINTENANCE

GENERAL

Mark Ia demand registers are constructed of compatible materials and designed to give maximum trouble-free service. The design is such that preventative maintenance is easily performed and should failure occur, the register can be repaired with minimum difficulty.

CLEANING THE REGISTER

The Mark Ia register can be ultrasonically cleaned. The following procedure is recommended for this cleaning.

1. Remove the motor from the register by removing the two screws in the backplate holding the motor in. The motor is then pushed upward and brought out through the top of the register by rotating slightly around the crown gear shaft No. 25.

2. The register can now be ultrasonically cleaned.

   CAUTION: In order to avoid trapping cleaning solutions in the over-rides and with some cleaning solutions causing corrosive action, the clutch should be propped open and rinsed properly. A toothpick or paper clip can be used to prop the clutch open.

Ultrasonic cleaning is an art and science in itself, and its' success or failure in many cases is related to the understanding of the subject and equipment by those who are responsible for its use. For instance, a knowledge of the following variables is essential: effects of frequency, power density, tank size, holding fixtures or basket design, solution contamination, attitude of parts to be cleaned, type of soil to be removed, cleaning agent concentration and its effects on the particular metals, plastic or fibers in the apparatus, time element to achieve satisfactory cleaning without damaging the components of the apparatus, the number of parts to be cleaned vs. the power level.

It is also important to realize that after the registers

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have been ultrasonically cleaned the parts are chemically clean and subject to galling; therefore, either a final dip, rinse, or application of a lubricant is recommended. One such lubricant solution for dipping or rinsing which is very satisfactory consists of .373 grms. lithium stearate per liter of denatured alcohol (.031 ounces per gallon). An alternate method of applying a lubricant would be to use powdered lithium stearate and apply to the bearing surfaces with a small artist brush. These materials are available from any chemical supply house.

A typical example of an ultrasonic cleaning process found to be satisfactory for Mark registers by Westinghouse using an ultrasonic cleaner with the following capacity is as follows: Average power output 1000 watts - peak output of 2000 watts - nominal frequency of 20 KC (variable from 18 to 20 KC) and a cleaning tank of 2-gallon capacity.

1. Suspend register in a solution of Bendix 25-1** (2 ounces per gallon water) heated to 140 to 150 degrees Fahrenheit and ultrasonically agitate for one minute.
2. Rinse in hot, running tap water for 30 seconds.
3. Ultrasonically rinse in hot, clean tap water 30 seconds.
4. Blow with clean compressed air until all signs of water are removed.
5. Dry in 100 degrees Centigrade (212 degrees Fahrenheit) oven for 5 minutes.
6. Allow to cool to room temperature.
7. Dip in an alcohol-lithium stearate solution 0.373 grams lithium stearate/liter denatured alcohol (0.031 ounces per gallon).
8. Drain over the lithium stearate solution until dripping ceases.
9. Hang to dry at room temperature for 10 to 15 minutes.

**Cleaner Concentrate, Pioneer Central Division, Bendix Aviation, Inc., Davenport, Iowa.

Where the ultrasonic method of cleaning is not used, the following cleaning procedure is recommended.

1. Disassemble the register completely as described under Disassembly of Register.
2. Each component should be cleaned with a good grade of clock cleaning fluid and rinses such as L & R solutions.
3. Dry all parts thoroughly after cleaning.
4. Reassemble the register as described under Reassembly of Register.
5. Apply lubricant as described under Ultrasonic Cleaning.

CHECKING THE MOTOR

Since the motor gear reduction is completely enclosed and running in a good grade of oil, it should not require cleaning. Instead, it is recommended that the motor be tilted so that the oil will drain down under the oil filler screw. Use a syringe to put oil in the motor. Insert it in the oil filler hole. Try to draw out the oil. When the motor contains the recommended 1-1/2 cc of oil, it is only possible to draw 6/10 to 8/10 cc with the syringe. The remainder is trapped in the bearings and lubricating clearances. If oil can be drawn up in the syringe or if it can definitely be established that there is oil in the motor and it is clean, then put this oil back in the motor and replace the oil filler screw. This should be all the service necessary for the motor. If oil is dirty, indicating wear, motor should be replaced.

DISASSEMBLY OF REGISTER

The following procedure is recommended for the disassembly of the Mark Ia register. An assembly block such as shown in Figure 4 facilitates the disassembly of the register.

By placing the register mounting bayonets in a meter, meter frame, or in a block the following parts can be removed (See Fig. 1 for Plates):

1. **Demand Pointer.** Remove the spring tension screw and then the two screws holding the pointer protective bracket and spring. Remove spinner, demand pointer, and fibre washer.
2. **Scale.** Remove the screws holding scale to dial plate.
3. **Pointers.** Using a pointer puller, Style No. 285A555H01, or large screw-driver with paper protecting the dial, remove pointers from ends of shafts being careful not to scratch the dial.
4. **Multiplier Tag.** Remove screw and take off or loosen screw and push tag up and lift off.
5. **Motor – Terminal Block – Back Plate.** Put register face down in assembly block. Remove 5 screws and take back plate, motor and terminal block assembly off. Remove No. 25 shaft assembly.

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CAUTION: Place back plate down on bayonet side to prevent damage to the worm wheel.

6. **Worm Wheel (No. 1 Shaft).** Turn screw until flat on screw head allows shaft to be removed.

7. **Nameplate.** Remove two screws.

8. **Ratio Plate – Dual Range Spring.** Remove No. 2 shaft. Remove 3 screws holding ratio plate and dual range spring and lift plate off. The following shafts can now be removed: No. 3, No. 4, No.10, and No. 11 shafts.

9. **Middle Plate.** Remove 4 screws holding middle plate and lift off. The following shaft assemblies can now be removed: (27), (28), (29), (30), (26), (5), and clutch shaft (6).

   The clutch shaft can be completely disassembled by removing the retaining rings on the front, middle, and rear of the shaft.

10. **Sub Plate.** Remove spacer, one screw, and lift plate off. The following kilowatt-hour shafts can now be removed: (11), (12), (13), (14), and (15).

11. **Sector Gear.** Remove the retaining ring and lift off.

REASSEMBLY OF REGISTER

The Mark Ia can be reassembled as follows: Again an assembly block as shown in Figure 4 facilitates this assembly. Applicators, Style No. 1960343, are available for applying retaining rings to shafts (See Fig. 1 for plates).

1. **Front Plate (Dial)**
   Place plate face down in assembly block. Put the sector gear (7) on its front plate pin. It is not necessary to apply retaining ring at this time. Put the following shaft assemblies in their bearing holes in the front plate with the long tapered pivot end thru the plate: (11), (12), (13), (14), and (15).

2. **Sub Plate.**
   Put sub plate on posts and guide shafts into bearing holes. Put screw in and tighten. Put spacer over post.

3. **Clutch Shaft (6)**
   If the clutch shaft was disassembled use the following procedure for reassembly:
   a. Put rear retaining ring into one of the inboard four grooves. Guide the spring centering spacer over the shaft with small diameter to the front.

   b. Place spring over shaft and guide on shoulder of spring centering spacer.

   c. Place rear assembly on shaft, compress spring and apply center retaining ring.

   d. Place front assembly on shaft and apply front retaining ring.

4. **Cam Shaft** No. 29

   Put this shaft in the front plate with the gear toward the rear of the register. Make sure small spring is on front end of shaft.

5. **Interval Gear Train**

   Assemble in the following order (Fig. 2):
   a. No. 26 shaft, put in with the driving disk and pins closest to the front plate.

   b. No. 30 shaft. (Interval Indicator) put in with the long tapered pivot end through the front plate.

   c. No. 27 shaft, put in with the driving disk and pins toward the rear of the register.

   d. No. 28 shaft, put in with the gear toward the rear of the register.

6. Orient disk and pins in neutral position and position cam shaft as shown in Figure 5 (b). This position will facilitate the assembly of the middle plate and trip lever.

7. **Middle Plate.**

   Guide the middle plate assembly into position making sure the prongs of the lever are located between the disk and the gear on the (6) clutch shaft. Put four screws in and tighten down. The cam should be in the second neutral position as shown in Figure 5 (b). The second neutral position facilitates the assembly of the middle plate.

8. **No. 10 Shaft**

   Keep register face down in assembly block and put No. 10 shaft in its front plate bearing hole. The other end of this shaft will have the gear on the outside of the middle plate and the shaft will go thru the cut out section of the plate.

9. **No. 5 Shaft**

   Put this into its bearing hole in the front plate thin gear closest to the front plate.

10. **No. 4 Shaft**

    Put this into its bearing holes in front plate so that large gear is closest to the front plate.

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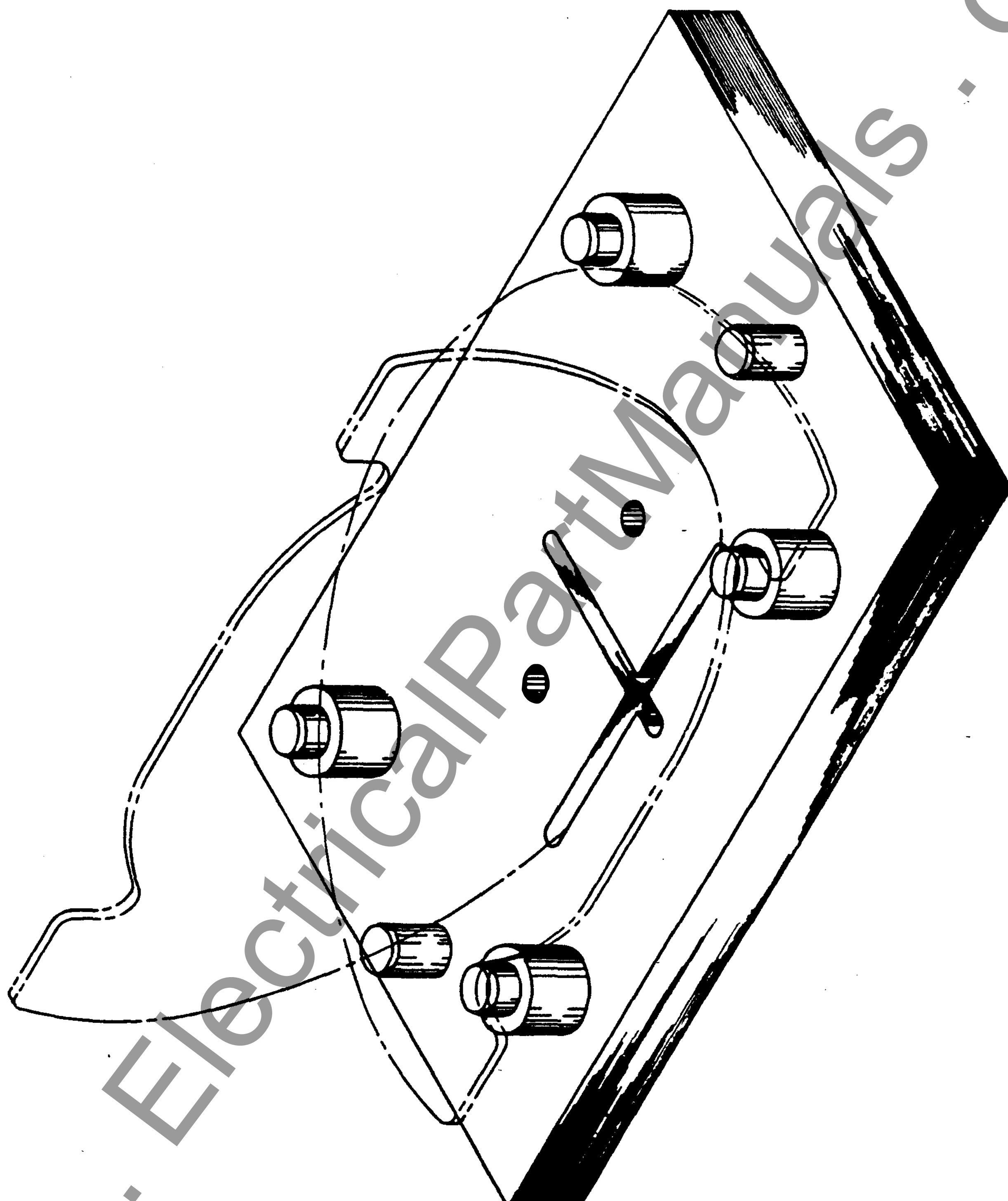

Fig. 4 Assembly Block S# 110C152G01

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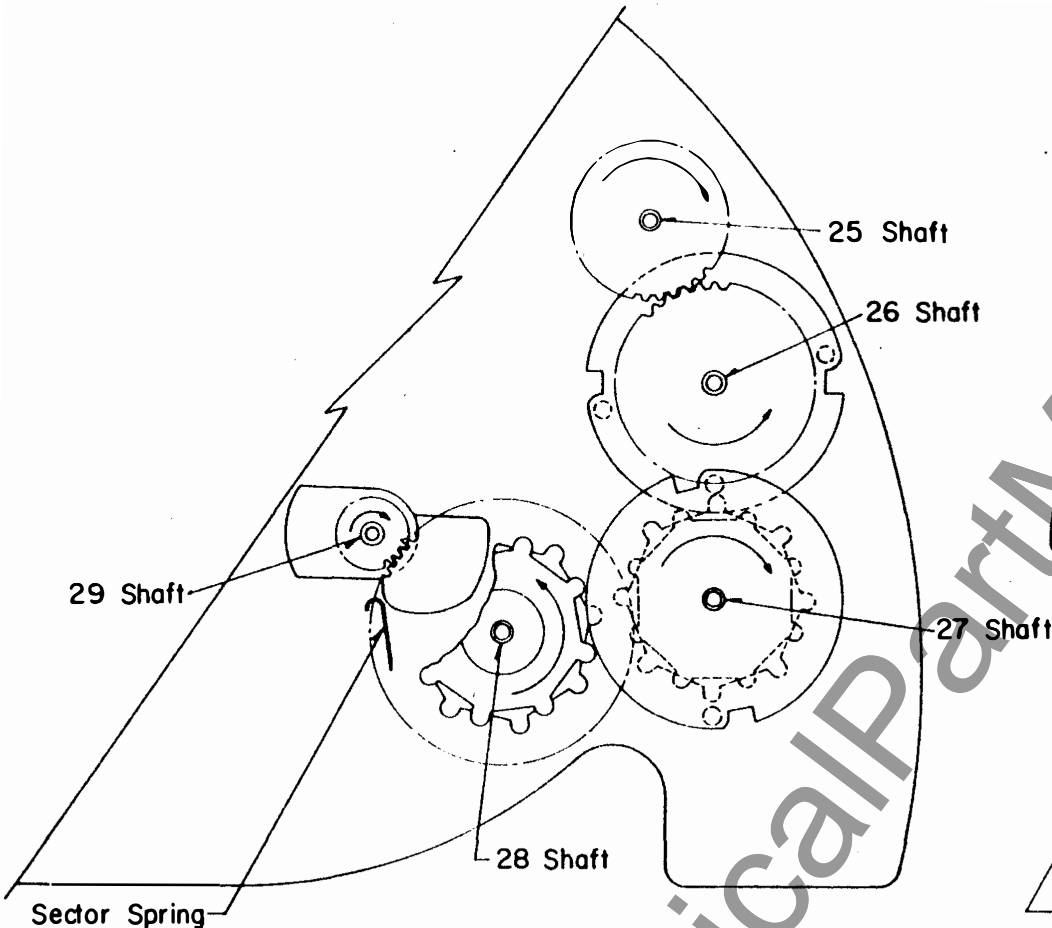
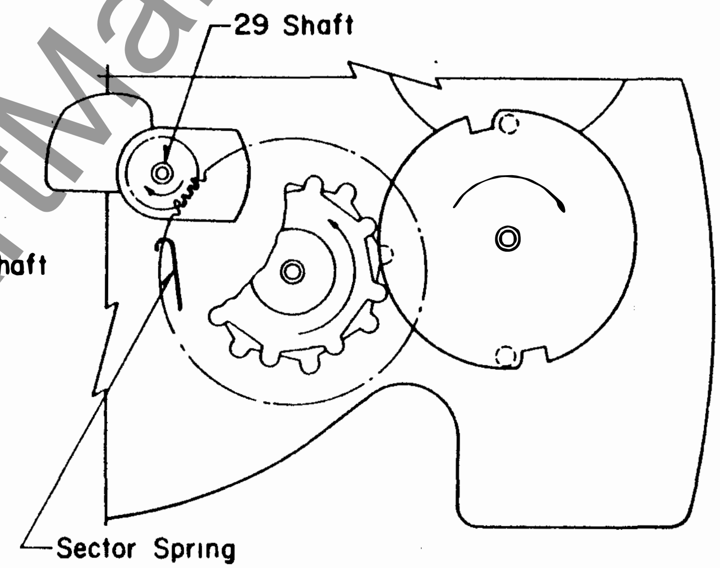


Cam, Interval Gear Train & Sector Spring Locations (1st Neutral Position)
Fig. 5A



Cam & Interval Gear Train Locations For Reassembly (2nd Neutral Position)
Fig. 5B

Fig. 5a & 5b Cam & Interval Gear Train Locations for Reassembly.

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11. **No. 3 Shaft (Dual Range Shaft) (Fig. 3)**

Put the long end of the shaft thru the hole in the middle plate and into the bearing hole in front plate.

12. **No. 11 Shaft**

Put this shaft into its front plate bearing hole with the long tapered pivot end through the front plate.

13. **Ratio Plate**

Put plate in its relative position and put each shaft in its bearing hole. Put 2 screws in right hand side and the flat spring goes under the 3rd screw on the left hand side. Center the spring over pivot of dual range shaft and tighten screw.

14. **No. 2 Shaft**

Put the end of the shaft which has three gears on it in the bearing hole of the middle plate and meshing with gear on dual range shaft. For some ratios it may be necessary to pull back on No. 3 shaft to allow the pivot of the No. 2 shaft to go in its bearing hole.

15. **No. 25 Shaft (Crown Gear)**

Put this shaft in its bearing hole in the sub plate.

16. **Motor Assembly**

Lay the motor in its proper position resting on the middle plate with the output pinion in relative position to mate with crown gear on No. 25 shaft.

17. **Back Plate Assembly**

If No. 1 shaft was removed, put it back in bearings and turn the round edge of the retaining screw toward the back plate.

Place back plate in proper relation to its posts and with worm mating with gear on No. 2 shaft, and seat the crown gear shaft in its bearing hole in the back plate.

Put the 5 screws, spacer, and motor-mounting lockwashers in and tighten down.

18. **Scale Assembly**

Put register on a meter, meter frame or assembly block as shown in Figure 4 with dial up. Put scale in place and put screws in.

19. **Multiplier Tag**

Replace multiplier tag if used by putting keyhole slot over screw and sliding the tag down. Tighten the screw.

20. **Kilowatt-Hour and Interval Pointers**

Put large pointers on kilowatt-hour shafts and the small pointer on interval indicator shaft.

21. **Demand Pointer Assembly**

With register in same position as described in Step 18, assemble as follows:

a. Put fibre washer on demand pointer hub.

b. Put demand pointer on.

c. Put spinner on.

d. Put protective bracket and spring on and tighten two screws down that hold bracket on.

e. Put spring tension screw in and tighten enough to hold spinner on.

22. **Zero Adjustment**

Turn the register dial face up and gently hold demand pointer against the pusher at the zero end of the scale. Rotate the zero adjusting post (Fig. 6) and position the demand pointer in the center of the zero line.

23. **Sector Gear Mesh Adjustment (Fig. 7)**

Put the register in the bottoms up position and insert sector spring adjusting pin Style No. 106R600H01 thru the hole in the middle plate until it rests in the hole provided in the front bearing plate.

a. Gently hold demand pointer against the zero end of the scale as described under Step 22 above.

b. Allow spring on sector gear to rest on adjusting pin and guide teeth of sector into groove in pinion of (6) clutch shaft. Slide sector forward on the shaft so that it can be meshed with pinion on the (6) shaft.

c. Put retaining ring on sector pivot post.

d. Remove spring adjusting pin from middle plate.

24. **Interval Indicator Adjustment**

The interval indicator can be set at 12 o'clock trip position by slipping small pointer on the shaft pivot.

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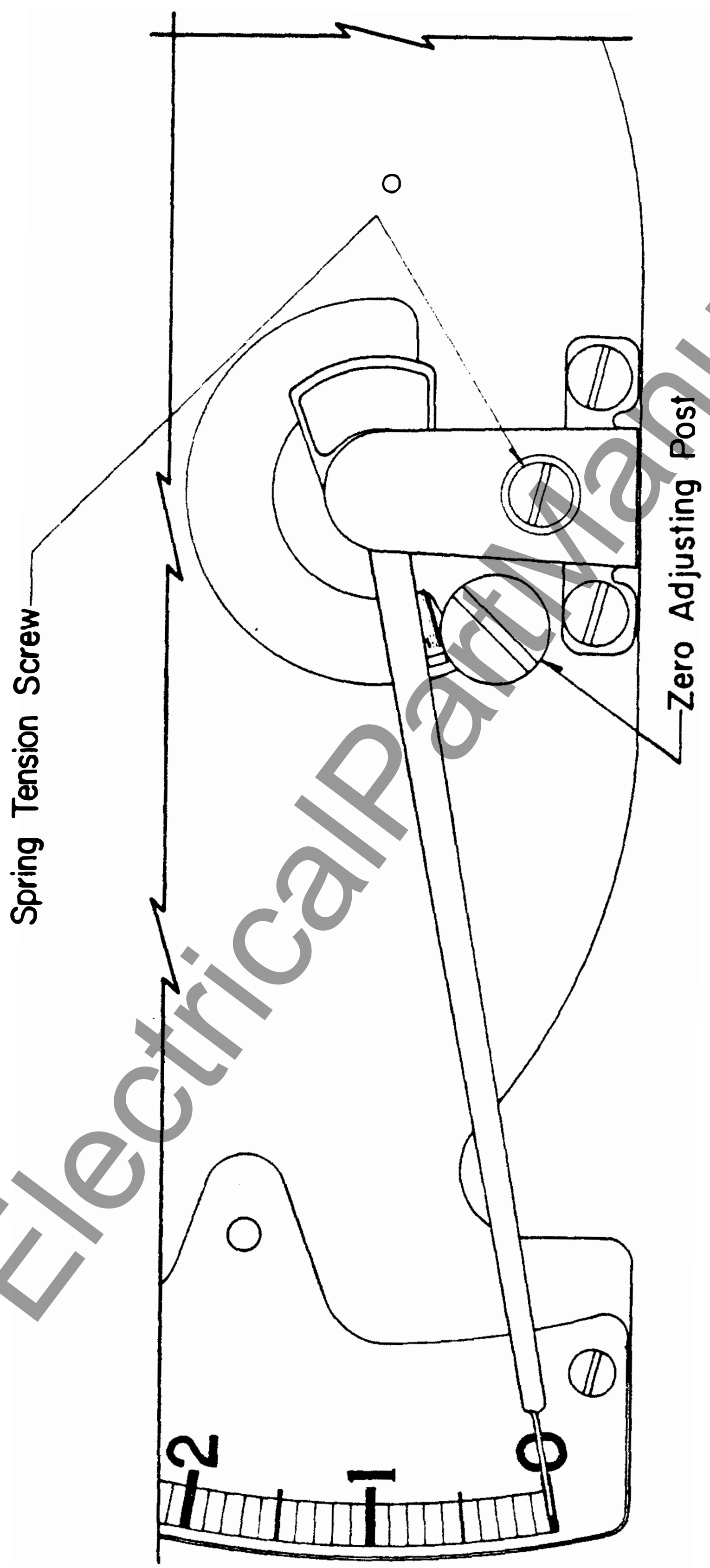

Fig. 6 Zero Adjustment

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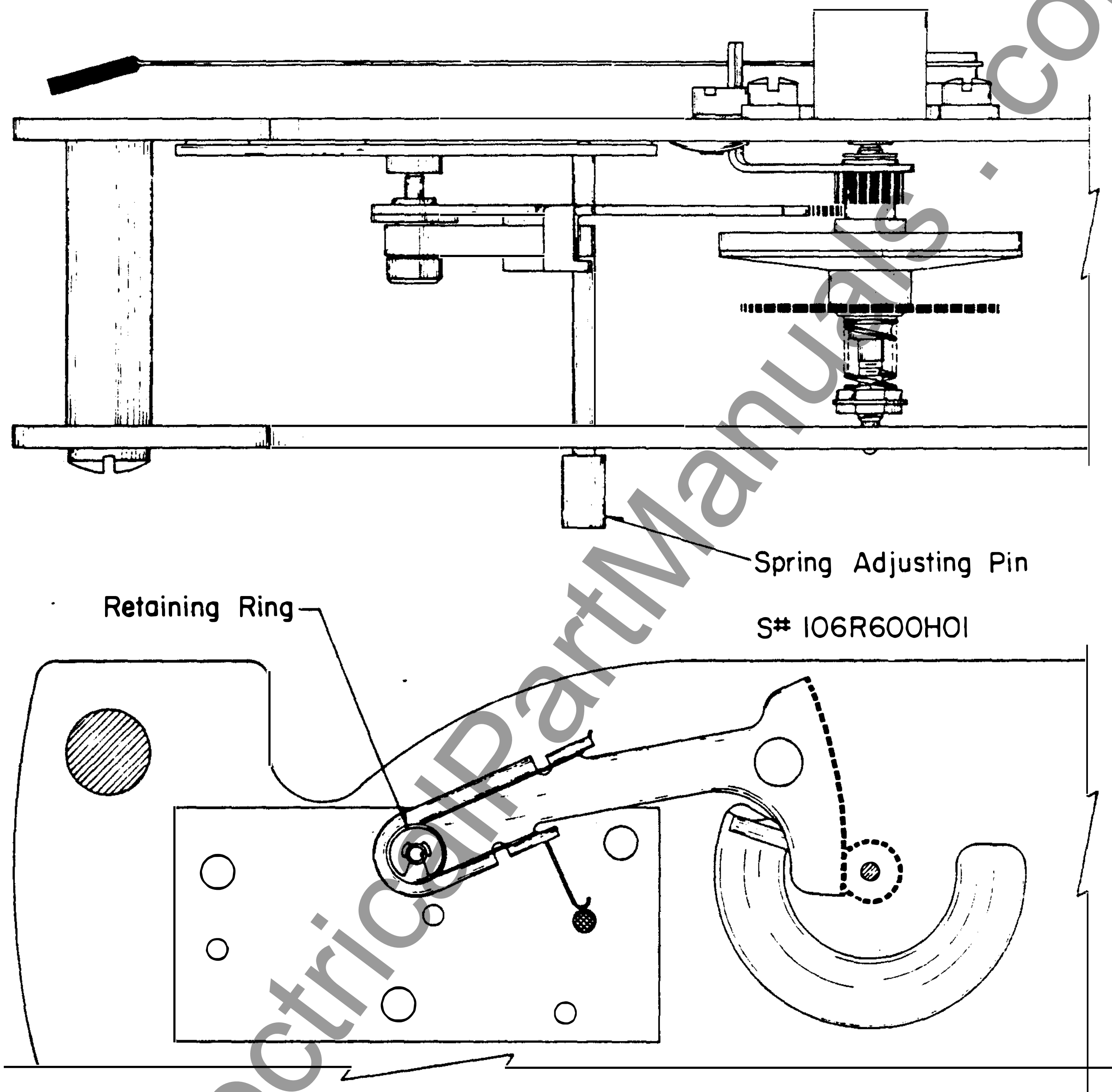

Fig. 7 Sector Adjustment

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25. **Checks to be Made After Assembly**

a. Check all shafts for end play.

b. Turn the power gear train thru manually by using the slip clutch on the (25) shaft.

c. Turn the (1) shaft and deflect the demand pointer to full scale making sure the sector spring clears the cam for both neutral positions (Fig. 5).

26. **Final Cam Setting**

Before the middle plate was assembled the interval gear train was positioned so that the cam neutral positions were as shown in Figures 5a and 5b. To insure the best location for smooth tripping action and proper open-time, the following check should be made.

a. Rotate the (1) shaft until the demand pointer is deflected to the off-scale (pegged) position.

b. Rotate the (25) shaft until the cam is in the first neutral position as shown in Figure 5a. Check to see that the sector spring is almost in contact but not putting pressure on the forward edge of the cam.

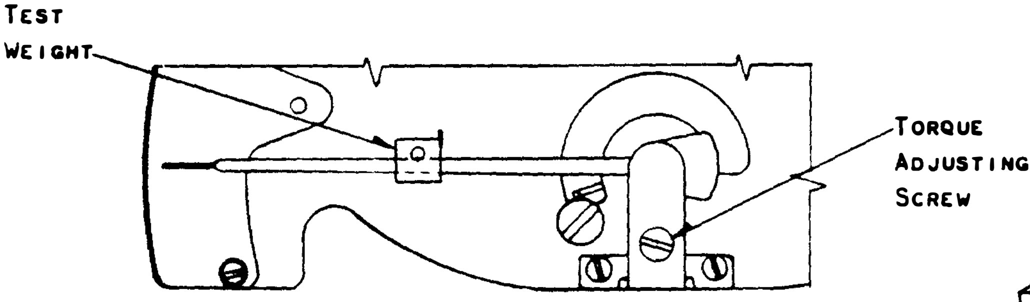
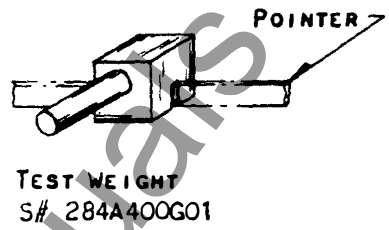


FIGURE 8A



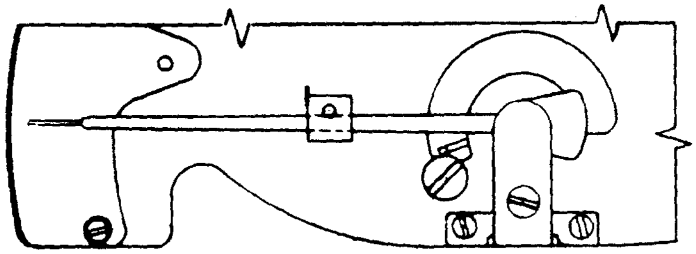


FIGURE 8B

c. In the event it is necessary to make an adjustment in the neutral position of the cam the following procedure should be followed:

1) Push the cam shaft forward compressing the coil spring until the pinion is demeshed from its mating gear on the (28) shaft.

   CAUTION. When pushing the cam forward in order to demesh make sure the lobe on the cam is not in a position to hit the large gear on the left hand kilowatt hour shaft.

2) With the gearing demeshed, the cam can be rotated in the desired direction.

3) Once the gear teeth are disengaged and rotation has commenced the pressure on the cam shaft can be released. The coil spring will snap the pinion back in mesh on the next tooth thereby insuring only one tooth rotation.

4) After rotating one tooth recheck the clearance between the lobe of the cam shaft and the sector spring per steps a and b, Pg. 15. Check the smoothness of operation by advancing the (25) shaft clutch manually and trip the (6) clutch.

27. **Clutch Open-Time Check**

If the cam has been set as outlined in Step 26 the open-time should be between 2 and 5 seconds. If the open-time is outside the 2 to 5 second range, the cam and sector probably needs to be shifted as outlined in Step 26. The open-time is checked with a stop watch as follows:

a. Turn the first (1) shaft and deflect the pusher (41) up scale.

b. With the motor energized, advance the demand gear train until the clutch is just before tripping as indicated by the interval indicator.

c. The open-time is measured between the time the pusher (41) drops back to zero and the clutch disk on the (6) shaft moves forward.

28. **Demand Pointer Spring Tension Adjustment**

The spring tension on the demand pointer is adjusted by using test weight Style No. 284A400G01 in the following manner. See Figure 8A and 8B.

1. Hold register in its normal operating position and make sure pusher is at zero.

2. Mount test weight to demand pointer and locate the right hand edge of weight with the vertical line as shown in Figure 8A. The pointer should slip down scale to a lower reading. (If pointer does not fall then turn counterclockwise on the torque adjusting screw until pointer does fall). This insures that the slip torque is below the maximum allowable.

3. Push demand pointer back to the horizontal position and slide test weight so that the left edge is in line with the vertical line as shown in Figure 8B. This insures that the slip torque is above the minimum requirement. (If pointer slips, it will be necessary to turn clockwise on screw until pointer does not slip and then recheck Step 2.)

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29. **Clutch Shaft Safety Check**

The clutch on the (6) shaft can be given a two to one safety check by positioning the test weight as shown in Figure 8a. If by turning the first (1) shaft in the register the pusher will rotate the demand pointer and advance the test weight through the horizontal, then the clutch has at least a two to one safety factor.

30. **Testing Watthour Demand Meters**

The same method of test employed for corresponding watthour meters are used when testing demand meters. However, when calibrating demand meters, the timing motor should be running and the register meshed. The demand pointer should be set at a position such that it will not be advanced by the pointer pusher at any time during the test.

TESTING DEMAND REGISTERS

1. **Mechanical Over-all Test Device Serial No. 110C174G01**

The best way to check the register calibration is by means of a constant speed device such as 110C174G01.

The test device simulates a meter operating under constant load. The register can be driven at a speed corresponding to meter speeds of 16-2/3, 33-1/3, and 66-2/3 rpm. This device has a shaft driven by a synchronous motor and three different worms to give the speeds indicated above.

The device is connected to a 120-volt source and the toggle switch is put in either the 120V or 240V position depending upon the voltage of the register motor. The register is mounted in the desired position and the motor leads coming from the binding posts on the left of the device are connected to the motor terminal block of the register. Varying frequency has no effect since both the test device drive motor and the timing motor in the register will change equally. The three speeds are used to check the full load point and multiples thereof. Therefore, this device will check all classes and three points of the scale.

The actual indication of a Mark II register may be computed by using the following formula.

$$\text{KW Reading} = \frac{6 \times \text{Test Device Setting } (16\text{-}2/3,\ 33\text{-}1/3,\ 66\text{-}2/3)}{\text{Register Ratio}}$$

2. **Portable Gear Checker 111C217G01**

This device shown in Figure 9 is designed for a quick check on the kilowatt demand gear train with respect to the interval timing gear train (exclusive of motor gearing). It is designed to check the full load point of all Mark Ia registers regardless of interval or register ratio.

Operation

Disconnect the motor leads and remove register from meter. Mount register checker bayonets in meter and tighten screws. Mount the register in the checker. This automatically engages the worm wheel of the register with the gear on the checker. Now pull the top of the checker (which is mounted on pivots) down on the register so that gear "A" on checker meshes with the overriding gear on the No. 25 shaft of the register. Push the latch on the front of the register checker under the post on the register to hold the checker in mesh. Turn the handle on the checker clockwise until the interval indicator on the register shows that the clutch is about to trip. Energize the motor and allow the motor to trip the clutch. Reset the demand pointer by hand below the point on the scale which is to be tested. Turn the handle advancing the gear train manually until the interval indicator shows that the clutch is again about to trip. Allow the motor to trip the clutch. Take the existing reading on the KW demand scale. The checker has a high (H) and low (L) deflection and is set by shifting a ratio plate that engages the desired gear train. Two register checkers are available depending on the desired deflection.

111C217G01 Low Range Deflection (Test KW) $= \frac{100}{Rr}$

High Range Deflection (200% Test KW) $= \frac{200}{Rr}$

111C217G04 Low Range Deflection (200% Test KW) $= \frac{200}{Rr}$

High Range Deflection (400% Test KW) $= \frac{400}{Rr}$

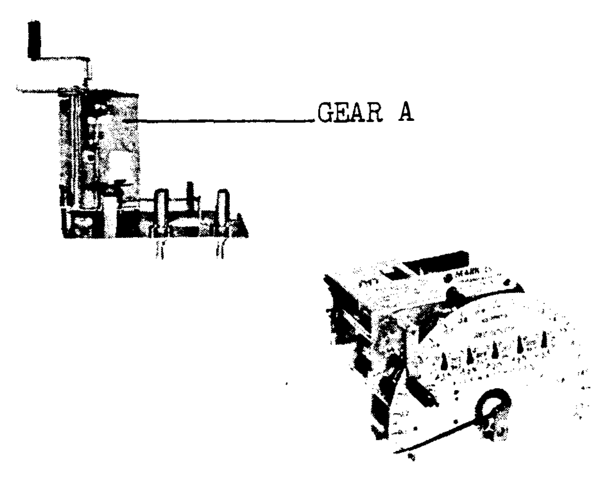

Fig. 9 Gear Checker for Mark Ia Register Style No. 111C217G01

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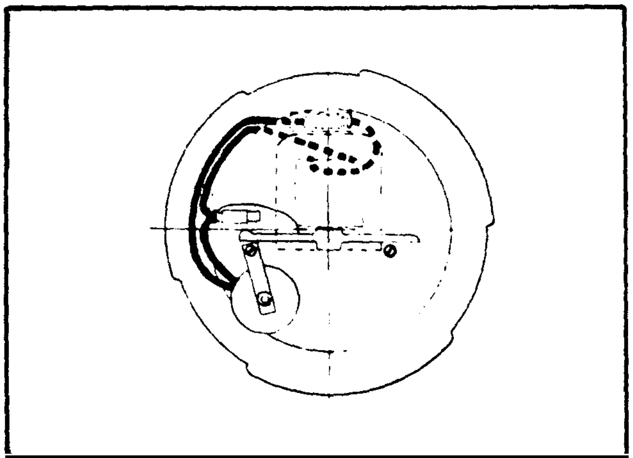

Fig. 10 D4SM-3 Wire Self Contained, 240V. (120V Reg. Motor).

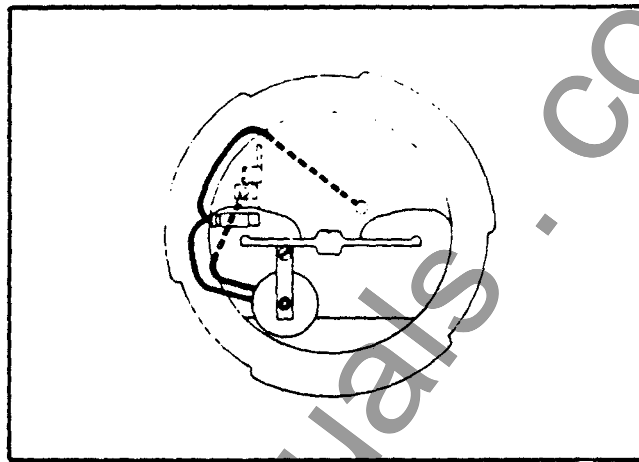

Fig. 11 DSM-D2SM & D3SM-3 Wire Self Contained, 240V. (120V Reg. Motor). DSM-D2SM & D3SM-3 Wire Self Contained, 480V. (240V Reg. Motor).

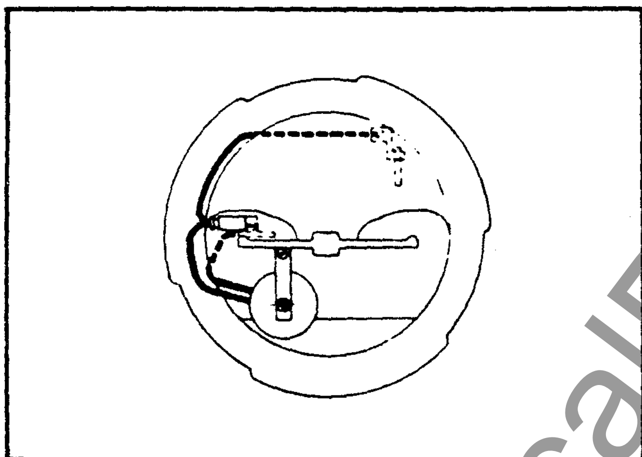

Fig. 12 DSM & D2SM 2 Wire Trans. Type, 240V. (120V Reg. Motor). DSM & D2SM 2 Wire Trans. Type, 480V. (240V Reg. Motor).

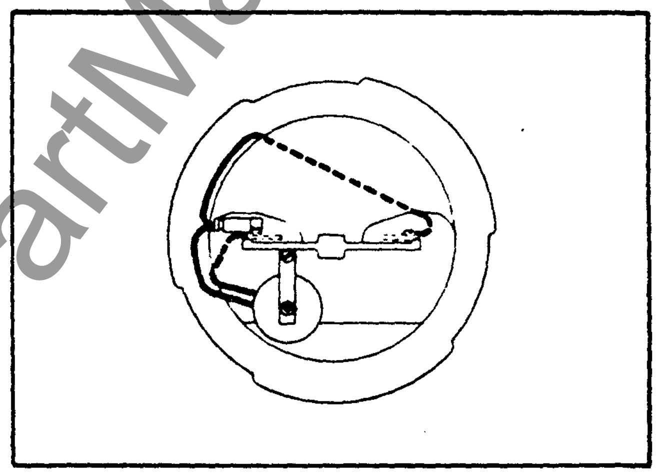

Fig. 13 DSM & D2SM 3 Wire Trans. Type, 240V. (120V Reg. Motor). DSM & D2SM 3 Wire Trans. Type 480V. (240V Reg. Motor).

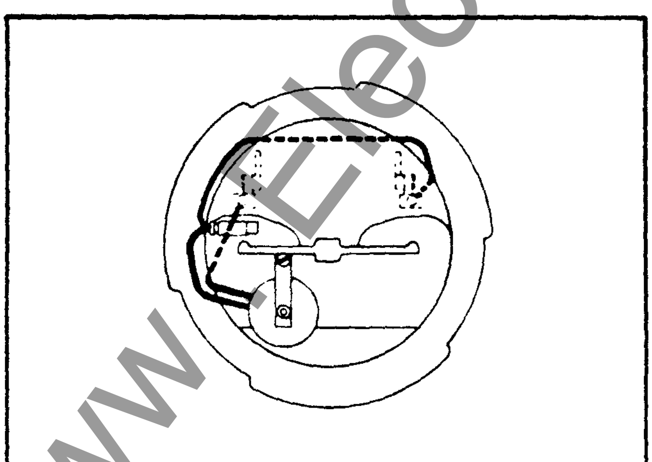

Fig. 14 DSM-D2SM & D3SM 2 Wire Self Contained, 240V. (120V Reg. Motor). DSM-D2SM & D3SM 2 Wire Self Contained, 480V. (240V Reg. Motor).

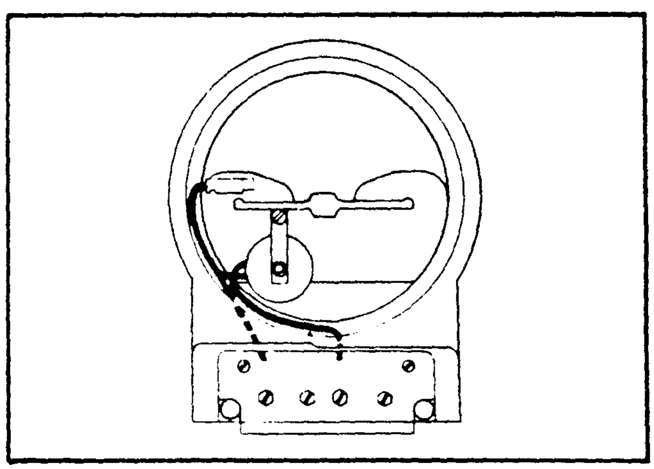

Fig. 15 DAM & D2AM 2 Wire Self Contained, 240V. (120V Reg. Motor). DAM & D2AM 2 Wire Self Contained, 480V. (240V Reg. Motor).

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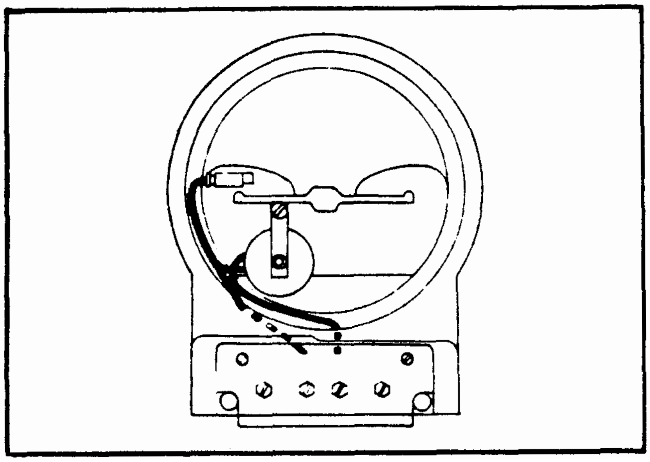

Fig. 16 DAM & D2AM 2 Wire Trans. Type, 240V. (120V Reg. Motor). DAM & D2AM 2 Wire Trans. Type, 480V. (240V Reg. Motor).

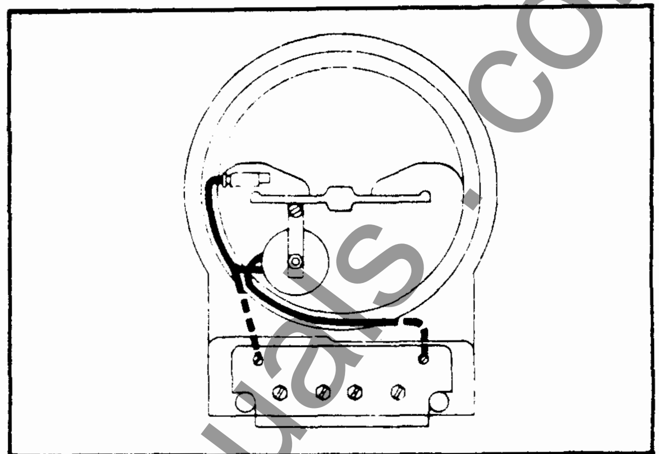

Fig. 17 DAM & D2AM 3 Wire Trans. Type, 240V., DAM & D2AM 3 Wire-4 Terminal Self Contained 240V. (120V Reg. Motor).

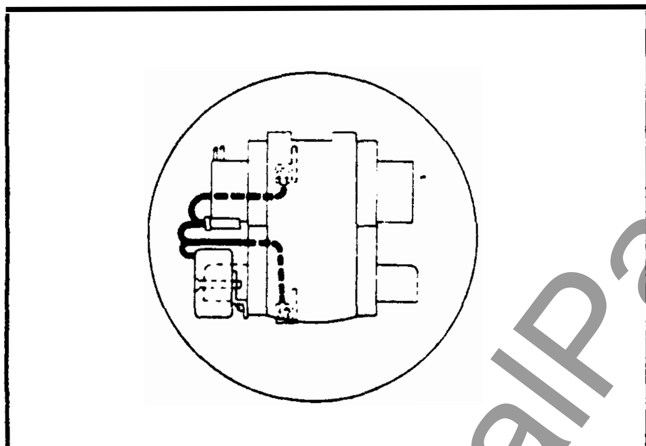

Fig. 18 DSP-2M & D2S-2M Self Cont. & Trans. Type, 240V. (120V. Reg. Motor). DSP-2M & D2S-2M Self Cont. & Trans. Type, 480V. (240V. Reg. Motor).

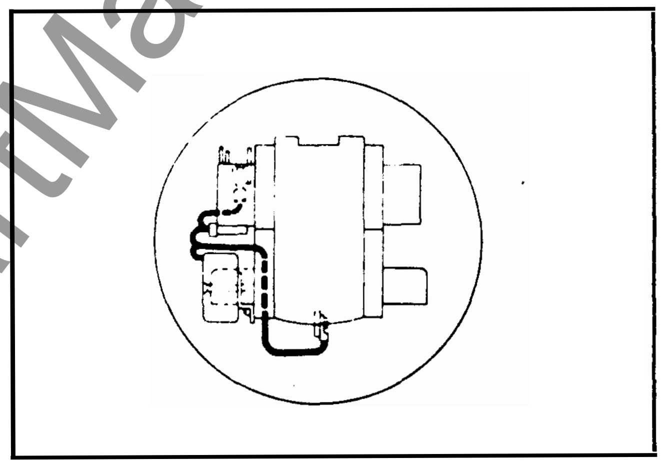

Fig. 19 DS-5M & D2S-5M 240V. (120V Reg. Motor). DS-5M & D2S-5M 480V. (240V Reg. Motor).

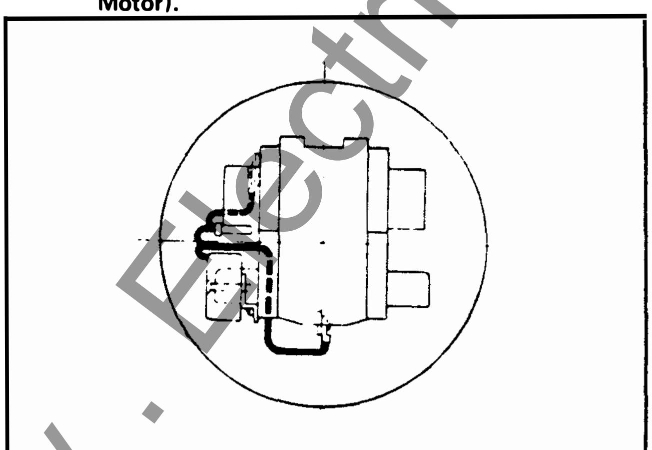

Fig. 20 DS-5M & D2S-5M-30 Amp-480V. (240V Reg. Motor).

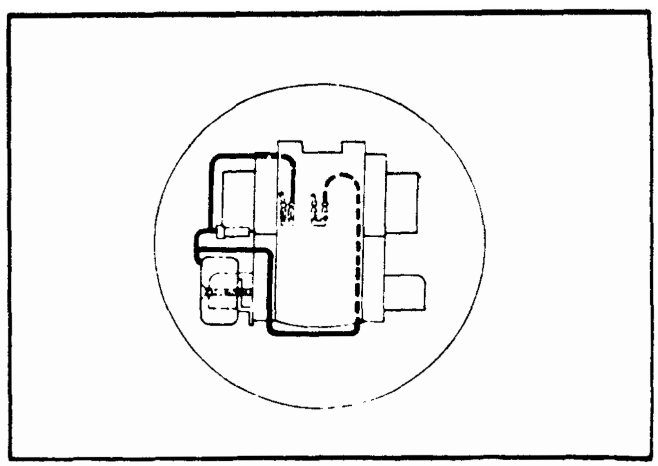

Fig. 21 DSP-7M & D2S-7M Self Contained, 240V. (120V Reg. Motor). DSP-7M & D2S-7M Self Contained, 480V (240V Reg Motor).

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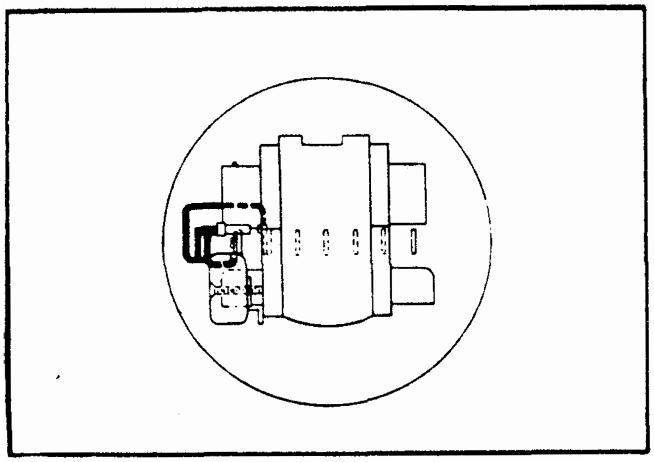

Fig. 22 DSP-7M & D2S-7M Trans. Type, 240V. (120V. Reg. Motor). DSP-7M & D2S-7M Trans. Type, 480V. (240V Reg. Motor).

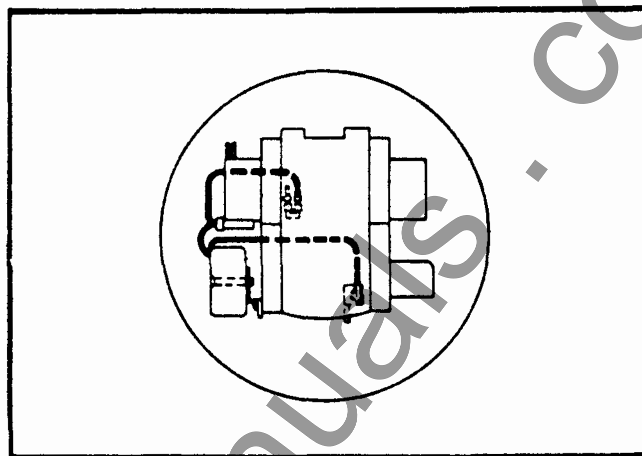

Fig. 23 DSP-8M & D2S-8M Self Contained, 240V. (120V Reg. Motor). DSP-8M & D2S-8M Self Contained, 480V. (240V Reg. Motor).

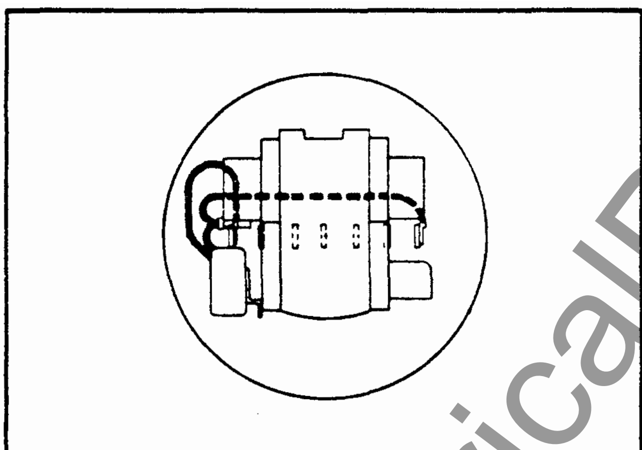

Fig. 24 DSP-8M & D2S-8M Trans. Type, 240V. (120V Reg. Motor). DSP-8M & D2S-8M Trans. Type, 480V. (240V Reg. Motor).

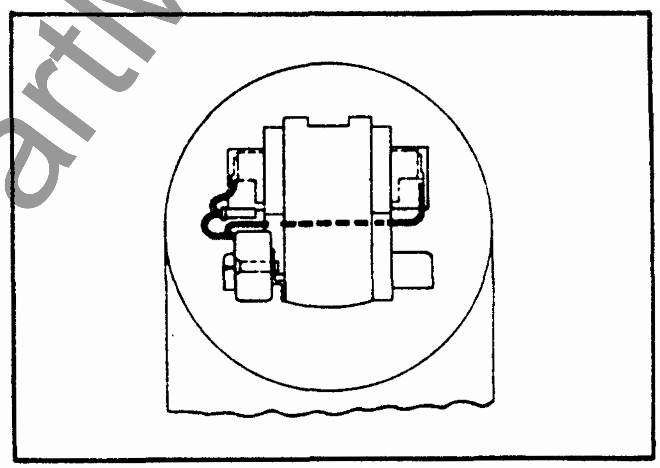

Fig. 25 DAP-2-7-8M & DA-5M & D2A-2-5-7-8M-240V (120V Reg. Motor). DAP-2-7-8M & DA-5M & D2A-2-5-7-8M, 480V. (240V Reg. Motor).

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