



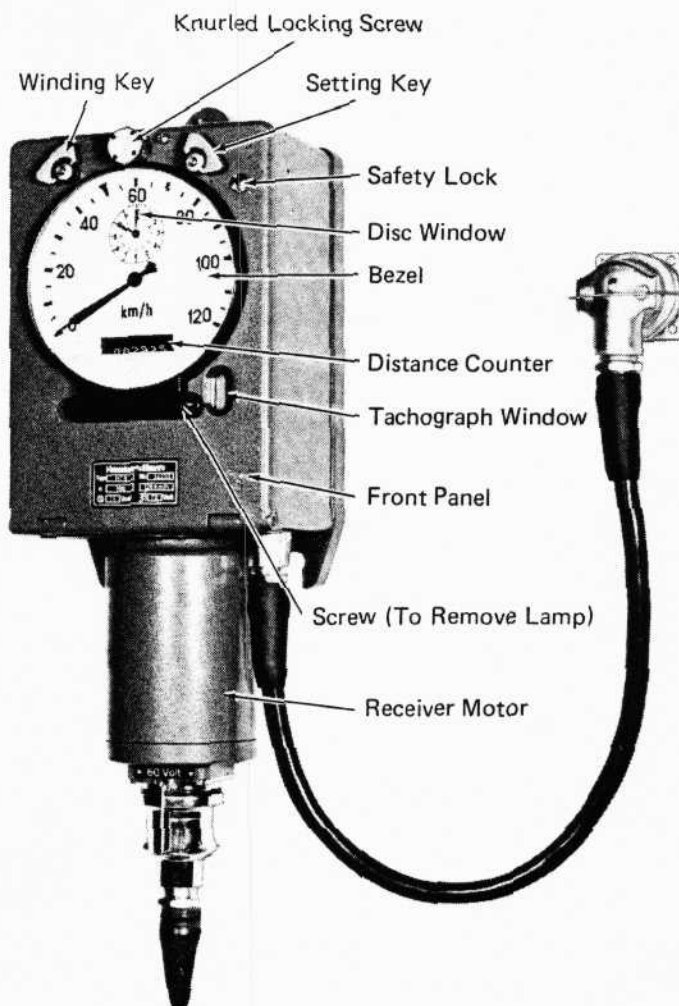
ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION

# MAINTENANCE INSTRUCTION

## HASLER-BERN SPEED MEASURING DEVICE -- MODEL RT9

### DESCRIPTION

The speed measuring device, Fig. 1, consists primarily of a drive unit, reduction gear train, clock, dial indicator (tachometer), and a recording mechanism (tachograph) which accurately portrays both operator and locomotive performance. This information is permanently illustrated on a paper diagram roll. The recording is clear and unadulterably drawn on specially treated paper, by a pen with a ruby ball-stylus.



22272

Fig. 1 - RT9 Speed Measuring Device

### OPERATION

Drive shaft rotary motion powers the instrument motor through a gear train which drives the dial indicating and recording mechanisms. This is accomplished through mechanical or electrical drive arrangements.

Electrical remote drive installations, Fig. 2, require a 60 VDC nominal power source to actuate the drive. Power is controlled by the engineer when placing the locomotive in or out of service. A current regulator or stabilizer, included in the feed circuit, controls the amount of resistance in relation to loading, and limits feed current to a definite maximum.

### DRIVES

Various drive mechanisms are available for installation of this equipment, and arrangement applications are individualized to suit specific locomotives. In general, gear ratio is calculated from the average diameter  $d_m$  of the wheel (average between the new wheel diameter and the worn wheel minimum permissible diameter).

1 revolution of the instrument shaft

equals

1 m (3.2') of travel for instruments with a maximum range of 60 km/h or 45 mph.

1 revolution of the instrument shaft

equals

2 m (6.5') of travel for instruments with a maximum range of 75 km/h or 60 mph.

### MECHANICAL DRIVE

This arrangement consists of 10 mm (0.4") flexible galvanized steel strip tubing. Coupling sleeves and nuts are fitted at each end for connecting to the end of the driving shaft of the speed indicator, and the end of the shaft of the gear box,

Tachograph  
RT 9

\*Second Receiver  
Optional

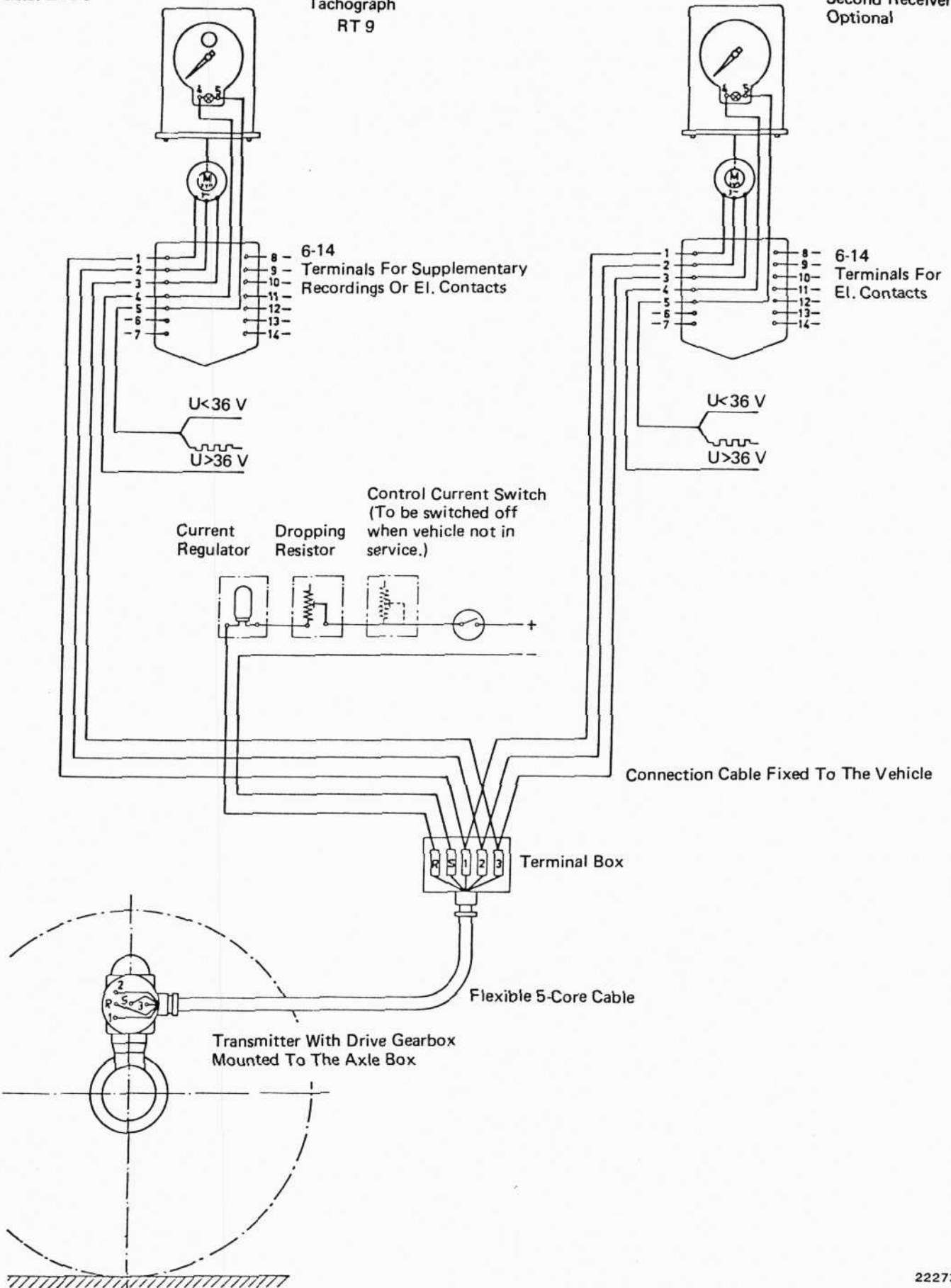


Fig. 2 - Wiring Diagram For Speed Measuring  
Device With Electrical Remote Drive

respectively. Speed to be measured is taken from axle RPM at the journal box. Gear boxes are fitted with bevel gear suitable to the speed of the indicating instrument.

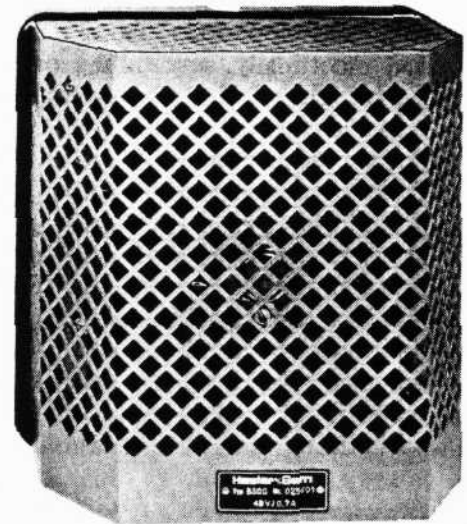
**ELECTRICAL REMOTE DRIVE**

The electrical remote drive is used in place of flexible shafting, and is fed with direct current from the vehicle supply batteries. This drive generally comprises the following components:

1. One transmitter with drive gear box.
2. One or two receiver motors.
3. Current regulator or electronic current stabilizer, Fig. 3.
4. One or two dropping resistors.
5. One sealed terminal box.

**TRANSMITTER**

The transmitter consists essentially of a rotor with frontal collector, electrical resistances, and 3 double collector-brushes. The transmitter aggregate is fitted at the driving shaft where the collector converts the direct current into 3-phase current. The frequency of the 3-phase current is proportional to the speed of rotation. The rotary motions of the transmitter are transmitted



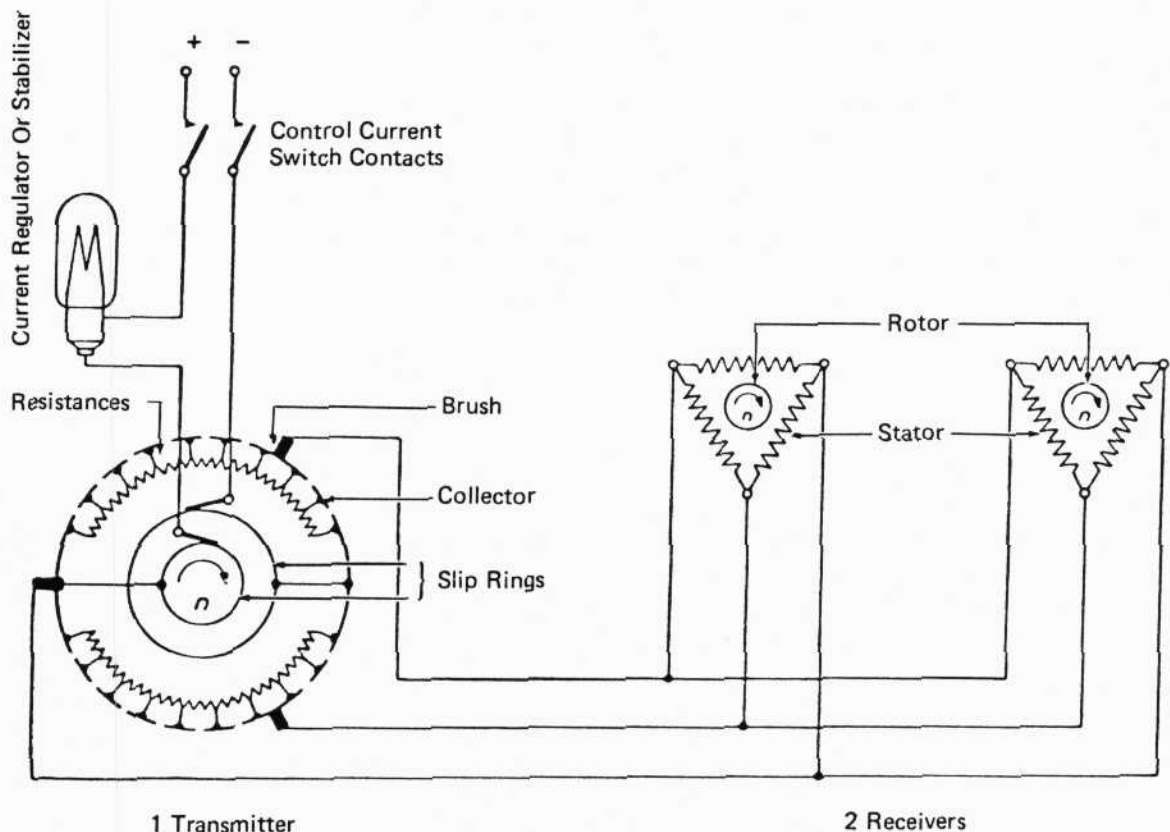
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Fig. 3 - Electronic Current Stabilizer (Replaces The Current Regulator)

synchronously to one or two receiver motors which are coupled directly to the measuring instruments, Fig. 4.

**RECEIVER**

This component comprises a rotor carried in ball bearings. It has no collector rings or winding, and rotates in a 3-phase stator field.



22275

Fig. 4 - Schematic Of Electrical Remote Drive

**NOTE:** Since the apparatus is synchronously tuned electrically, any falling out of step due to electrical or mechanical fault would be clearly visible by a drop in speed of approximately 80%. Any asynchronous running is impossible.

In order to obtain current conditions as uniform as possible at the different speeds of rotation, particularly when the vehicle is at rest, a current regulator is included in the feed circuit. This regulator changes the amount of resistance in accordance with the loading, and limits the feed current to a definite admissible maximum.

## **SPEED INDICATION**

In order to give steady pointer readings, the tachometer requires a minimum drive speed of approximately 3% of maximum. At speeds below this, the pointer may oscillate. Also, if the locomotive comes to a halt extremely gradually, the pointer may not return to zero. If this occurs, **DO NOT** adjust the pointer. The indication will correct itself as soon as the speed exceeds the nominal value.

## **SAFETY LOCK**

To open the instrument, insert key in lock, Fig. 1, and turn in a counterclockwise direction. After unscrewing the knurled closing screw, the front can be hinged down.

To open units not equipped with a safety lock, it is only necessary to rotate the knurled closing screw until the hinged front cover will open.

## **MAINTENANCE**

### **CLOCK**

#### **Rewinding**

Wind the clock daily using key, Fig. 1. Pull key forward, then turn in counterclockwise direction until the spring is fully wound. After windup is completed, return key to original position by pressing key backwards.

#### **Setting The Hands**

After having wound the clock, set the hands to the correct time using setting key, Fig. 1. Pull key forward, then rotate hands in either direction. Approximately 5-10 minutes prior to the

desired clock setting, ensure hand movement is in a clockwise direction.

Should the minute hand pass the 60 minute mark at the moment the hour is punched when turning hands backward before final setting, continue rotating the hands in a counterclockwise direction until the 30 minute mark is reached. Turn hands clockwise to the desired setting.

Make certain the color of the disc in window on the dial, Fig. 1, shows **WHITE** between the hours of 0-12, and **BLUE** between the hours of 12-24 o'clock. Figure color should match disc color. If colors do not agree, or if disc color is incorrectly set, the hours punched on the chart will not correspond with the time setting.

**NOTE:** If setting the clock necessitates moving the hands more than 8-10 hours, the clock should be rewound after the hands have been reset.

After the hands are correctly set, return key to original position.

## **ADJUSTMENT AND CHANGEOUT**

### **SETTING THE SIX DIGIT TOTAL DISTANCE COUNTER**

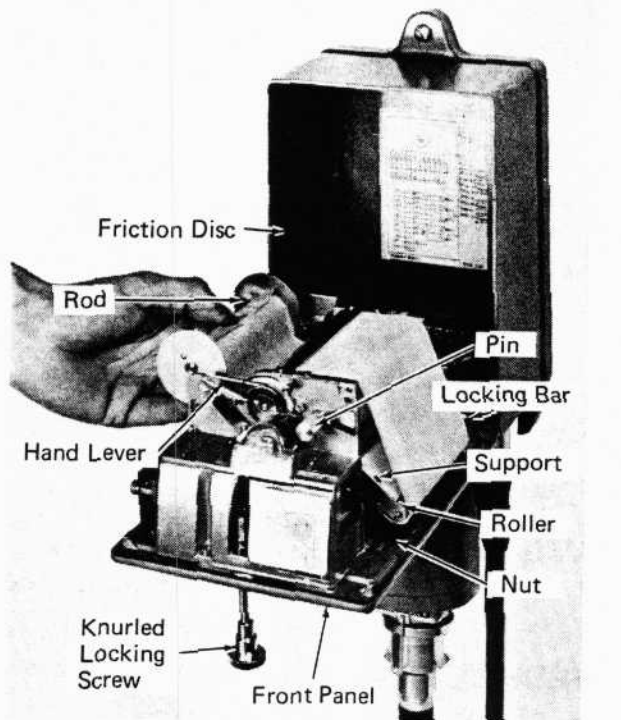
1. Open the instrument.
2. Unscrew nut, Fig. 5, and remove the bezel, Fig. 1. If necessary, pry up using a small screwdriver.
3. Turn the counter rollers from left to right to the desired setting, using a small wooden peg or blunt-edged screwdriver.

**NOTE:** If the right-hand roller blocks, turn the toothwheel (on left side beneath paper feed unit) several times, to free roller.

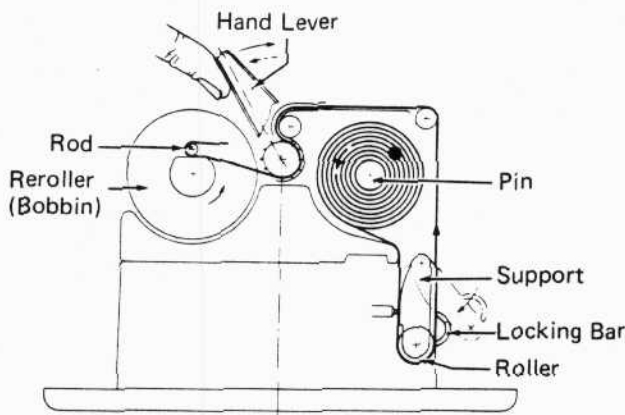
4. Replace the bezel, ensuring proper engagement of slot and fixing screw.
5. Tighten nut.

### **CHANGING DIAL ILLUMINATION LAMP**

To change the lamp which illuminates the dial, first interrupt the voltage. Loosen screw, Fig. 1, and gently pivot lamp cover downwards. Change lamp and replace cover.



22276



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Fig. 5 - Instrument Interior Views

### REPLACING PAPER DIAGRAM ROLL (Fig. 5)

The diagram rolls are marked towards the end of each roll with inclined black lines which appear initially at the top of strip chart window, and gradually descend towards the bottom of the window as the roll is used up. Appearance of these lines is an indication that the diagram roll needs to be changed. The end markings must show at least 4 mm (0.16") above the frame to ensure a recording.

1. Open the front panel by unscrewing and pulling forward on the knurled locking screw.
2. Remove pin, and disengage support by pushing back locking bar.

3. Insert a new paper diagram roll ensuring proper orientation with red point facing upward.
4. Replace pin.
5. Pass the end of paper behind support, and around roller.
6. Push roller support back into place.
7. Operate hand lever until the paper projects approximately 80 mm (3").
8. Pass the end of the paper between rod and spool of reroller, and fold back over rod.
9. Ensure reroller is secured in guides.
10. Close front panel, and secure with locking screw.

NOTE: Periodically remove the paper guides, and clean off ink accumulations to ensure against paper stain.

### REMOVING RECORDED PORTION OF PAPER (Fig. 5)

1. Open the front panel by unscrewing and pulling forward on the knurled locking screw.
2. Advance the paper using hand lever only, until the desired portion is wound up on the reroller.

CAUTION: To avoid tearing the paper at the edges, do not activate the reroller.

3. Cut the paper near the spool, and lift the reroller from guides.
4. Remove the upper disc, and turn back the paper roll on the spool to facilitate removal of the recorded roll.
5. Replace the disc, and push back the reroller between the guides.

CAUTION: The reroller bobbin can hold approximately 3/4 of the length of a new diagram roll. If the recorded portion is not removed daily, it will be necessary to cut out a proportionate section of the new diagram roll to avoid blockage of the recording.

6. Secure end of paper as previously described in Steps 5 through 10 under "Replacing Paper Diagram Roll."

## ELECTRIC REMOTE DRIVE

### TRANSMITTER

#### Inspection - Weekly Maintenance

Perform a visual external examination of the screwed joints and the transmitter connecting cable. After determining fastness of all joints and connections, ensure proper transmission while locomotive is underway.

#### Cleaning - Intermediate Maintenance

Every 4 to 6 months, the transmitter, commutator, and housing with carbon brush holder must be thoroughly checked and cleaned. The brushes should move freely in the guides. Broken brushes or those with damaged compression springs should be replaced. Provided the transmitter is easily accessible, this maintenance can be performed while unit is on the locomotive.

Dip dismounted parts in pure benzine and clean with a hard brush. Before reassembling, wipe parts with a slightly oily rag to prevent rust.

### DISASSEMBLY (Fig. 6)

1. Open the transmitter by removing the two sealed locking screws.
2. Loosen the two ring nuts by turning them clockwise with a spanner wrench. Always loosen the top ring nut first nearest the outgoing cable.
3. Check brushes for accumulated carbon dust. If brushes jam, press out from opposite side.

NOTE: The double carbon brushes are 20 mm (0.8") long, and the minimum admissible length is 10 mm (0.4").

4. After ring nuts have been completely undone, lift the housing to expose the commutator.

CAUTION: When installing a new commutator, it is essential that it matches the installation voltage (designated by different colored markings: yellow = 24 V, red = 36 V, green = 48 V, and blue = 60 V).

5. Commutators are clamped in position by means of a split taper sleeve on the parallel shaft, and a groove fixture which is provided by a locking plate engaging in the ribs. If necessary to remove commutator, use spanner to loosen cap nut by turning in a clockwise direction.

CAUTION: Protect taper sleeve from dirt by wrapping in a clean, lint-free, bound edge shop cloth.

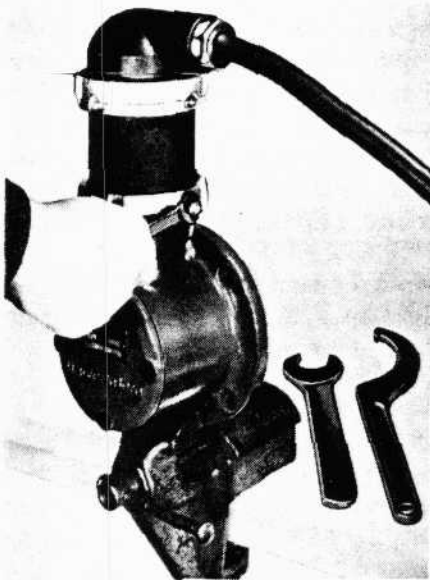
6. Check and clean the fixing components by removing the retaining ring from the end of shaft, the washer, taper sleeve nut with spring plate, and protective disc, respectively.

CAUTION: Handle these components with care, and replace in a thoroughly clean condition.

### ASSEMBLY (Fig. 6)

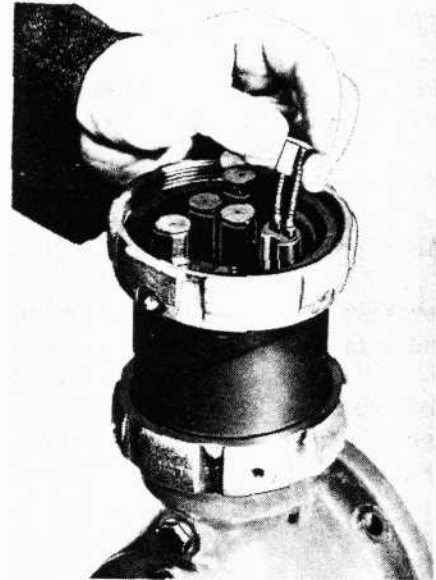
Assembly is generally the reverse of the above procedure. However, special attention should be paid to the following points:

1. When bolting up the commutator with spanner wrench, tighten the cap nut adequately but not excessively; meanwhile, ensure engagement of spring plate between ribs of commutator.
2. Check by hand that commutator cannot be turned on the shaft.
3. Prior to replacing cylindrical housing, place all carbon brushes in the guides and ensure free brush movement and proper spring functioning. The carbon brushes should project 1 mm (0.04") on the commutator side.
4. Place housing carefully over the commutator on the bearing cover so index pin engages in housing groove. Ensure correct cable outlet position is maintained by checking cable box cover.
5. Ring nuts must be well tightened in a counterclockwise direction using a spanner wrench. Lightly tap spanner handle with rubber mallet, if necessary, to ensure adequate tightness.
6. Tighten locking screws until the heads rest on the plane surface of ring nuts.
7. Seal locking screws with wire.



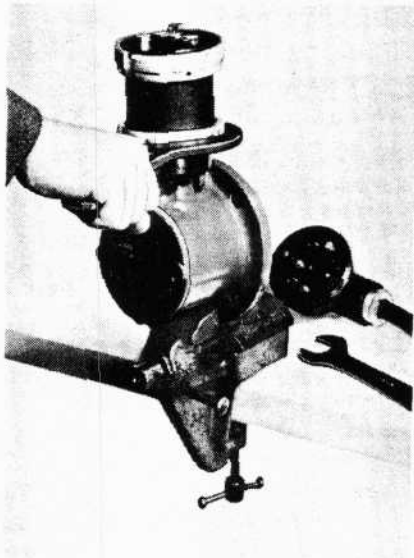
Loosen the locking screw

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Inspection of the double carbon brushes

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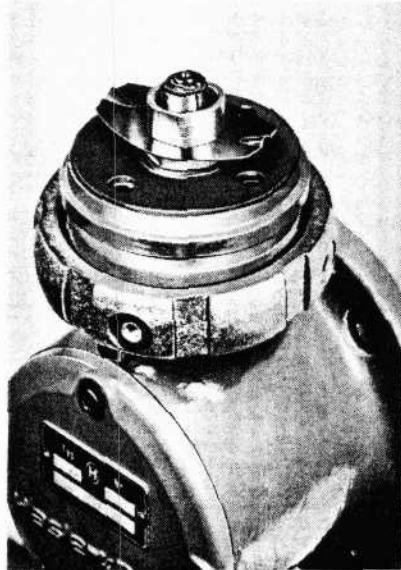
Loosen the lower ring nut

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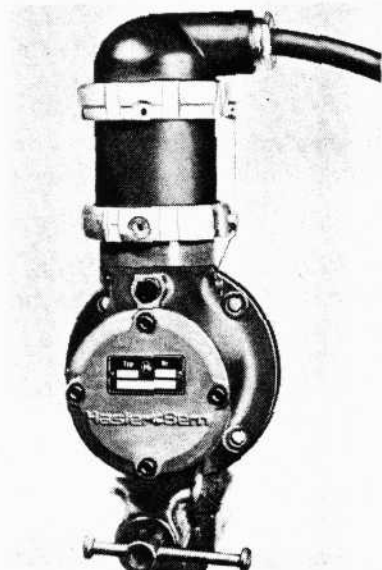
Loosen the collector

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Fixing device with locking plate for collector

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Transmitter assembled and sealed

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Fig. 6 - Transmitter Disassembly

## RECEIVER

The receiver motor does not require any weekly or intermediate maintenance.

## OVERHAUL

### TRANSMITTER

During overhaul, the transmitter must be unbolted and removed from the locomotive. Open instrument in a suitably equipped workshop in accordance with the directions furnished under "Disassembly." In addition, perform the following procedures.

1. Unbolt gear box cover and remove the grease.
2. If difficulty is encountered when removing the bevel gears, first unscrew the associated bevel-gear wheel in the gear box.
3. After the components securing the commutator have been removed, alternately loosen the 4 internal, hexagonal screws on the bearing cover. Do not damage the rubber seal or the cover after bearing sleeve is removed.

NOTE: When reassembling, use only perfect seals and gaskets.

### RECEIVER

1. Unscrew motor from speedometer housing, and remove coupling from shaft.
2. Remove the lower cover and bearing as far as the cable joining the stator winding and plug connection will allow. (This limitation does not apply to receiver motors with the cable outlet at the side.)
3. Mark the position of the cover with plug, and the bearing bushing with respect to the housing, to facilitate reassembly.
4. Carefully withdraw the rotor from the stator. (The stator is shrink-fit in the housing and cannot be removed.)
5. Thoroughly clean the rotor with a solvent-saturated cloth, and regrease the bearings.

CAUTION: Care must be taken to ensure that the plug cable is not clamped when the cover is replaced, and rotor must rotate freely.

6. Remagnetize the rotor after motor teardown and reassemble by connecting two of the three motor connections to a DC supply of approximately twice the rated motor voltage. Apply two or three short impulses while allowing the motor freedom of movement under the influence of the magnetic field.

NOTE: Motors magnetized in this manner should develop a torque adequate for driving the tachometer, with a properly adjusted supply voltage.

7. When a torque indicator and remote-drive testing equipment are available, connect the receiver with the remote drive installation and run at 100-300 rpm at rated voltage. The torque available at the receiver motor must amount to at least 0.118 N·m (approximately 1 in.-lb).

## LUBRICATION

Lubrication to be performed in accordance with manufacturer's recommendations.

## TROUBLESHOOTING (Fig. 7)

The following examples demonstrate possible defects which can be interpreted from the fault record.

CONDITION: Speed point and stylus fall back to zero at each measuring period, (1); or, speed pointer and stylus at starting mount to maximum, (2).

CAUSE: Improper escapement of measuring mechanism, or oil and grease has thickened.

CONDITION: During operation, speed pointer and stylus suddenly move to a certain height (3), or mount to maximum, (4).

CAUSE: Check for broken anchor cam; balance spring; measuring wheel spring; main spring in the barrel.

CONDITION: Speed pointer and stylus are not stable, and indicate excessively high speed, (5).

CAUSE: Variable escapement speed causing increase of measuring time, or improperly working winding spring.

**CONDITION:** Speed pointer and stylus indication too low, or record appears irregular, (6); or, pointer and stylus make irregular jumps but only above the correct reading, (7).

**CAUSE:** Escapement working badly, reducing the measuring time: regulator displaced (active part of spring shortened); spiral spring broken and repaired rather than replaced; broken anchor pallet pins causing escapement to double-beat because main spring either too tight or too strong; measuring spring too weak - unable to regularly return wheel back to zero.

**CONDITION:** Speed pointer and stylus remain at highest speed obtained, (8).

**CAUSE:** Pawl not working due to broken pawl point, broken cam, or seized pointer spindle or rack.

**CONDITION:** Speed pointer and stylus fall back to zero at each measuring period, (9).

**CAUSE:** Coupling lever spring or pawl spring broken or bent, or either or both at the same time.

**CONDITION:** Recording strip only fed by the clock, even while traveling. Speed diagram very contracted and minute diagram similar to record during stops, (10).

**CAUSE:** Faulty paper feed. Reroller is not in correct location or has fallen out of engagement due to weakened or displaced leaf springs; roller counter does not work - rocking lever, pawl, ratchet wheel on spindle or pawl spring worn or broken.

**NOTE:** This defect usually means total failure, but may show up only at certain speeds.

**CONDITION:** Speed pointer and stylus do not operate (no indication).

**CAUSE:** Faulty drive and/or coupling between motor and paper feed unit; insufficient friction in corrector of measuring movement; electrical interruption in drive, or bad contact in plugs.

**CONDITION:** The record of speed is normal, but minute marking is faulty:

a. Minute record shows only a horizontal line, (11);

b. Minute record shows horizontal parts at each change of direction, (12);

c. Minute record rises and descends irregularly, spreading an abnormal length, (13).

**CAUSE:** a. & b. Check escapement - main spring unwound or only partially wound; broken pivot.

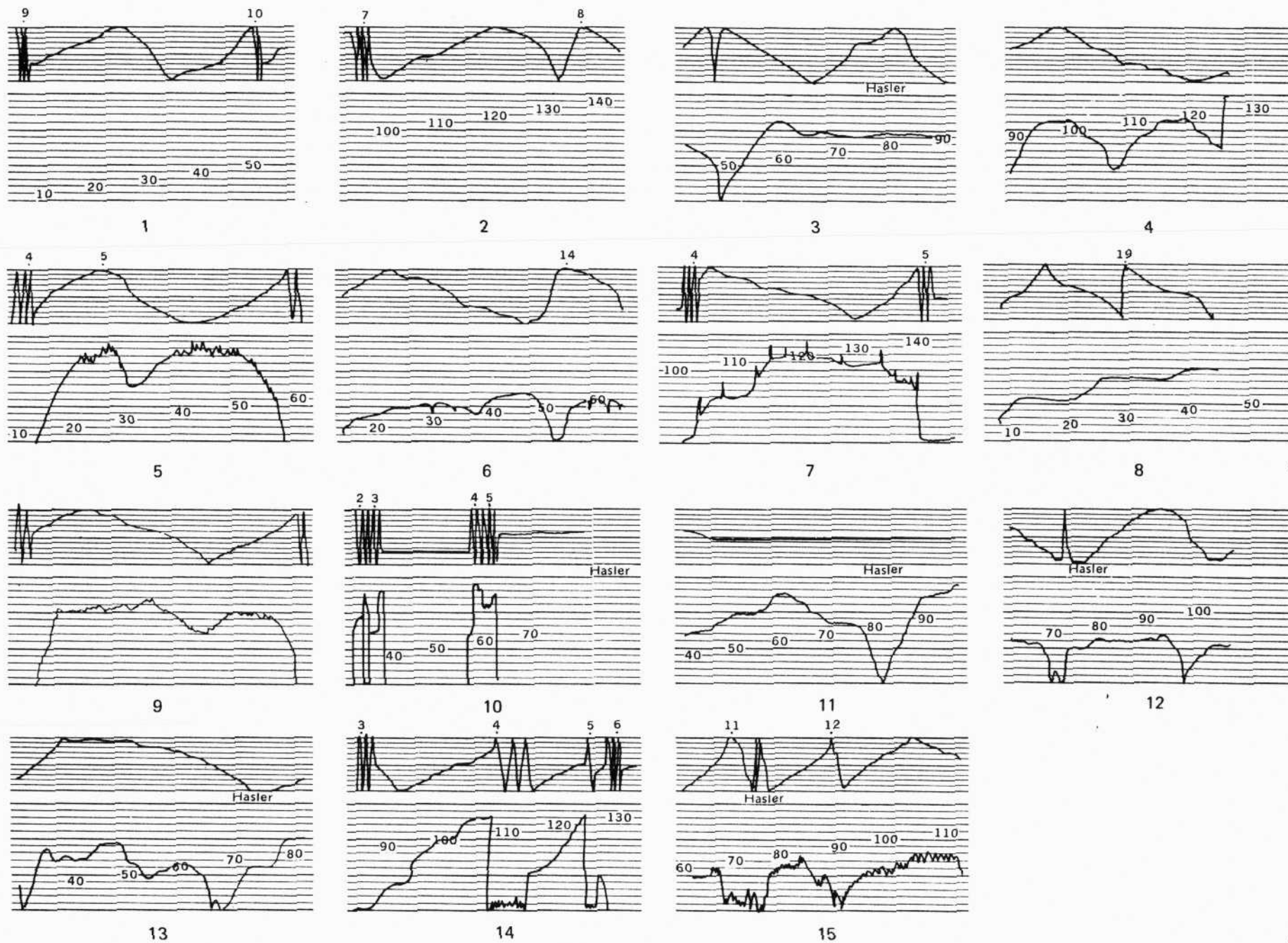
c. Check nominal tension (too low), or battery discharged - readjust resistance; intermittent break in the electrical circuit.

**CONDITION:** Speed pointer and stylus fall back to zero after having obtained a certain height, then reoperate normally after a stop or at very low speed, (14); speed indication and record approximately correct, but very jumpy, (15).

**CAUSE:** Check electric remote drive - gear box incorrectly mounted over turning point resulting in uneven, irregular angular speeds within one turn over two measuring periods; eccentric movement loosens the axle bushing - ensure gear box is fixed concentrically to driving devices.

**CONDITION:** Paper is torn or cut.

**CAUSE:** Check paper feed; stylus - friction of reroller too tight: oil the fiber disc; guide plates torn or scratched: changeout defective parts; stylus cuts paper: check pressure, reduce if necessary.



22284

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Fig. 7 - Examples Of Fault Records