Westinghouse

Type RO Single-Phase Watthour Demand Meter

Westinghouse Electric & Manufacturing Company

Newark Works

Newark, N. J.

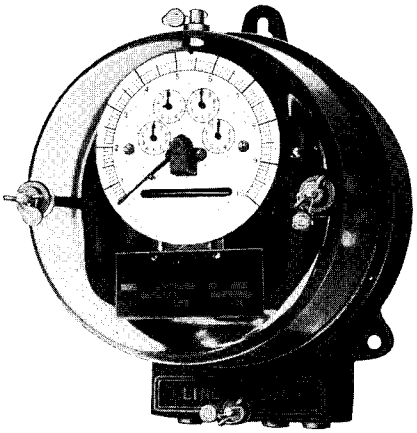

Fig. 1—Glass-Covered Meter

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Type RO Single-Ppase Watthour Demand Meter

GENERAL

1. Before attempting to adjust the meter for use, read carefully the following description of the instrument and the instructions that follow.

DESCRIPTION

2. This instrument has been designed to meet the requirements of central station meter service. It is a single instrument that records both the kilowatt hours consumed and the maximum demand in kilowatts. It is installed as an ordinary watthour meter and requires no additional apparatus or wiring.

3. The maximum demand is indicated directly by a pointer sweeping over a four-inch dial, the integrated load being registered on the usual four-dial counter. The demand pointer is reset manually by pressing a button at the top of the meter cover, thus making it unnecessary to open the meter. The button can be sealed after each operation.

4. The meter has a definite time constant, yet requires no clock or contacts. The watthour meter element is provided with micrometer light-load and full-load adjustments. The demand meter element is provided with a micrometer zero-adjustment and a spring clamp for making changes in length of spring. These adjustments are accessible at the top of the instrument.

5. The calibration is simple and when once adjusted the instrument may be depended upon to perform its functions with the same unvarying accuracy as the ordinary watthour meter.

6. Construction—As shown in Fig. 2, the instrument consists of a watthour meter, including a standard electromagnet, permanent magnet, and aluminum disk, geared to a standard counter. A second or auxiliary disk *2* is supported on a jewel-and-ball bearing *2* so that it can move freely in the airgap of the electromagnet without interfering with the

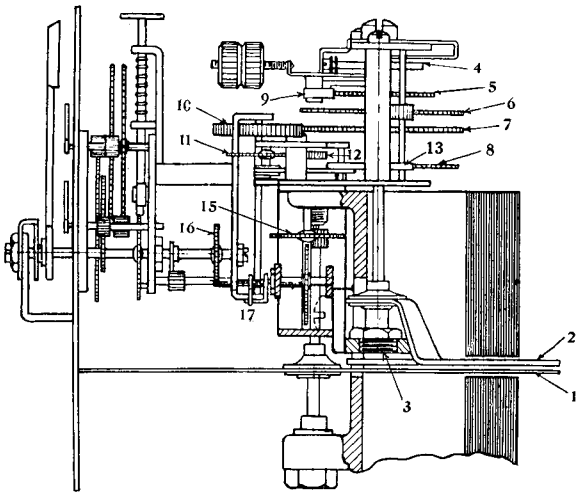

Fig. 2—Vertical Section Through the Meter Element

main disk. The series and shunt fluxes pass through both disks, inducing eddy currents which react on these fields in the usual manner, producing a torque in each, proportional to the load. The two disks are entirely independent, the auxiliary disk being so shaped that it does not interfere with the accuracy of the main disk, which rotates at a speed always proportional to the load. The auxiliary shaft carries a spiral spring *4* at its upper end, the tension of which opposes the deflection of the disk. The gear *7* fixed to the auxiliary shaft meshes with the gear *10* on the counter, thus transmitting the motion of the auxiliary disk through a dog drive to the demand pointer. A fine-tooth ratchet and pawl on the pointer shaft retains the pointer in its position of maximum deflection. Hence, if no other mechanism were introduced, the auxiliary disk would instantly deflect the pointer through an arc proportional to the load.

The auxiliary is, however, geared to an escapement wheel *8* which engages with a claw *13*. A forked lever fixed to the claw is caused to oscillate by an eccentric geared to the main disk by gears *11*, *12* and *15*.

7. Principle of Operation—The action of the instrument is as follows: The instant power flows through the instrument the main disk begins to rotate at a speed proportional to the load, driving the watthour gear train and oscillating the escapement claw. The auxiliary disk tends to deflect instantly to indicate the load, but is prevented by the escapement claw engaging its wheel. As the claw oscillates, the teeth of the escapement wheel are allowed to pass, one by one, until the tension on the spring *4* balances the torque developed in the auxiliary disk. The system is then in equilibrium, the demand pointer indicating the load, and although the main disk continues to rotate so long as the load is maintained, no further deflection takes place, since **the escapement claw oscillates freely between the teeth of the escapement wheel.**

8. The mechanism is very similar to the ordinary clock; the auxiliary disk furnishing the power for driving the escapement like a main spring, while the rate of movement is controlled by the motion of the main disk which performs the function of a balance wheel. The escapement wheel and claw have radial teeth to prevent interchange of energy between the two disks. It is to be observed that the function of the main disk is simply to regulate the rate of deflection of the auxiliary disk. It supplies no power whatever except the negligible amount required to oscillate the escapement claw.

9. The escapement wheel is not driven directly from the auxiliary shaft by gear *6* but is driven by a ratchet wheel *5* mounted on a sleeve which is loose on the auxiliary shaft to which the gear *6* is attached. This ratchet wheel is driven by a pawl *9* carried by an arm fixed to the auxiliary shaft. This device causes the auxiliary disk to drive through the escapement wheel when the pointer is advancing across the scale but allows it to drop back freely to equilibrium when the load is reduced. Hence, the auxiliary disk will follow the variation in load while the demand pointer indicates its maximum deflection.

10. Time Element—The time required to reach equilibrium when any constant load is passed through the instrument is constant, since the deflection and rate of deflection vary in direct proportion. For example, suppose the instrument is so calibrated and adjusted that it requires 15 minutes to reach equilibrium when a constant load of 500 watts is passed through the instrument, then if we start again from zero and pass 1000 watts through the instrument it is evident that the demand pointer must travel through twice the former arc, but since the main disc is rotating at double the former speed the pointer will reach equilibrium in the same time as it did before.

INSTRUCTIONS FOR USING

11. Inspect the meter to see that no parts have been broken or deranged in shipment.

12. Take off the cover and remove the card and string that secure the moving element for shipment.

13. Remove the paper loop that holds the pointer.

Inspection

14. Inspect the following points carefully on receipt of instrument and when installation is complete.

15. Does the pointer remain in any position when moved up by hand? If it does not hold positively, the tension on the pointer pawl spring (the small helical spring to the right of the trip rod) is too light. Increase the tension of this spring by screwing down the two small nuts on the guide pin; this will increase the pressure on the pawl and cause it to act more positively.

16. Does the pointer return to the stop when the trip button is depressed? If not there is probably a large error in the zero adjustment (see paragraph 27).

17. Does the moving element swing freely when the main pawl (see Fig. *2*) is disengaged and the trip button depressed? If not there is probably excessive friction between the hub of wheels *5* and *6* (Fig. 2) and the auxiliary shaft; in such case this bearing should be thoroughly cleaned with benzine and re-oiled.

18. Does the pointer swing up quickly when load is applied to the meter, instead of advancing slowly? If so, the main pawl (see Fig. 3) is not engaged.

19. Does the pointer advance? Owing to the "suppressed zero" the pointer will not begin to advance with full load on the meter until about one-tenth of the time element of

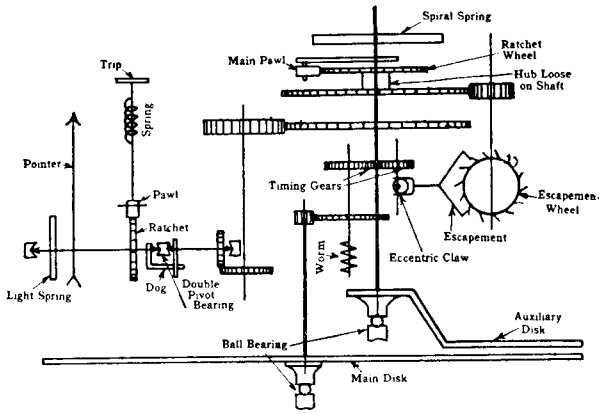

Fig. 3—Schematic Diagram of Meter Without Dial Mechanism

the meter has elapsed (½ minute on 5-minute meters, 1½ minutes on 15-minute meters, etc.). The auxiliary disk, however, should begin to advance at once. If it does not advance, the escapement claw is probably out of adjustment (see paragraph 38).

20. Does the pointer jump in advancing at light loads? If it does the pointer spring is a little weak and should be tightened by turning the spring holder (see paragraph 35).

TESTS AND ADJUSTMENTS

21. Each meter should be tested before being installed. Connect in the same way as a watthour meter.

Checking Indicating Mechanism

22. In checking the indicating element use an indicating wattmeter, preferably a Westinghouse precision wattmeter or type PC wattmeter **using alternating current.** Perform the tests in the order noted below. Note that **full load** on the meter is the watthour meter rating stamped on the nameplate. **Full scale deflection** of the indicating pointer requires double the full load of the meter (to provide for overload demands), and is also noted on the nameplate.

23. Move the balance arm of the auxiliary (indicating) mechanism to the right. Note whether the pointer reaches the maximum stop when the balance arm reaches the right-hand stop. If either strikes the stop before the other, the counter should be reset (see paragraph 34). If this error is present, the back pivot bearing probably requires tightening (see paragraph 36).

24. Apply full load in watts according to the watthour meter rating noted on the nameplate. With this load applied, disengage the main pawl and press the trip rod (allow the main disk to revolve normally); the pointer should swing a little beyond "5". Tap the meter gently and note the exact reading.

25. Leave full load on the meter, engage the main pawl, press the trip, and move the balance arm to the left until the pointer indicates about 4.5 and let go of the trip. Then let the indicator advance normally until it comes to rest. If it does not stop at the 5 point, note the exact reading and readjust the zero (see paragraph 27).

26. If the difference in the readings obtained in tests in paragraphs 24 and 25 amounts to more than one division, there is excessive friction. See paragraph 17.

27. Zero Adjustment—With full load on the meter, disengage the main pawl and press the trip as in paragraph 24. Tapping the meter gently, turn the small zero adjusting pinion at the top of the meter until the pointer reads beyond the "5" point an amount equal to the difference between the readings obtained by tests in paragraphs 24 and 25. Then repeat the test of paragraph 25 and if not correct make further zero adjustment. Note that as the actual zero point of the scale is suppressed, *zero adjustment must be made by means of the full-load point.*

28. Repeat the test of paragraphs 24 and 25 at the "1" point and the "9" point, using loads of respectively one-tenth and nine-tenths of full *scale* rating. If correct at "5" and not correct at "1" and "9" the length of the main spring must be changed (see paragraph 29). If the meter reads *high* at the "1" point and low at the "9" point the spring should be *lengthened.* If it reads *low* at the "1" point and high at the "9" point the spring should be *shortened.*

29. Adjusting Main Spring—To adjust the main spring loosen the spring clamp at the top of the meter, feed through the desired amount of spring, and tighten the clamp. Adjustment of the length of the spring necessitates a readjustment of the zero. Repeat the tests in paragraphs 24, 25, and 28.

Checking Watthour Mechanism

30. Disengage the main pawl by swinging it back. Check the speed of the watthour meter disk on 5 per cent and full load, in the same manner as a watthour meter is tested, allowing the auxiliary disk to swing freely. The watthour adjustments are the same as those on Westinghouse watthour meters.

31. After these tests are completed be sure to engage the main pawl.

Checking Time Element

32. A stop-watch is required for this test. The following tests should be taken up in the order given:

(a) Apply full load to the meter till the pointer reaches approximately "5".

(b) Open the line switch and allow the auxiliary mechanism to rotate back to its zero stop.

(c) Apply a load, preferably about full load, to the meter, the same instant starting the stop-watch. A little later press the pointer trip, allowing the pointer to go back as far as it will.

(d) Hold the load steady until the pointer comes to rest then stop the stop-watch.

The stop-watch reading should be the same as the time element of the meter, noted on the nameplate.

33. Adjustment of time element is made by moving the left-hand stop of the balance arm, located on the top plate at the left of the spring-zero adjustment. If the stop-watch reading (paragraph 32) is *high*, this stop should be moved very slightly to the *right*. If stop-watch reading is *low*, the stop should be moved to the *left*.

REPAIR ADJUSTMENTS

34. Setting the Counter—If the counter is removed it should be carefully set when replaced, as follows:

(a) Place the counter in position, but do not tighten up so the gears mesh.

(b) Move the pointer to its maximum position *by turning gear-wheel 10* (Fig. 2). Use a light sharp instrument for this purpose—do not touch the gear wheel with the fingers.

(c) Disengage the main pawl and with the left hand move the balance arm of the auxiliary shaft to the right till it touches the right-hand stop, and hold it there.

(d) Now with the right hand tighten the counter screws so the gears mesh.

35. Adjustment of Pointer Spring—The pointer spring should have enough tension to insure that the pointer returns positively to the lower stop. Too much tension on the spring may cause binding between gears *16* and *17* (Fig. 2).

36. Adjustment of Rear Pivot Bearing—The bearings of the shaft of gear *16* (Fig. 3) should have very little play. The rear bearing screw should be tightened sufficiently to prevent the right-angled gears from slipping out of mesh, but not so tight as to cause binding.

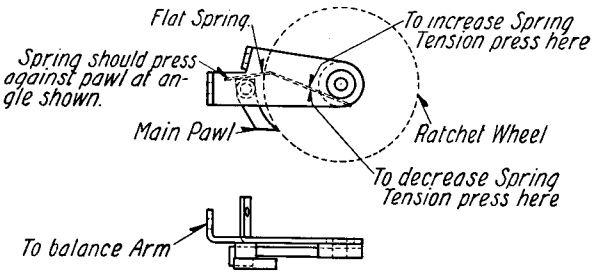

Fig. 4—Proper Adjustment of Main Pawl Spring

37. Adjustment of Main Pawl Spring—The spring should bear on the main pawl as shown in Fig. 4. Method of adjusting this spring is shown in Fig. 4.

38. Adjustment of Escapement—The distance the claw passes within and out of the circumference of the escapement wheel should be made equal by means of adjustment provided at the end of the operating lever. If this does not provide sufficient adjustment, the phosphor bronze spring that transmits the motion from the lever to the claw should be bent until the error is within the range of the adjuster.

CAUTIONS

39. Do not handle the meter roughly after untying the moving element.

40. Inspect as per paragraph 18 whenever the meter is re-located.

41. Do not disturb the balance weights of the auxiliary mechanism or change their adjustment.

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