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DUAL-LOAD METER

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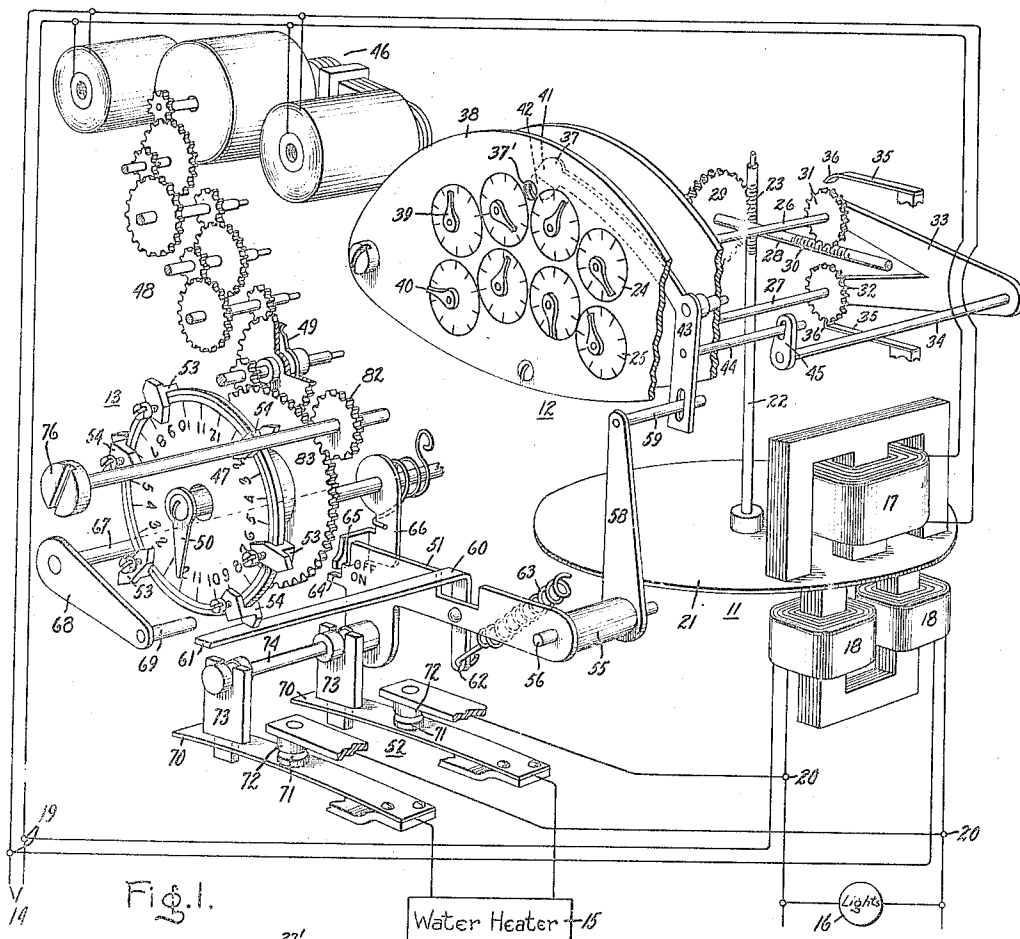


Fig. 1.

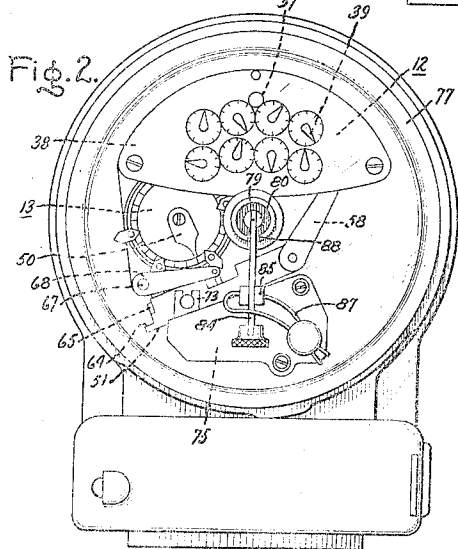


Fig. 2.

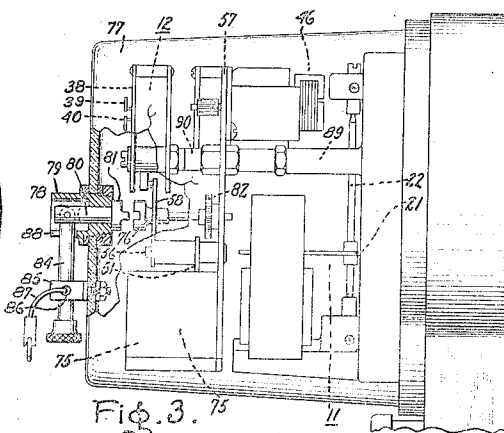


Fig. 3.

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UNITED STATES PATENT OFFICE

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DUAL-LOAD METER

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7 Claims. (Cl. 171-268)

My invention relates to metering and controlling apparatus and concerns particularly such apparatus for use with electric power systems serving more than one class of load or systems selling electric energy at different rates at different times of the day.

It is an object of my invention to provide compact, easily installed attachments or units for converting a watt-hour meter of conventional design into apparatus for controlling electric circuits according to the time of the day and giving separate registrations for different periods of the day.

Another object of my invention is to encourage and to cause greater power consumption during off-peak hours of the day.

Still another object is to provide a system for furnishing electrical energy to high wattage loads at relatively little cost to either the power station or the customer.

Still another object is to provide apparatus which may safely be set, adjusted, or installed by power station employees.

More specific objects of my invention are to provide arrangements for automatically connecting water heaters to electric supply circuits during off-peak hours or for preventing such connection except during off-peak hours in order to fill in valleys in the central station load curve, and for separately registering energy drawn from the central station during off-peak hours and during the remainder of the day.

Other and further objects and advantages of my invention will become apparent as the description proceeds.

In carrying out my invention in its preferred form, I provide a watt-hour meter mechanism of conventional design, a detachable time-switch unit, interchangeable single or double-dial registers and linkage associated with the time-switch unit for shifting the driving connections of the register, and an indicator showing the connections of the register.

The invention may be understood more readily from the following detailed description when considered in connection with the accompanying drawing and those features of the invention which are believed to be novel and patentable will be pointed out in the claims appended hereto. In the drawing, Fig. 1 is an exploded perspective view of one embodiment of my invention, partially distorted and rearranged for the sake of clarity; Fig. 2 is a front view of the apparatus of Fig. 1; and Fig. 3 is a side view.

Like reference characters are utilized throughout the drawing to designate like parts.

The apparatus shown in the drawing by way of illustration consists of a power-responsive integrating mechanism or watt-hour meter unit 11, a double-dial register 12, and a time-switch unit 13, with connections to a source of electric current or power 14, to a water heater 15, or other relatively large and constant wattage load, and connections to a variable wattage load 16, such as lights and appliances which may be turned on and off according to the needs of the customer whose electricity load is metered by the apparatus.

The watt-hour meter unit 11 is of the well-known conventional design, having a voltage or pressure winding 17 connected across the current source 14, current coils 18 connected between input terminals 19 and output terminals 20 so as to carry the load currents, an induction disk 21 acted upon by windings 17 and 18, and a shaft 22 supporting the disk 21 and carrying a worm wheel or helical threads 23 for driving the dials of a register through suitable gearing.

The register 12 is of the double-dial type having two independent dials or sets of dials 24 and 25, including driving shafts 26 and 27, respectively, and gearing (not shown) for converting rotation of the driving shafts into appropriate rotation of the dial pointers. A horizontal shaft 28 is provided, carrying a worm gear 29 meshing with the worm 23, and carrying a worm wheel or threaded portion 30. The shafts 26 and 27 carry worm gears 31 and 32, respectively, adapted to mesh with the worm 30. The ends of the shafts 26 and 27 at the register 12 are so supported as to permit slight lateral movement of the ends carrying the gears 31 and 32. The latter ends are supported in bearings carried by a bifurcated arm 33 secured to a rod 34 journaled in stationary bearings, not shown but supported by the register 12.

To prevent coasting of either dial 24 or 25 while disengaged from the worm 30 and to prevent falsification of the dial readings, a pair of detents 35 is provided. The detents 35 may be composed of resilient strips, each secured at one end to a stationary portion of the apparatus supported by the register 12 and bent at the other end toward the gears 31 and 32 to form spurs 36 adapted to fit between adjacent gear teeth. It will be understood that the arrangement of the arm 33 and the positions of the shaft 28 and the detents 35 are such that one or the other of the gears 31 and 32 is in mesh with the worm

30, being then clear of the associated detent 35, whereas the gear not in mesh with the worm 30 is engaged by one of the detents 35. Thus, dial readings are prevented from changing except by operation of the meter unit 11.

In order that it will be unnecessary to examine the interior of the mechanism and study its construction to determine which of the dials 24 and 25 is at the time connected or in which position the time switch 13 is, a target or indicator 37 is provided and an aperture 37' is cut in the front plate 38 of the register 12 for the purpose of showing the existing condition of the apparatus in this respect.

Suitable means are provided for indicating a distinction between the dials 24 and 25. For example, their pointers 39 and 40 may be painted distinctive colors such as black and red and the target 37 may be divided into two areas 41 and 42, painted black and red, respectively. The target 37 is arranged to drop into the position exposing the red 41 when the gear 32 of the red pointer dial 25 is in mesh and to rise into the position exposing the black 42 when the gear 31 of the black pointer dial 24 is in mesh. In the arrangement shown, the target 37 is part of a bell-crank lever 43 mechanically connected by a pin 44 and a crank 45 to the rod 34 carrying the arm 33. As will be explained more in detail hereinafter, the bell crank 43 is operated by the time-switch unit 13 to shift the dial connection and the indicator position at the desired times of the day.

The time-switch unit 13 includes a timing motor 46 connected across the meter input terminals 19, a rotatable time dial 47, a train of gears 48 including a slip clutch 49 for connecting the motor 46 to the dial 47, a stationary pointer 50, and a snap-action movable member 51 for operating both a switch 52 and the bell-crank lever 43 of the register 12. For the purpose of operating the movable member 51, the dial 47 carries one or more "on" riders 53 and one or more "off" riders 54, all of which are adjustable in position on the periphery of the dial 47. The movable member 51 is pivotally mounted by being secured to a bushing 55 fitting over a post 56 attached to a stationary plate 57 (Fig. 3). The bushing 55 also has secured to it a shift lever 58, carrying a pin 59 for engagement with a slotted portion of the bell-crank lever 43.

The member 51 is arranged to be moved between two limiting positions, designated "On" and "Off" positions, by snap action. To this end, a member 60, having a transverse projection 61 at one end and a spring-receiving eye 62 at the other end, is pivotally mounted upon the member 51. The projection 61 is of just sufficient length to engage the "off" riders 54 but not the "on" riders 53. It will be observed that the "off" riders 54 have extending fingers lying behind the plane of the dial 47, whereas the "on" riders 53 have extending fingers lying in front of the plane of the dial 47. There is a biasing spring 63 fastened at one end in the eye 62 of the member 60 and fastened at the other end to a pin (not shown) on the plate 57. The member 51 is notched at the end to form a step-shaped configuration with an "on" notch 64 at a greater distance from the pivot post 56 than the "off" notch 65. There is a spring-biased detent 66 co-operating with the stepped notches 64 and 65 and the detent 66 is connected by a pivot shaft 67 to an arm 68 in front of the dial 47. The arm 68 carries a pin 69 of just enough length to en-

gage the "on" riders 53 but not the "off" riders 54.

The switch 52 comprises resilient switch blades 70, carrying movable contacts 71, stationary contacts 72, insulating thrust members 73, and a rod 74 projecting transversely from the movable member 51. The switch blades and contacts are enclosed in insulating chambers 75 (Figs. 2 and 3) open at the ends receiving the thrust members 73. The insulating chambers 75 are formed as separate pieces in order that the apparatus may be assembled for any desired number of switch blades merely by utilizing the requisite number of duplicate parts and substituting a rod 74 of the proper length.

In order that the time-switch unit 13 may be reset without opening the casing for the meter unit 11, a slotted adjusting knob 76 is provided and the glass cover 77 of the meter casing is provided with an opening for a suitable implement, such as a screw driver, or a suitable setting tool 78 is permanently mounted in the cover 77. Preferably, a metal bushing 79 is set into the glass cover 77 and suitable means are provided for sealing the opening in the bushing, such as a removable plug arranged to be sealed with a sealing wire, or, if the setting tool 78 is employed, the arrangement is such that it may be sealed.

The setting tool 78 consists of a rod 80 fitting loosely in the bushing 79 and having a head 81 with a ridge adapted to engage the slotted setting knob 76. The knob 76 is fastened to a gear 82 engaging a gear 83 secured to the dial 47. A strip 84 is joined to the rod 80 and a fork 85 secured to the cover 77 and having openings 86 for receiving a sealing wire 87 is provided for sealing the setting tool 78 in the inoperative position shown. The bushing 79 has a slot 88 for the strip 84 of such depth as to hold the head 81 of the rod 80 out of engagement with the knob 76 when the strip 84 is in the position shown, and the arrangement is such that, by breaking the seal 87, the setting tool 78 may be released and moved into operative engagement with the knob 76. My construction protects central station employees from the hazards of electrical shock since it enables resetting the time switch, if necessary, without removing the cover 77 and exposing any live terminals. Likewise, the construction prevents a central station employee authorized only to reset time switches from making any other changes or adjustments in the meter.

The operation of the apparatus as a whole is as follows:

Let it be assumed that there is a valley in the central station load curve between two and five-thirty in the afternoon and that the central station can well afford to furnish power at a lower rate during this period if it can obtain additional load during this period, particularly if it can be assured that such extra load cannot be connected between five-thirty and nine-thirty, the assumed peak load period. One of the "on" riders 53 is clamped at two o'clock and one of the "off" riders 54 is clamped at five-thirty on the dial 47, which rotates counterclockwise. Assuming that the dial is initially in the position shown in Fig. 1, the first event will be that the rider 53 will strike the pin 69, pushing it downward. The detent 66 will thereby be rotated clockwise against the force of its spring, the member 51 will be released, the spring 63 will draw the member 51 upward, and two functions of the member 51 will be performed. First, the switch blades 70 will be allowed to rise, closing the switch contacts 71-72 and connecting the water heater 15 to the sup-

ply source 14 through the meter unit 11. Second, the shift lever 58 will be rotated to the right. The latter action, in turn, will move the target 37 to bring the red portion 41 in view and will raise the arm 33 to bring the gear 32 in mesh, connecting the red-pointer dial 25 to the meter unit 11. It will be understood that the meter reader will note separately the readings of the dials 24 and 25 and that the central station will charge the kilowatt hours recorded on the dial 25 at a lower rate than those recorded on the dial 24.

Just before five-thirty, the "off" rider 54 clamped at five-thirty on the dial will strike the transverse projection 61 of the member 60, thereby stretching the spring 63. Finally, the member 60 will have been rotated so far that the projection 61 rides off the rider 54 while bearing upward against the rider 54, thus forcing the member 51 downward with a snap action, the time now being five-thirty. The movement of the member 51 opens the switch contacts 71-72 to disconnect the water heater 15 and shifts the bell-crank lever 43 to move the target 36 to the black 42 and to bring the gear 31 into mesh again to drive the black-pointer dial 24. It will be understood that additional "on" and "off" riders may be provided for either filling in additional valleys in the load curve or for the purpose of preventing connection of the water heater 15 during peaks in the daily load curve.

Water heaters and other devices of like character are ordinarily so designed that they need not operate continuously and, since the heat is stored, it is immaterial whether they are connected during one time of the day or another. Consequently, it is desirable to provide apparatus for connecting a water heater at times of the day which will be most profitable to the central station and will permit giving the customer a rate reduction. However, the apparatus is useful also in case no load is to be controlled but different rates at different times of the day are desired or if, vice versa, the rates are to be constant but the load is to be controlled.

If no load control is desired, the contact chambers 75 (Figs. 2 and 3) are removed from the plate 57 and the rod 74 is unscrewed from the member 51. If uniform rates are acceptable and a double-dial register is not desired, a single-dial register of standard design is substituted for the register 38. Since the rod 34, the arm 33, the bell crank 43, and the detents 35 are supported by the register 37, the removal of the double-dial register will, of course, result in the removal of the parts mentioned and a gear attached to a standard single-dial register will be in constant mesh with either the worm 30 or the worm 23 in accordance with standard practice. If the automatic timing feature is not desired, the plate 57 (Fig. 3) and all the apparatus attached to it, such as the time-switch unit 13 with the motor 46, etc., will be unbolted from the posts 89 and the register 12 will be removed from the spacer bushings 90 and bolted or screwed directly to the posts 89, in which case, a shorter shaft will obviously be substituted for the shafts 26 and 27. It thus is apparent that the various units described form interchangeable and removable units which may be used or not according to whether their functions are desired in cooperation with the remainder of the apparatus and each other. Furthermore, the complete apparatus can be built up by the central station from standard watt-hour meters which they have in stock by removing a single rate standard reg-

ister from posts 89 and adding the additional units described.

I have herein shown and particularly described certain embodiments of my invention and certain methods of operation embraced therein for the purpose of explaining its principle and showing its application but it will be obvious to those skilled in the art that many modifications and variations are possible and I am, therefore, to cover all such modifications and variations as fall within the scope of my invention which is defined in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Apparatus for metering at differing rates two classes of load supplied by a common power source and controlling one of the classes of load according to the time, said apparatus comprising in combination, a power-responsive integrating mechanism including input terminals for electrical connection to a power source, output terminals for continuous electrical connection to a load of one class and intermittent connection to a load of a second class, and a rotatable shaft carrying a worm wheel, a pair of register dials, each including a driving shaft carrying a worm gear adapted alternately to mesh with said worm wheel, a time-switch unit including timing mechanism, tripping mechanism and a movable member, said tripping mechanism being arranged to move said movable member to one or the other of two alternative positions according to the time, relatively movable switch contacts in operative relation with said movable member for connecting and disconnecting a load of the second class to and from the output terminals of said integrating mechanism, an indicator connected to and operable by said movable member to show in which of its positions said movable member is, movable supports for said dial shafts connected to said movable member to follow the motion thereof and cause one or the other of said gears to mesh with said worm wheel according to the position of said movable member, and resilient substantially stationary means so positioned as to be engaged by whichever of said gears is not in mesh with said worm wheel to prevent rotation of said out-of-mesh gear and its associated dial.

2. In combination, a source of electric power, a load of relatively large and constant wattage, a variable wattage load with input terminals, a power-responsive integrating mechanism interposed between said power source and said variable wattage load and including a rotatable shaft, a pair of register dials each including a driving shaft, a time-switch unit having a movable member arranged to be moved to one or the other of two alternative positions according to the time, relatively movable switch contacts in operable relation with said movable member and interposed between said relatively constant wattage load and the input terminals of said variable wattage load, alternative connecting means for forming a driving connection between said rotatable shaft and one or the other of said dial-driving shafts, and linkage between said movable member and said alternative connecting means arranged to cause the position of said movable member to indicate which of said dial-driving shafts is connected.

3. Apparatus for metering at differing rates two classes of load supplied by a common power source and controlling one of the classes of load according to the time, said apparatus comprising in combination, a power-responsive integrating

mechanism including input terminals for electrical connection to a power source, output terminals for continuous electrical connection to a load of one class and intermittent connection to a load of a second class, and a rotatable shaft driven by said integrating mechanism, a pair of register dials, each including a driving shaft, a time-switch unit having a movable member adapted to be moved to one or the other of two alternative positions according to the time, relatively movable switch contacts in operable relation with said movable member for connecting and disconnecting a load of the second class to and from the output terminals of said integrating mechanism, alternative connecting means for forming a driving connection between said rotatable shaft and one or the other of said dial-driving shafts, and linkage between said movable member and said alternative connecting means arranged to cause the position of said movable member to indicate which of said dial-driving shafts is connected.

4. In combination, a power-responsive integrating mechanism including input terminals for electrical connection to a power source, output terminals, a rotatable shaft driven by the integrating mechanism, a register including a driving shaft, a time-switch unit having a movable member adapted to be moved to one or the other of two alternative positions according to the time, relatively movable switch contacts in operable relation with said movable member for connecting and disconnecting a load to and from the output terminals of said integrating mechanism, connecting means for forming a driving connection between said rotatable shaft and said register-driving shaft, and linkage between said movable member and said connecting means arranged to cause said connecting means to be in or out of operation according to the position of said movable member.

5. A dual-rate meter comprising in combination, a power-responsive integrating mechanism having a rotatable shaft carrying a worm wheel, a pair of register dials each including a driving shaft carrying a worm gear adapted to alternately mesh with said worm wheel, a time-switch unit having a movable member adapted to be moved

to one or the other of two alternative positions according to the time, an indicator connected to and operable by said movable member to show in which of its positions said movable member is, movable supports for said dial shafts connected to said movable member to follow the motion thereof and cause one or the other of said gears to mesh with said worm wheel according to the position of said movable member, and resilient substantially stationary means so positioned as to be engaged by whichever of said gears is not in mesh with said worm wheel to prevent rotation of said out-of-mesh gear and its associated dial.

6. In a dual-rate meter including power-responsive integrating mechanism, a rotatable shaft carrying a worm wheel, a pair of register dials each including a driving shaft carrying a worm gear adapted alternately to mesh with said worm wheel, a time-switch unit having a movable member adapted to be moved to one or the other of two alternative positions according to the time, and supports for said dial shafts attached to said movable member in such relation as to cause one of said gears to mesh with said worm wheel when said movable member is in one position and to cause the other of said gears to mesh with said worm wheel when the movable member is in the other of its positions.

7. Apparatus for metering at different rates according to the time, said apparatus comprising in combination, a power-responsive integrating mechanism including a rotatable shaft carrying a worm wheel, a pair of register dials, each including a driving shaft carrying a worm gear adapted alternately to mesh with said worm wheel, a time-switch unit having a movable member adapted to be moved to one or the other of two alternative positions according to the time, movable supports for said dial shafts connected to said movable member to follow the motion thereof and cause one or the other of said gears to mesh with said worm wheel according to the position of said movable member, and resilient substantially stationary means so positioned as to be engaged by whichever of said gears is not in mesh with said worm wheel to prevent rotation of said out-of-mesh gear and its associated dial.

DONALD G. CAMERON.