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E. H. PORTER & B. CURRIER.

ELECTRIC METER.

APPLICATION FILED JUNE 17, 1904.

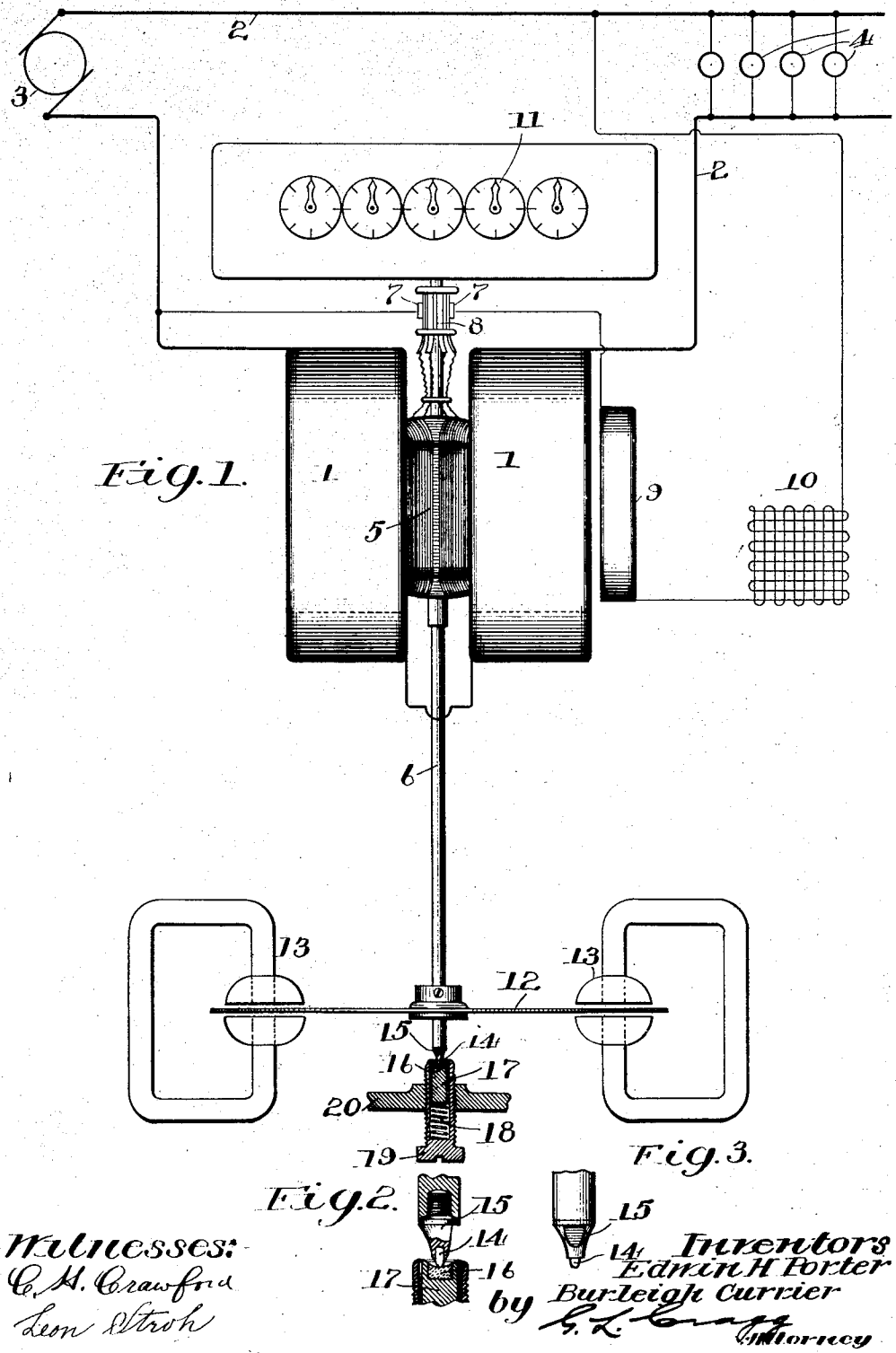


Fig. 1.

Fig. 2.

Fig. 3.

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# UNITED STATES PATENT OFFICE.

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## ELECTRIC METER.

No. 811,323. Specification of Letters Patent. Patented Jan. 30, 1906.

Application filed June 17, 1904. Serial No. 212,990.

*To all whom it may concern:*

Be it known that we, EDWIN H. PORTER and BURLEIGH CURRIER, citizens of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Improvement in Electric Meters, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

The invention relates to electric meters and other instruments wherein rotating shafts engaging bearings are employed, the invention having particular utility in connection with recording-watt meters, especially those of the commutated type wherein the armature shafts or spindles are carried upon bearings, though the invention is not to be limited to any particular kind of electrical measuring instrument.

It is known to those skilled in the art that the source of greatest mechanical difficulty in the operation of meters resides in the bearings for the meter-spindles. These bearings have been hitherto formed of stones of crystalline formation, usually sapphires, which stones or jewels were of cup-like formation to receive the hardened-steel ends of the meter-spindles. In the early practice these hardened-steel ends of the meter-spindles were made integral with the spindles; but it was soon found that these spindle ends rapidly deteriorated, and in order that the life of a meter might be renewed the practice of forming separable sections upon the ends of the spindles engaging the jewels was adopted, so that only the lower ends of the spindles had to be replaced. These ends or pivots of the spindles have uniformly been of hardened steel, which in coöperation with the jewels gave the best results in the operation of meters that had been obtained prior to the device of the present invention. These steel ends or bearings, however, were not of long life, nor did the jewels long withstand the action of the steel ends, though these jewels were frequently of longer life than the steel ends or pivots. The jewels soon became full of holes, appearing deep under the microscope, while particles of steel would be worn from the spindle-pivot ends, which, accumulating in the cavities of the jewel-cups, would oxidize and act as a grinding powder to promote the impairment of the jewels and pivots. A large number of careful tests of bearings for meters as found in commerce show that it is frequently difficult for a shaft-pivot to withstand five thousand revolutions without spoiling the cup-jewel and becoming unserviceable. Harmful results have been observed even after two thousand revolutions. Tests show that the deterioration in the meter-bearings varies, some lasting a great deal longer than others. There is no means of approximating the life of the meter-bearings, so that frequent tests should be made at much cost, which tests are of course very difficult and which occasion frequent replacement of the worn parts. It is now the custom of large electric companies and small active companies to test their meters periodically, a common practice being to make tests yearly and a frequent practice being to make the tests every three, four, or six months, particularly if the meters are of large capacity or if the consumer uses considerable current. For reasons above stated, the results of those tests show that after a meter has been in service it does not register accurately on small loads. This inaccuracy shows itself upon the entire curve of the meter, but more particularly when current is used to a small extent of the meter's capacity—as five per cent., (5%,) for example. The amount of revenue thus lost and which is justly due the power companies is enormous. The cost of renewing the parts in order to bring the meters to a proper degree of accuracy is also large. The inaccuracy mentioned in commutated meters, while being caused largely by the commutator-brushes, is due in great measure to the bearings, for the inaccuracy due to the commutator and brushes may be largely, if not entirely, eliminated by aging process.

The object of the present invention is to provide an improved bearing for meters (and by "meters" is meant all classes of electrical measuring instruments having pivoted shafts) which will not be readily impaired. By means of the invention results very far superior to any that have hitherto been secured have been obtained.

The invention while very simple in nature is most far-reaching in results, and in accordance with the preferred embodiment thereof there are provided stones upon the ends of the shafts to engage stones that act as sup-

porting-bearings for the shafts. These stones are preferably crystalline in formation and desirably of the precious variety, as diamonds, and stones of the corundum group, as sapphires. These stones are preferably such as are found in nature, but are desirably not of the amorphous variety, though novelty is claimed for the association of any stones in a meter in the manner specified. The stones that are preferably used in each meter structure are of the same nature, sapphires being preferred because of their comparative cheapness and of the general satisfaction secured by their use. One of the sapphires in each meter is preferably cupped, while the companion sapphire may be mounted upon a metal plug or section having separable union with the balance of the shaft, as by threaded engagement, or, if desired, the sapphire or stone carried by the spindle may be held in separable union by suction or magnetic attraction by having the same mounted upon smooth iron or steel pins that project in the bores of magnetized spindles. Meters of the commutated or direct-current type thus equipped with sapphire bearings have been under careful examination, the bearings having very great length of life. Hundreds of thousands of revolutions of meter-spindles equipped with stone ends and stone-bearing supports have been had without causing the stones to be deteriorated sufficiently to warrant their rejection. In one instance a spindle with a sapphire pivot end turned several million revolutions on various jewels, having only become worn enough to decrease the efficiency of a meter five per cent. (5 %) on five per cent. (5 %) of its rated capacity—a result that has not, so far as known, been even remotely approached in the use of steel pivots. When these results are compared with results secured in connection with the employment of steel pivots that frequently become so roughened, and so roughen the jewels upon and in the neighborhood of five thousand revolutions as to warrant a replacement of the jewel-cups and spindle-pivots, the importance of the invention will be appreciated. There have been specific instances in which meters equipped with sapphire pivots and sapphire cups have been in as good condition after six hundred thousand revolutions as the average jewel and steel pivot after ten to thirty thousand revolutions.

The invention will be explained more fully by reference to the accompanying drawings, showing the application thereof to an integrating direct-current or commutated motor wattmeter, in which—

Figure 1 is a general view of the meter, showing its circuit connections. Fig. 2 is an enlarged view in sectional elevation of the lower end of the meter structure. Fig. 3 is a face view of a removable block containing a jewel.

Like parts are indicated by similar characters of reference throughout the different figures.

The meter or measuring instrument illustrated has a current or series field-winding subdivided into coils 1 1, that are included in series with one of the mains 2, that are supplied from a source of direct current 3, translating devices, as lamps 4, being illustrated as a load for the circuit. The winding 5 is subdivided into coils that are mounted upon a spindle 6 and which are included in bridge of the supply-mains 2 by commutator-brushes 7, engaging a commutator 8, that is connected with the coils of the winding 5, the windings 1 and 5 coöperating to produce a watt-meter. A friction-compensating coil 9 is provided in series with the armature-coils and in series with extraneous artificial resistance 10. The instrument being a recording instrument, a counter 11 is shown as being adapted for operation by the shaft 6. A damping-disk 12 is provided upon the lower end of the spindle and rotates within a permanent magnetic field that may be furnished by the magnets 13. The lower end of the spindle 6 is equipped with a stone 14, that is preferably separably secured to the shaft, so that on occasion the stone may be replaced. This stone is desirably set into a metal plug 15, that has threaded engagement with the spindle 6. A cup-shaped stone 16 is seated in a jewel-block 17, that is supported upon a spring 18 within the hollow jewel-post 19, that is shown as having threaded engagement with a frame portion 20 of the meter. As stated, these stones are preferably crystalline and are desirably of the corundum group, being, preferably, sapphire. The two elements 14 and 16 are thus of similar material, giving results, however, that are contrary to natural expectation because of the general accepted theory that two substances of the same material in direct contact are not likely to wear as two dissimilar substances. Hitherto the steel pivots have frequently worn out before the jewel-cups. This is not the tendency in the present arrangement.

It will be seen that we have provided a moving element, a stationary element, and jewels where the movable element engages the stationary element. We consider it new with us to have both of said elements jeweled at their contacting places.

Having thus described the invention, the claims of novelty are—

1. An electric meter having a bearing of sapphire, the meter-spindle having an end also of sapphire engaging said bearing, substantially as described.

2. An electric meter having a bearing of crystalline stone, the meter-spindle having an end of sapphire engaging said bearing, substantially as described.

3. An electric meter having a bearing of

stone, the meter-spindle having an end of sapphire engaging said bearing, substantially as described.

4. An electric meter having a bearing of sapphire, the meter-spindle having an end of crystalline stone engaging said bearing, substantially as described.

5. An electric meter having a bearing of sapphire, the meter-spindle having an end of stone engaging said bearing, substantially as described.

6. An electric meter having a bearing of corundum, the meter-spindle having an end also of corundum engaging said bearing, substantially as described.

7. An electric meter having a bearing of crystalline stone, the meter-spindle having an end of corundum engaging said bearing, substantially as described.

8. An electric meter having a bearing of stone, the meter-spindle having an end of corundum engaging said bearing, substantially as described.

9. An electric meter having a bearing of corundum, the meter-spindle having an end of crystalline stone engaging said bearing, substantially as described.

10. An electric meter having a bearing of corundum, the meter-spindle having an end of stone engaging said bearing, substantially as described.

11. An electric meter having a bearing of sapphire, the meter-spindle having an end of corundum engaging said bearing, substantially as described.

12. An electric meter having a bearing of crystalline stone, the meter-spindle having an end of crystalline stone engaging said bearing, substantially as described.

13. An electric meter having a bearing of crystalline stone, the meter-spindle having an end of stone engaging said bearing, substantially as described.

14. An electric meter having a bearing of stone, the meter-spindle having an end of crystalline stone engaging said bearing, substantially as described.

15. An electric meter having a bearing of corundum, the meter-spindle having an end of sapphire engaging the bearing, substantially as described.

16. An electric meter having a bearing of stone, the meter-spindle having an end of stone engaging said bearing, substantially as described.

17. An electric meter having a stone bearing, the meter-spindle having an end of similar stone engaging said bearing, substantially as described.

18. An electric meter having a crystalline-stone bearing, the meter-spindle having an end of similar crystalline stone engaging said bearing, substantially as described.

19. In a device of the character described, a stationary element and a movable element to contact therewith, both of said elements being jeweled at their contacting places.

In witness whereof we hereunto subscribe our names this 8th day of June, A. D. 1904.

EDWIN H. PORTER.
BURLEIGH CURRIER.

Witnesses:
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WM. R. STACKHOUSE.