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MAGNETIC DEVICE

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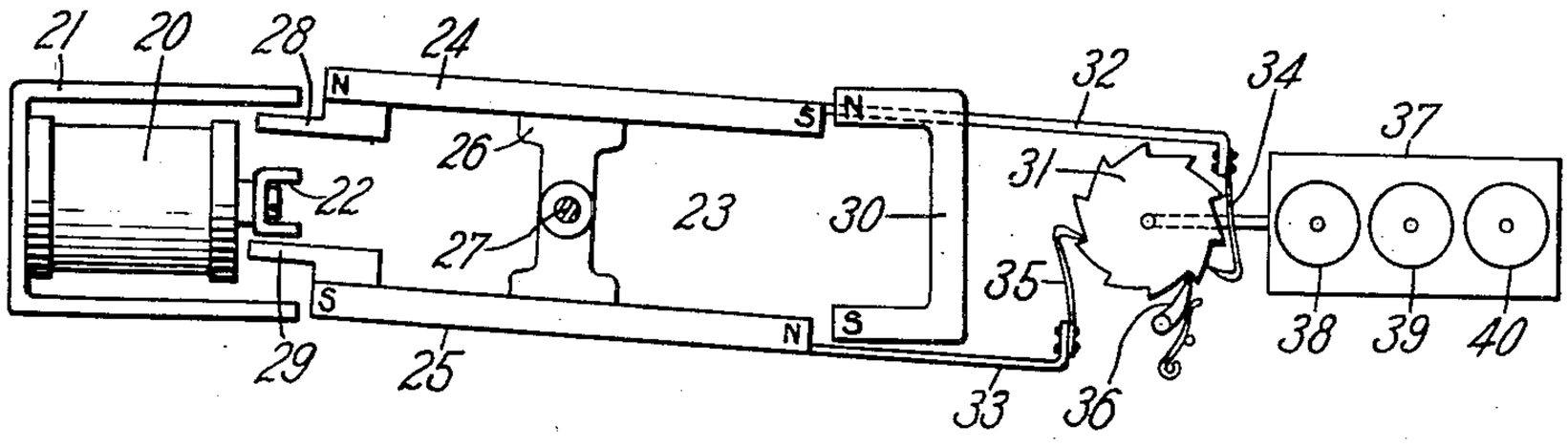

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MAGNETIC DEVICE

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This invention relates to magnetic actuating devices and particularly to such devices when applied to telephone meters.

Its object is to increase the sensitivity and to improve the operating characteristics of these devices.

It has been the practice, heretofore, in constructing the magnetic actuating devices for telephone substation meters, to provide an oscillating element which cooperates with the pole-pieces of a stationary magnet in such a way that the air-gap varies in length for different positions of the oscillating element. With this construction, the force required to move the oscillating element varies with its different positions. When in its extreme position, and when the air-gap is of minimum length, a much greater force is required, due to the strong magnetic attraction, than is necessary to move the oscillating element in other parts of its travel. This is a serious objection to the use of such a magnetic design for substation instruments for the reason that the operating currents available are very small in magnitude.

According to the present invention these devices are improved and rendered more sensitive by providing a compensating element which coacts with the oscillating member to compensate in all positions for the variable force exerted thereon by the pole-pieces of the stationary magnet. By this means the oscillating member may comprise a permanent magnet, thereby rendering it more readily responsive to small energizing currents in the electromagnet.

A feature of the invention is an arrangement in which the compensating effect is maintained regardless of the deterioration of the permanent magnet.

The drawing shows the detailed construction of a device embodying the features of this invention.

The magnetic device herein described is designed to operate in response to successive reversals of current and is particularly well suited to drive a counting train at a calling subscriber's station to measure the length of conversation. The movable element of the device, which responds to each current reversal, acts on a registering train which makes a record of the total length of conversation. The said movable element comprises a permanent magnet and depends for its movement upon the magnetic action between it and the pole-pieces of a stationary electromagnet. As the movable element oscillates from one position to another, the air-gap between said element and pole-pieces varies from its maximum to its minimum length, and, as is well known, the force of attraction between a permanent magnet and a mass of magnetic material varies with the air-gap. Consequently when the movable element of the device is in such position that the air-gap is of minimum length there exists a maximum force of attraction between the movable and stationary members.

The device, being operated by the talking current, which is of comparatively low intensity, must respond to small changes in magnetic attraction or, in other words, it must be sensitive to changes in the talking current. It is also desirable that it respond to each reversal of current regardless of its position. Due to the variable air-gap, however, greater forces will be required to move the device element in some positions than in others, unless provision be made to counteract the variable forces. The manner in which this compensation is effected will be explained presently in the detailed description.

The drawing shows the construction of the device in which a stationary electromagnet 20, which may have one or two windings, is mounted on a member 21, which forms two of the pole-pieces. The member 22 attached to the core of the magnet 20 also provides two additional pole-pieces.

The movable portion of the device comprises an oscillating member 23, which is made up of two permanent magnets 24 and 25 attached to a yoke 26 of suitable material which in turn is mounted on an axis 27. The permanent magnets 24 and 25 are provided with pole-pieces 28 and 29 which cooperate magnetically with the pole-pieces 21 and 22. When the movable member 23 is in the position shown, which is one of its extreme positions, the air-gap between the pole-piece 28

and the upper pole-piece 21, and the air-gap between the pole-piece 29 and the lower pole-piece 22 are of minimum length. The same will be true of the other two air-gaps when the member 23 is tilted to its opposite extreme position. In these extreme positions the force of attraction between the movable and stationary parts of the device is greatest and consequently there is a tendency to stick when attempt is made to rotate the movable element 23 to its opposite position. This tendency requires a comparatively larger force to start the element in rotation than would be required at some other position in its cycle.

To compensate for this variable force of attraction there is provided a permanent magnetic member 30 which cooperates with the other ends of the permanent magnets 24 and 25. The relation between the magnetic member 30 and the magnets 24 and 25 is such that a force is exerted upon the member 23 by the member 30 which varies in the same relation and counteracts the force exerted on the pole-pieces 28 and 29. Accordingly, for any position of the oscillating member 23 the same force is required to set it in motion.

The oscillating member 23 operates a set of registers 37 comprising a train of counters 38, 39 and 40 which are driven by a ratchet wheel 31. The ratchet wheel is operated by pawls 34 and 35 mounted on arms 32 and 33, and attached to the member 23. For each oscillation of the member 23 the ratchet 31 is advanced to step the counting train 37 a corresponding amount.

For a detailed explanation of a suitable method of reversing the current to operate a device of this character, reference is made to the patent to Beattie, No. 912,268, granted February 9, 1909.

While only one embodiment has been shown, it is to be understood that the invention is not so limited, but may be incorporated in a variety of devices.

What is claimed is:

1. The combination in a magnetic device of a stationary electromagnet having a winding and pole-pieces, a magnetic member arranged to oscillate about its axis and in cooperative relation to said pole-pieces, and means acting on said member to compensate for variations in the force exerted between such member and said pole-pieces.

2. The combination in a magnetic device of an electromagnet having a winding and pole-pieces, a permanent magnet cooperating with said pole-pieces and arranged to oscillate from one position to another, and a compensating element acting on the permanent magnet to compensate for variations in the force exerted between said permanent magnet and the pole-pieces.

3. The combination in a magnetic device of an electromagnet having a winding and pole-pieces, an oscillatable permanent magnet balanced to remain in either of its extreme positions, said permanent magnet cooperating with said pole-pieces, and a compensating element acting on the permanent magnet to compensate for variations in the force exerted between said permanent magnet and the pole-pieces.

4. The combination in a magnetic device of an electromagnet having a winding and pole-pieces, a permanent magnet cooperating with said pole-pieces and arranged to oscillate from one position to another, a magnetic element exerting a variable force on the permanent magnet to compensate for the variable force exerted between said permanent magnet and the pole-pieces, and an element actuated by said permanent magnet.

5. In combination, an electromagnet having a winding and pole-pieces, a permanent magnet cooperating with said pole-pieces and pivoted to oscillate between two positions due to the energization of said winding, the flux of said permanent magnet causing a variable force between such magnet and said pole-pieces for different positions of the permanent magnet, and means acting on said permanent magnet to compensate for the variable force exerted between the permanent magnet and the electromagnet.

6. In combination, an electromagnet having a winding and pole pieces, a permanent magnetic member comprising two permanent magnets secured together and arranged to oscillate between two positions, each of said permanent magnets having one of its free ends in magnetic relation with the pole pieces of said electromagnet, and a magnetic device coacting with the other ends of said permanent magnets to compensate for the difference in the forces exerted between said permanent magnets and said electromagnet.

7. In combination, an electromagnet having a winding and pole pieces, a permanent magnetic member comprising two permanent magnetic bars secured to each other and mounted to oscillate from one position to another and arranged to remain in either of the extreme positions, said permanent magnets cooperating magnetically with the pole pieces of said electromagnet, and a magnetic compensating element coacting with the pole pieces of said permanent magnets to compensate for the variable forces existing between the permanent magnets and the electromagnet.

8. The combination in a magnetic device of a stationary electromagnet, a permanent magnet mounted to move from one position to another, the pole-pieces of said magnets forming air-gaps which vary for different positions of said permanent magnet, and a compensating element exerting variable magnetic forces on said permanent magnet to compensate for the variable forces existing

between said magnets due to the variation in said air-gaps.

9. In combination, a stationary electromagnet having a winding and pole-pieces, a permanent magnetic member comprising two parallel permanent magnetic bars secured together and mounted to oscillate from one position to another, each of said bars having an end coacting with the pole-pieces of said electromagnet and forming therewith air-gaps which vary with the position of oscillation, a stationary magnetic compensating element spanning the opposite ends of said bars and exerting thereon forces which vary according to the position of oscillation to compensate for the variable forces existing between said electromagnet and said permanent magnetic bars, and means actuated by said permanent magnetic member.

In witness whereof, I hereunto subscribe my name this 19th day of October A. D., 1927.

EDWARD J. PRATT.