J. T. DEMPSTER.

GRAPHIC RECORDING APPARATUS.

APPLICATION FILED OCT. 20, 1913.

1,132,308. Patented Mar. 16, 1915.

Fig. 1.

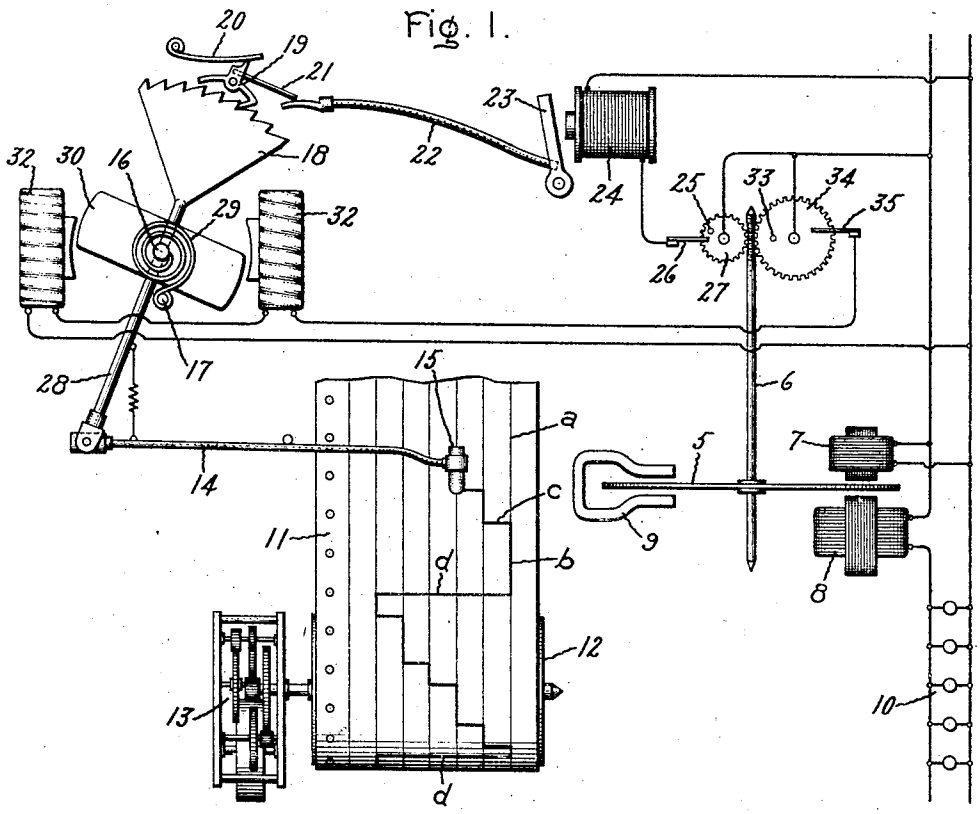
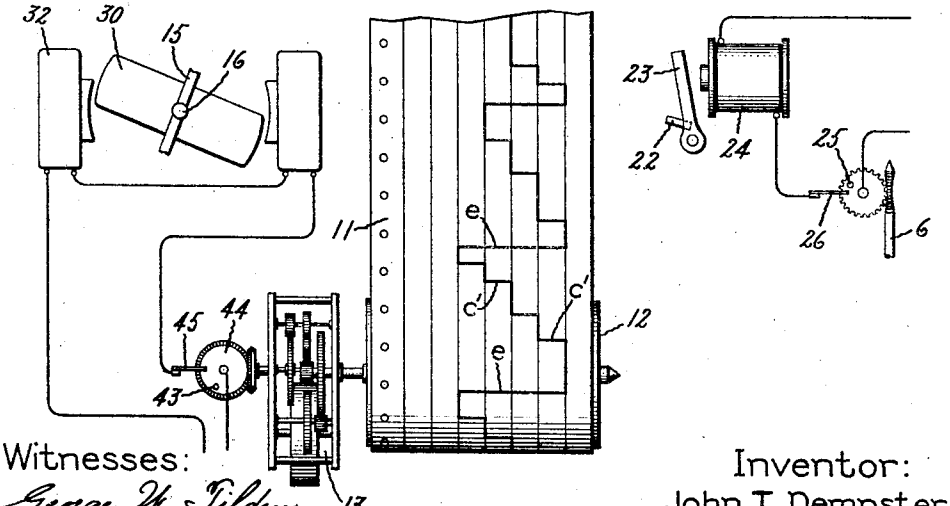


Fig. 2.



Witnesses:

George W. Tilden

J. Ellis Glen.

Inventor:

John T. Dempster,

by Albert G. Davis

His Attorney.

UNITED STATES PATENT OFFICE.

JOHN T. DEMPSTER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

GRAPHIC RECORDING APPARATUS.

1,132,308. Specification of Letters Patent. Patented Mar. 16, 1915.

Application filed October 20, 1913. Serial No. 796,107.

To all whom it may concern:

Be it known that I, JOHN T. DEMPSTER, a subject of the King of Great Britain, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Graphic Recording Apparatus, of which the following is a specification.

My invention relates to graphic recording apparatus and particularly to apparatus for recording electrical characteristics and quantities.

More particularly my invention relates to apparatus comprising in combination with an electric meter a graphic recording instrument, and more specifically my invention relates to an electric recording apparatus in which a step by step record is imparted on a time actuated record sheet by a marking device whose movement is wholly or partially controlled by an electric meter shaft.

The object of my invention is to generally improve the present construction of graphic recording apparatus.

More particularly the object of my invention is to provide a novel and improved form of actuating mechanism for the marking device of a recording apparatus of the type to which my invention relates.

Other objects of my invention will be apparent from a consideration of the following description of my improved graphic recording apparatus.

The features of my invention which I consider patentably novel are definitely indicated in the claims appended hereto.

The construction and mode of operation of an electrical recording apparatus embodying the novel features of my invention will be understood from the following description taken in connection with the accompanying drawings in which:

Figure 1 is a diagrammatic view of my improved type of graphic recording apparatus operatively connected to an electric meter, and Fig. 2 is a diagrammatic view of the same apparatus with a modified means for controlling the return of the marking device to its initial position.

Referring first to Fig. 1 of the drawings, there is diagrammatically represented an electric motor meter of the induction type. This meter comprises a rotatable disk armature 5 secured to a pivoted shaft 6. The disk armature is located within the influence of a potential coil 7 and a series coil 8 and its revolutions are damped in the usual manner by a permanent magnet 9. The revolutions of the armature 5 are thus directly proportional to the quantity of energy supplied to the translating devices 10.

The graphic recording apparatus comprises a record sheet 11 which is movably mounted on suitable rotatable drums. One of these drums 12 is shown in the drawings and is operatively connected to a clockwork mechanism 13. While I have illustrated in the drawings a clockwork mechanism for moving the drum 12, it will be understood that any constant speed driving mechanism, such as a constant speed electric motor, may be employed if desired. In any event the record sheet 11 moves at uniform speed and is thus, in effect, time actuated.

A marking device is arranged in operative relation to the movable record sheet and is adapted to be moved substantially transversely of the direction of movement of the record sheet. The marking device comprises a transversely movable arm 14 which carries at one end a suitable marking means, as for example, an ink receptacle and marking pen 15 of the usual type, diagrammatically shown in Fig. 1 of the drawings. The other end of the arm 14 is pivoted to an arm 28. The arm 28 is rigidly secured to a pivoted shaft 16.

A coiled spring 29 is secured at one end to a fixed pin 17 and at the other end to the pivoted shaft 16, and when energized acts as a motive means for moving the marking device. The response of the marking device to the action of the spring motive means is normally prevented by an escapement. This escapement comprises a ratchet segment 18 secured to the arm 28 and thus operatively related to the spring motive means. An escapement pawl 19 operatively engages the teeth of the ratchet segment and when the pawl is released the segment is permitted to move a distance corresponding to the tooth pitch of the ratchet. A spring 20 normally holds the escapement pawl in engagement with the ratchet teeth. A pin 21 is secured to the pawl and when raised permits the ratchet segment and hence the marking device to move a distance corresponding to the tooth pitch of the ratchet.

An arm 22 secured to the pivoted arma-

ture 23 of an electromagnet 24 engages beneath the pin 21, and operates to raise the pin and release the escapement when the electromagnet is energized. The circuit of the winding of the electromagnet is completed when the movable contact 25 engages a fixed contact 26. The movable contact is mounted on a gear member 27 which is rotated by the shaft 6 of the electric meter. Each time that a predetermined quantity of energy has been consumed in the translating devices 10 and metered the movable contact 25 will engage the fixed contact 26 and electromagnet 24 will be energized. The escapement pawl 19 is thereupon released and the marking device imparts a short transverse mark on the time actuated record sheet.

The remaining features of construction of my novel graphic recording apparatus will be best understood from a description of the operation thereof. When the marking device is in its zero or initial position the marking means 15 will be positioned over the zero line indicated by reference character *a* in the drawings. The marking means remains stationary and as the record sheet moves, a vertical line such as *b* is drawn on the record sheet. When the predetermined quantity of electricity has been consumed and metered the electromagnet 24 is energized and the marking device moves a predetermined distance toward the left of the fiure, as heretofore explained. A record mark *c* is thereby drawn on the record sheet. The vertical lines on the record sheet thus indicate the lengths of time required to consume a predetermined amount of electricity, and the horizontal lines indicate the times of the beginning and ending of the consumption of each of such predetermined quantities of electricity.

When a definite number of equal and predetermined quantities of energy have been metered it is necessary to return the marking device to its initial position. The means which I have devised for accomplishing this end constitute an important feature of my invention. A soft iron armature 30 is rigidly secured to the shaft 16 and has its ends operatively arranged within the influence of the pole pieces of magnetizing coils 32. The circuit of the magnetizing coils 32 is closed when a movable contact 33 mounted on a rotatable gear 34 engages a fixed contact 35. The gear 34 is rotated by the meter shaft 6, and thus the energizing of the magnetizing coils is controlled by the meter shaft. When the magnetizing coils 32 are energized, the armature 30 will turn to a horizontal position thereby energizing the spring motive means 29 and moving the marking means 15 of the marking device to its initial position over the line *a*. It will thus be seen that the periodic releasing of the escapement pawl and the periodic energizing of the spring motive means are both controlled by the rotatable meter shaft 6. In the drawings I have represented a construction in which the spring motive means is energized and the marking device returned to its initial position after the metering of six equal and predetermined quantities of energy as determined by the engagement of contacts 25 and 26. In returning to its initial position the marking device imparts a long horizontal line *d* on the record sheet. This distance between any two lines *d* therefore indicates the length of time required to consume and meter a quantity of energy equal to six of the smaller predetermined and equal quantities of energy.

In Fig. 2 of the drawings I have illustrated a slightly modified form of my improved graphic recording apparatus. In this modification the marking device is returned to its initial position at the end of a predetermined interval of time, as for example, at the end of every 15 minutes. The only change necessary in the construction of Fig. 1 to produce the modification of Fig. 2 is to substitute a time actuated movable contact for the meter actuated contact 33 in Fig. 1. This result I accomplish by driving a gear member 44 provided with a movable contact 43 from the clockwork mechanism 13. The contact 43 coöperates with a fixed contact 45 to close the circuit of the magnetizing coils 32 at the end of equal time intervals. The record obtained by the modification of Fig. 2 is substantially the same as that obtained by the apparatus of Fig. 1. The long horizontal lines *e* on the record sheet of Fig. 2 are equally spaced and by counting the number of short horizontal lines C′ between any two lines *e* and interpolating for fractional quantities of the predetermined energy interval the total amount of energy consumed during the time between two engagements of the contacts 44 and 45 can be readily ascertained.

It will be evident from the foregoing description that I have provided an arrangement of elements in a graphic recorder which coöperate to form an accurate, simple, and extremely satisfactory type of apparatus. The operation of the marking device by an independent motive means relieves the electric meter of any objectionable external load, since the meter has only to close the contacts in the circuits of the electromagnetic controlling devices. The step by step record is a peculiarly advantageous form in which to record the demand of an electrical installation, and the division of the record into blocks by the periodic return of the marking device to its initial position facilitates a quick and comprehensive examination of the record. The use of a

periodically energized motive means for actuating the marking device is further of decided advantage in this type of apparatus since it permits the use of a motive means of small energy capacity.

Numerous modifications in the details of construction of my improved graphic recorder will be obvious to those skilled in the art. I do not, therefore, desire to be limited to the specific arrangement of elements herein shown and described for the purpose of illustrating my invention. I, accordingly, aim in the appended claims to cover all modifications which are within the spirit and scope of my invention.

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

1. A graphic recording apparatus comprising a movable record sheet, a marking device operatively related to said record sheet, motive means operatively connected to said marking device and adapted to move the marking device to impart a mark on said record sheet, means whereby said motive means is adapted to impart a periodic movement to said marking device, and means for periodically energizing said motive means whereby said marking device is returned to an initial position.

2. A graphic recording apparatus comprising a movable record sheet, a marking device operatively related to said record sheet, a spring motive means operatively connected to said marking device and adapted to move the marking device substantially transversely of the direction of movement of the record sheet, means whereby said spring motive means is adapted to impart a periodic movement to said marking device thereby producing a step by step record on the record sheet, and means for periodically energizing said spring motive means whereby said marking device is returned to an initial position.

3. A graphic recording apparatus comprising a movable record sheet, a marking device operatively related to said record sheet, a spring motive means operatively connected to said marking device, an escapement operatively related to said spring motive means and adapted when released to permit a certain movement of the marking device in response to the action of the spring motive means, means whereby said escapement is periodically released, and means for periodically energizing said spring motive means whereby said marking device is returned to an initial position.

4. A graphic recording apparatus comprising a movable record sheet, a marking device operatively related to said record sheet, a spring motive means operatively connected to said marking device, a ratchet operatively related to said spring motive means, an escapement pawl adapted when released to permit the ratchet to move in response to the spring motive means a distance corresponding to the tooth pitch of the ratchet, means whereby said escapement is periodically released, and means for periodically energizing said spring motive means whereby said marking device is returned to an initial position.

5. The combination with an electric meter of a time actuated record sheet, a marking device operatively related to said record sheet, motive means operatively connected to said marking device, means whereby said motive means impart a periodic movement to said marking device, and means for periodically energizing said motive means whereby said marking device is returned to an initial position.

6. The combination with an electric meter of a time actuated record sheet, a marking device operatively related to said record sheet, motive means tending to move said marking device, an escapement operatively related to said motive means, means for periodically releasing said escapement whereby a mark is produced on said record sheet, and means for periodically energizing said motive means whereby said marking device is returned to an initial position.

7. The combination with an electric meter of a time actuated record sheet, a marking device operatively related to said record sheet, means for moving said marking device a predetermined distance at the end of the metering of each of a number of equal quantities of energy whereby a step by step record is produced on said record sheet, and means for returning said marking device to an initial position at the end of the metering of a predetermined number of said equal quantities of energy.

8. The combination with an electric meter of a time actuated record sheet, a marking device operatively related to said record sheet, motive means operatively connected to said marking device, means operatively related to said motive means for moving said marking device a predetermined distance at the end of the metering of each of a number of equal quantities of energy whereby a step by step record is produced on said record sheet, means operatively related to said motive means and adapted when actuated to energize the motive means and to return the marking device to an initial position, and means for actuating said last mentioned means at the end of the metering of a predetermined number of said equal quantities of energy.

9. The combination with an electric meter having a rotatable shaft of a time actuated record sheet, a marking device operatively related to said record sheet, motive means operatively connected to said marking device, means operatively related to said mo-

tive means and controlled by the meter shaft whereby a periodic movement is imparted to said marking device, and means for periodically energizing said motive means whereby said marking device is returned to an initial position.

10. The combination with an electric meter having a rotatable shaft of a time actuated record sheet, a marking device operatively related to said record sheet, motive means operatively connected to said marking device, means operatively related to said motive means and controlled by the meter shaft whereby the motive means imparts a periodic movement to said marking device, and means controlled by the meter shaft for energizing said motive means whereby said marking device is periodically returned to an initial position.

11. The combination with an electric meter of a time actuated record sheet, a marking device operatively related to said record sheet, motive means operatively connected to said marking device, means whereby said motive means imparts a movement to said marking device at the end of the metering of each of a number of predetermined and equal quantities of energy, and means for periodically energizing said motive means whereby said marking device is returned to an initial position.

12. The combination with an electric meter of a time actuated record sheet, a marking device operatively related to said record sheet, motive means operatively connected to said marking device, an escapement operatively related to said motive means, means for releasing said escapement at the end of the metering of each of a number of predetermined and equal quantities of energy whereby said motive means imparts a periodic movement to said marking device, and means for periodically energizing said motive means whereby said marking device is returned to an initial position.

13. The combination with an electric meter of a time actuated record sheet, a marking device operatively related to said record sheet, a spring operatively connected to said marking device and adapted to move the marking device to impart a mark on the record sheet, an escapement operatively related to said spring and adapted to prevent the response of the marking device to the action of the spring, means for periodically releasing said escapement, and means for periodically energizing said spring whereby said marking device is returned to an initial position.

14. The combination with an electric meter having a rotatable shaft of a time actuated record sheet, a marking device operatively related to said record sheet, a spring operatively connected to said marking device and adapted to move the marking device to impart a mark on the record sheet, an escapement operatively related to said spring and adapted to prevent the response of the marking device to the action of the spring, means controlled by the meter shaft for releasing the escapement at the end of the metering of each of a number of equal quantities of energy, and means controlled by the meter shaft for energizing said spring whereby said marking device is periodically returned to an initial position.

15. The combination with an electric meter having a rotatable shaft of a time actuated record sheet, a marking device operatively related to said record sheet, a spring motive means operatively connected to said marking device, a ratchet operatively related to said spring motive means, an escapement pawl adapted when released to permit the ratchet to move in response to the action of the spring motive means a distance corresponding to the tooth pitch of the ratchet, means controlled by the meter shaft for releasing the escapement at the end of the metering of each of a number of equal quantities of energy whereby a step by step record is produced on the record sheet, electroresponsive means operatively related to said spring motive means and adapted when actuated to energize the spring motive means and to return the marking device to an initial position, and means controlled by the meter shaft for actuating said electroresponsive means at the end of the metering of a predetermined number of said equal quantities of energy.

In witness whereof, I have hereunto set my hand this 18th day of October, 1913.

JOHN T. DEMPSTER.

Witnesses:
HELEN ORFORD,
MAX WEISBROD.