Aug. 15, 1933. A. P. DAVIS 1,922,759

REMOTE CONTROL SYSTEM

Filed July 11, 1927 2 Sheets-Sheet 1

Fig. 1

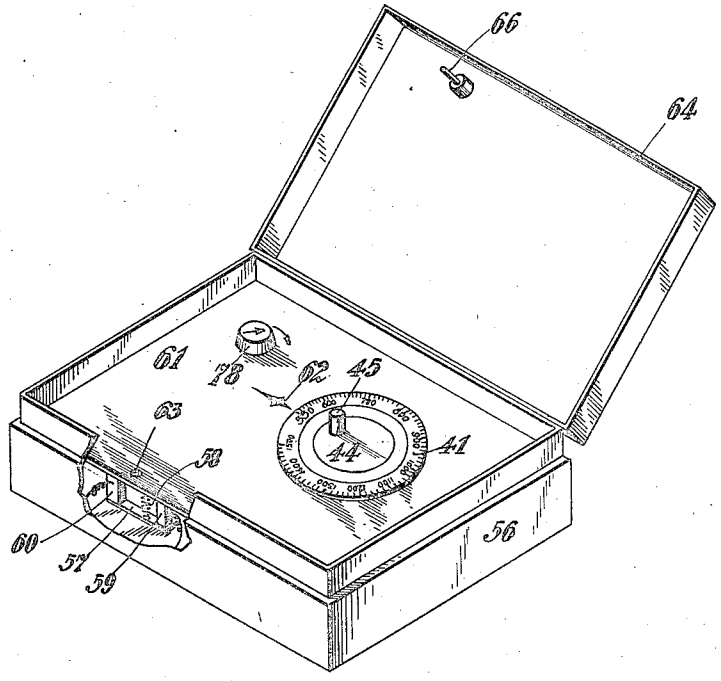
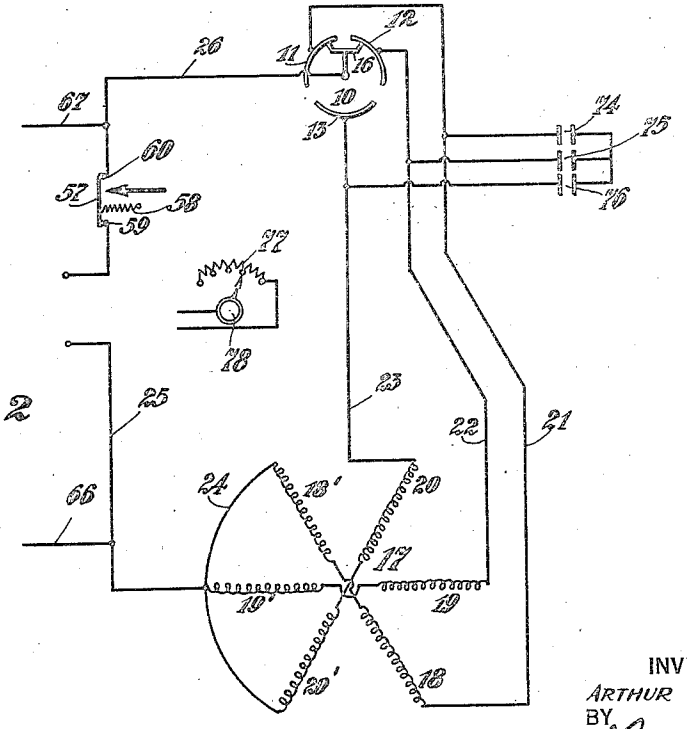


Fig. 2



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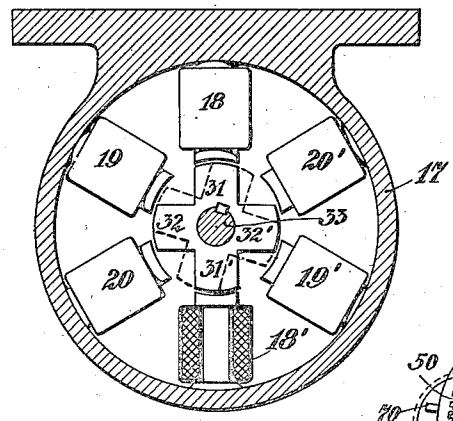


Fig. 3

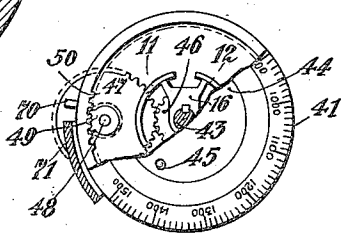


Fig. 5

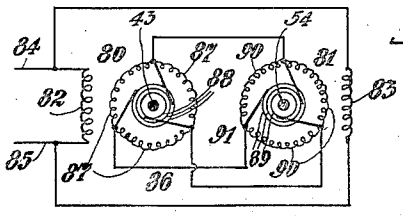


Fig. 6

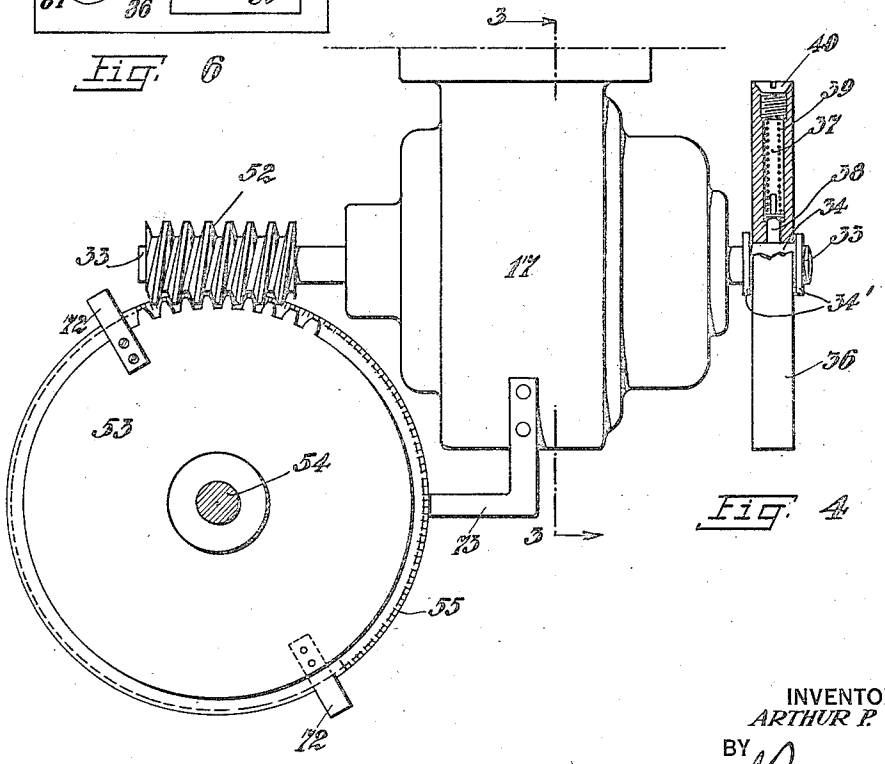


Fig. 4

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UNITED STATES PATENT OFFICE

1,922,759

REMOTE CONTROL SYSTEM

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Application July 11, 1927. Serial No. 204,919

11 Claims. (Cl. 172—239)

My invention relates to improvements in remote control systems of the type in which movement of a hand lever, indicator, dial or the like at a control station will cause a corresponding movement of a dial, indicator, or other means at an operating station.

My invention will be found particularly useful in connection with radio receiving apparatus. It is found desirable in practice to locate a receiving set at a considerable distance from the loud speaker in order to obtain the best results, but heretofore there has been no way of tuning the set at or in the immediate vicinity of the loud speaker where the tone effects are reproduced, and the operator has been put to considerable inconvenience in obtaining accurate tuning. It is an object of my invention to provide a remote control system by which the condenser dials of a receiving set may be operated from one or more convenient locations at a distance from the set. The loud speaker could then be placed wherever desired, while the receiver set need not be conspicuously placed in the same room, but could be stowed away wherever convenient, as, for instance, in the attic or the cellar of the building. At some convenient point adjacent to the loud speaker a control station would be provided from which the tuning of the set could be effected. Together with this control system means would be provided for varying the volume or amplitude of the sound reproduced by the loud speaker.

With such a control system in view I have invented a very simple apparatus for operating the tuning dials of a radio receiving set from a remote station.

I am aware that systems have been devised for controlling movable apparatus from a remote station. There are two general types of remote control systems; one operable only with alternating current and the other with direct current. The alternating current system calls for a pair of interconnected self-synchronous motors, while in the direct current system a step-by-step motor at the operating station is controlled by a commutator located at the remote control station.

My invention has for an object to adapt either of these systems to the remote control of a radio receiving apparatus.

Heretofore, efforts to run a step-by-step motor on alternating current have not proved successful. The armature of the motor would not follow the commutator brush with any degree of certainty and was just as liable to run in a reverse direction. I have found that the difficulty is due to the fact that when the field coils of the motor are energized by alternating current, the armature is given an oscillatory movement which may grow to such amplitude that when the next adjacent field coil is energized the wrong pole of the armature might happen to be in position to be attracted thereby, and the armature would turn in the wrong direction. It is an object of my invention to overcome this difficulty by providing means for damping oscillations of the armature, and I have found that a step-by-step motor provided with such means will run as satisfactorily and with the same degree of reliability as a motor run on direct current. I am aware that damping means have been employed on self-synchronous motors to prevent over-running of the rotor, but I believe that no one heretofore has applied such means to step-by-step motors to permit operating them with alternating current.

Another object of my invention is to provide means for bringing the apparatus at the control and operating stations into synchronism, should they, by any chance, fall out of step.

Another object of my invention is to provide means for preventing operation of the control apparatus unless it be connected with the operating station. Thus in the case of a step-by-step system there will be no danger of throwing the two stations out of step unless there should chance to be a failure of current during the operation of the control apparatus.

Another object of my invention is to provide means for preventing inductive effects in connection with the control system which might affect the operation of the receiving apparatus and produce disturbing noises in the loud speaker.

With these and other objects in view which will appear hereinafter, I shall now describe a preferred embodiment and an alternative form of my invention and will point out the novelty and scope of my invention in the appended claims.

In the drawings,

Fig. 1 is a view in perspective of my improved control station partly broken away to illustrate certain interior details;

Fig. 2 is a diagram illustrating the electrical connections between the control station and the operating station of my improved step-by-step system;

Fig. 3 is a view in cross-section of a step-by-step motor employed at the operating station, the section being taken on the line 3—3 of Fig. 4;

Fig. 4 is a side elevation of mechanism located at the operating station;

Fig. 5 is a plan view partly broken away, of certain mechanism employed at the control station; and

Fig. 6 is a diagram of connections showing the use of a pair of self-synchronous motors for controlling a radio receiving set.

In the preferred embodiment of my invention I use a step-by-step motor at the operating station, which is controlled by a commutator at the control station. The arrangement is shown diagrammatically in Fig. 2. The commutator 10 at the control station is provided with three segments 11, 12 and 13 respectively which are adapted to be engaged by a brush 16. The motor 17 at the operating station has six field coils which are connected in diametrically opposed pairs and are designated in the diagram by the reference numerals 18—18', 19—19' and 20—20' respectively. These pairs of coils are so wound that their diametrically opposed poles will be of opposite polarity. Furthermore, the coil 19 is oppositely wound with respect to coils 18 and 20 so that alternate coils present poles of opposite polarity. The outer ends of coils 18, 19 and 20 are connected by leads 21, 22, and 23 to the segments 11, 12 and 13 respectively. The outer ends of the coils 18', 19' and 20' are connected by a lead 24 which in turn is connected by a wire 25 to one terminal of a suitable source of current, the other terminal of which is connected by the wire 26 to the brush 16.

The span of the brush 16 is such that for each complete rotation of the brush there will be six distinct steps in the progression of electro-magnetic waves sweeping about the field coils. These steps are of equal angular measure so that as the brush is progressed about the commutator segments the pairs of field coils will be energized alternately by ones and twos. Thus in the diagram the brush is shown as spanning the commutator segments 11 and 12 and the coils 18, 18' and 19, 19' are simultaneously energized. Further movement of the brush clockwise would result in energizing the coil 19 only after which the brush would span the segments 12 and 13 and the coils 19, 19' and 20, 20' would be simultaneously energized.

The motor is preferably provided with a four pole armature provided with salient pole-pieces 31, 31' and 32, 32', as shown in Fig. 3. We may assume that current is passing through the coils 18, 18' and that the opposite poles 31, 31' are attracted by the magnetic flux induced in the energized field coils. As the brush sweeps clockwise through an angle of 60 degrees energizing the coils 19, 19' and 18, 18' simultaneously, the poles 31, 31' and 32, 32' will move clockwise to the position shown by dotted lines in Fig. 3 or in a direction which is the reverse of the progression of the wave of energy in the field coil. The actual angular movement of the armature will be but 15 degrees. On the next clockwise advance of the brush through an angle of 60 degrees the armature will swing clockwise 15 degrees farther, bringing the poles 32, 32' into alinement with the field coils 19, 19'. Thus the armature travels at one-quarter the angular speed of the brush and in the same direction as the brush.

To prevent oscillation of the armature when alternating current is passed through the field coils I provide a damping device which may be of the type shown in Fig. 4. The armature shaft 33 has secured thereto a sleeve 34 provided with a collar 34' at each end, and mounted on this sleeve between the collars is a fly wheel 36. The fly wheel is radially bored to receive a plunger 38 which is preferably formed of leather or similar soft material. The plunger bears against the sleeve 34 being pressed into engagement therewith by a coil spring 39 seated in the bore 37. A screw 40 threaded in the bore 37 provides means for adjusting the pressure of the spring on the plunger 38.

The operation of this device is as follows: When the armature shaft is rotated, the fly wheel 36, by reason of frictional engagement of plunger 38 with the sleeve 34, rotates with the shaft 33. However, any rapid oscillatory movements of the shaft 33 are hindered by the braking action of the plunger 38 in the fly wheel 36. Owing to its inertia the fly wheel cannot respond readily to the rapid oscillatory movements of the armature, and the energy of these movements is absorbed by the frictional engagement of the plunger 38 with the sleeve 34. On the other hand when the armature is turned under control of the brush 16, the acceleration of the armature shaft is comparatively slow, and the fly wheel will be turned by the shaft with practically no absorption of energy by the brake plunger 38.

Damping mechanism very similar to this has been employed on the rotor at the operating station of a self-synchronous system, but its purpose is not to prevent oscillations due to rapid alternations of the field (such oscillations are not present), but to prevent oscillations due to over-running of the rotor when the controller is suddenly stopped or reversed. Thus the damping mechanism as I use it with a step-by-step motor is new in purpose as well as in effect, and makes it possible to use a remote control system which may be operated either on direct current or alternating current.

In applying remote control to a radio receiving set it is desirable to provide an indicator at the control station which will give a true indication of the position of the condensers or other tuning means in the radio receiving set. To this end I provide a reduction gear between the brush 16 and a rotatable dial 41, while at the receiving set a reduction gear is provided between the armature shaft of the motor and the condenser shaft. The two gear trains are such that the dial at the control station will make almost a complete turn while the condensers pass through their full tuning range.

The reduction gear at the commutator end of the system is shown in Fig. 5. Mounted on a vertical shaft 43 is a disk 44 which carries an eccentric handle 45 by which the disk may be rotated. Secured to this disk is the brush 16 which sweeps over the segments 11, 12 and 13 of the commutator. The shaft 43 has secured thereto, a pinion 46 which engages a gear 47 mounted on a shaft 48. The latter, in turn, carries a pinion 49 which engages an internal gear 50 mounted to rotate freely on the shaft 43. The internal gear bears the dial 41 which is of annular form and rotates in the plane of the disk 44.

At the motor end of the system the armature shaft 33 has secured thereto a worm 52 which engages a worm wheel 53 fixed to the condenser shaft 54. The latter carries the movable sector plates of the radio receiver condensers. The condenser shaft 54 carries the usual graduated dial 55 which indicates the position of the condensers. The disk dial 41 at the control station is correspondingly calibrated so that when the handle 45 is operated to turn the dial 41 through a certain number of graduations the condenser dial 55 will move through the same number of graduations.

The arrangement of the control apparatus is optional and can be varied as desired but I prefer to mount it in a small box 56 which may be of attractive and ornamental design. In the box 56 I provide a switch which is shown diagrammatically in Fig. 2. The switch consists of a member 57 which is urged by a spring 58 into contact with terminals 59 and 60 in the line 26. The box is provided with a panel plate 61 having an opening therein to receive the dial 41 and disk 44. The latter lie flush with the face of the panel and a fixed mark or arrow 62 on the panel plate provides a starting point from which the graduations on the dial 51 may be read. In the panel plate 61 is an opening 63 alined with the switch member 57. The box 56 is provided with a hinged lid 64 which carries a pin 65 adapted to enter the opening 63 when the cover is closed and depress the plate 57 against the action of spring 58, thereby opening a gap in the circuit of the system. By this arrangement whenever the box is closed the circuit of the remote control system is opened and whenever the box is open the circuit of the remote control is closed. Thus it will be impossible to operate the control system when the box cover is closed because the control handle 45 will be inaccessible.

One important feature of this arrangement is that the dial 41 is prevented from getting out of step with the dial 55. It will be understood that owing to the worm and worm wheel connection between the motor 17 and condenser shaft 54 it will be impossible to turn the shaft 54 by any other means than that of operating the handle 45. The only way in which the dials might be thrown out of step would be to have a failure of current in the control system, due to some outside interruption, while the handle 45 was being operated. However, should this occur they could readily be brought into step by operating the handle 45 until the dial 51 reached one or the other extreme limit of its travel. Projecting from the gear 50 is a pin 70 and which engages a stop 71 carried by the panel 61. The pin and stop cooperate to limit movement of the dial when either extreme of its graduations reaches the arrow 62. Similarly the gear 53 carries a pair of stop members 72 which are adapted respectively to engage a finger 73 depending from the motor 17 when the dial 55 has reached the limit of its travel in one direction or the other. Thus assuming that the readings on the dial 51 and 55 run from "550" to "1500", when the handle 45 is operated to turn the dial 51 to the reading "550", the dial 55 should indicate the same reading and one of the stop members 72 will be brought into engagement with the finger 73. However, should the dials be out of step and should the stop 72 engage the finger 73 before the dial 51 has been moved to the position "550" the condenser shaft 54 would be prevented from turning and would be held fixed until the dial 51 had caught up with the dial 55. The same adjustment could be effected at the other extreme of movement of the dials. It will be understood that the torque of the motor 17 is so slight that no harm will result from operating the motor while the armature shaft is prevented from turning by a stop 72 engaging the finger 73.

The radio receiving set is preferably powered from the same source as is the remote control system, through leads 66 and 67 running from lines 25 and 26 respectively, so that when the box lid 64 is closed the power circuit of the receiving set will be opened. Thus a convenient means is provided for simultaneously turning on the receiving set and providing for the control of the set from a remote station.

When the remote control system is used in connection with a radio receiving set it is essential to eliminate any inductive effects which might be reproduced in a loud speaker. To this end I provide condensers 74, 75 and 76 which are bridged across the leads 21, 22, and 23 respectively. These condensers absorb the inductive kick produced as the brush 16 passes from one segment to the other, and thus interference with the reception of the set is avoided.

It is desirable to provide means for controlling the volume of sound reproduced by the loud speaker and to this end I provide a rheostat 77 in the circuit of the loud speaker which is controlled by a button 78 on the panel board 61. By this means in a single control station compactly mounted in the box 56, I provide for turning a radio set on or off, tuning the set, and controlling the amplitude or volume of sound reproduced by the set. Furthermore, the control station can be operated either on direct or alternating current.

In Fig. 6 I show an alternative form of my invention adapted for use solely with alternating current. In this system two self-synchronous motors are employed which are indicated in the diagram at 80 and 81. The motor 80 at the control station has a field coil 82 while motor 81 at the operating station has a field coil 83. The two fields are connected in parallel with a suitable source of current through leads 84 and 85. The rotor 86 at the operating station is provided with windings 87 which are respectively connected through slip rings 88 and 89 with similar windings 90 of the rotor 91 at the operating station. The rotor 86 takes the place of the brush 16 in the step-by-step system and because the gearing at the control station is practically the same as that shown in Figs. 1 and 5 I have used the reference numeral 43 to indicate the shaft to which the rotor 86 is affixed. At the operating station the rotor 91 is geared to the condenser shaft 54 in the same way as is the armature 30 and for this reason I have used the reference numeral 33 to indicate the rotor shaft. This rotor shaft also carries the fly wheel 36 and damping mechanism to prevent oscillation of the shaft 33 when it is suddenly stopped or reversed from the control station. The only changes necessary are in the relative gear ratios at the two stations because the rotor 91 runs at the same speed as the rotor 86 while the armature 30 runs at one quarter the speed of the brush 16.

The self-synchronous remote control is operated in the same way as in the step-by-step system above described. As the handle 45 is turned, varying the position of the rotor 86 with respect to the winding 82 the rotor 91 will be correspondingly turned with respect to the field coil 83 and this movement will be transmitted through the gearing at the operating station so that calibrations on the dial 55 will keep in step with those on dial 41.

While I have described my invention as applied to radio-receiving apparatus I do not limit myself to such application for it will be evident that my invention, either in whole or in part, could be used with a wide variety of apparatus. Furthermore, my invention is not confined to the specific constructions shown, but includes variations in details and arrangements of parts which will occur to any one skilled in the art. There-

fore I wish it to be understood that the accompanying drawings and the description given above are to be considered in the illustrative sense and not as limitations of my invention, and that I am at liberty to make such changes, as fall within the spirit and scope of my invention as defined in the appended claims.

I claim:

1. A step-by-step alternating current motor comprising a plurality of field coils arranged to be energized in succession by alternating current, a shaft, an armature mounted on and fixed to the shaft, a fly wheel freely mounted on the shaft, a friction member carried by the fly wheel, and means for pressing the friction member against the shaft.

2. A step-by-step alternating current motor comprising a plurality of field coils arranged to be energized in succession by alternating current, a shaft, an armature mounted on and fixed to the shaft, a fly wheel freely mounted on the shaft, a friction member carried by the fly wheel, means for pressing the friction member against the shaft, and means for varying the pressure of said member on said shaft.

3. In a remote control system, a step-by-step motor at an operating station, a commutator for the motor at a control station, means for manually operating the commutator to control angular movement of the motor, a switch for opening and closing the circuit of the commutator, a casing in which the switch and commutator are enclosed, said casing having a lid, said lid when closed rendering the commutator operating means inaccessible, means for closing the switch when the lid is open, and means for opening the switch when the lid is closed.

4. In a remote control system, a step-by-step motor at an operating station, a controller for the motor at a control station, means for manually operating the controller to control angular movement of the motor, a switch for opening and closing the circuit of the controller, and means for rendering the controller inaccessible when the switch is open.

5. The combination with an alternating current step-by-step motor comprising a plurality of pairs of poles arranged to be energized in succession by alternating current and an unwound polar armature, of inertia means, frictionally engaging the armature to damp oscillations thereof.

6. The combination with a salient pole, step-by-step motor, comprising a plurality of field coils, means including a source of alternating current for energizing said field coils in succession, a shaft, an armature fixed to said shaft in rotary relation to said field coils, of a flywheel loosely mounted on said shaft, a friction member carried by said flywheel, and means for pressing the friction member against said shaft.

7. In a system of the class described, a salient pole, step-by-step motor comprising a plurality of stationary poles having their axes radiating from a common point, means including a source of alternating current for energizing said poles in succession, an unwound polar rotor armature having poles radiating from a common point, and inertia means to damp the oscillations of said armature due to said alternating current, whereby said armature is prevented from undirected reversal.

8. A combination of a step-by-step alternating current motor comprising a stator, including a group of stator elements, a rotor including a group of rotor elements, one of said groups of elements being arranged to be energized in succession by alternating current, and means for frictionally damping oscillatory movements of the rotor.

9. A combination of a step-by-step alternating current motor comprising a stator, including a group of stator elements, a rotor including a group of rotor elements, one of said groups of elements being arranged to be energized in succession by alternating current, and means for frictionally engaging the rotor.

10. A combination of a step-by-step alternating current motor comprising a stator, including a group of stator elements, a rotor including a group of rotor elements, one of said groups of elements being arranged to be energized in succession by alternating current, a weight movable relatively to the rotor, and a friction clutch connecting the rotor and said weight.

11. A combination of a step-by-step alternating current motor comprising a stator, including a group of stator elements, a rotor including a group of rotor elements, one of said groups of elements being arranged to be energized in succession by alternating current, a weight movable relatively to the rotor, a friction clutch connecting the rotor and the weight, and means for adjusting the frictional engagement of the clutch.

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