

April 14, 1931.

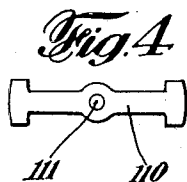
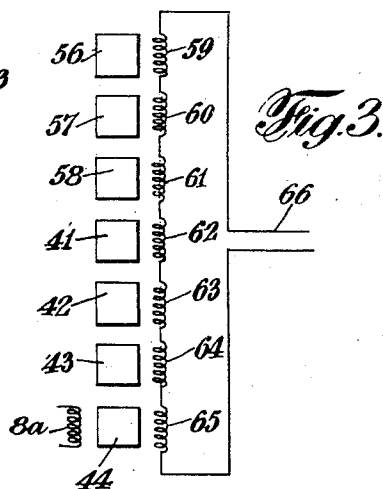
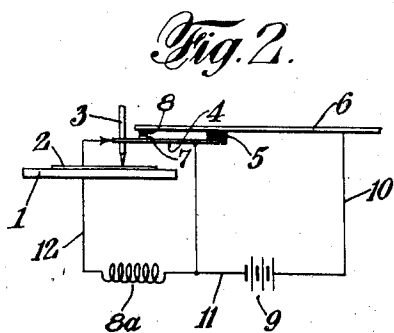
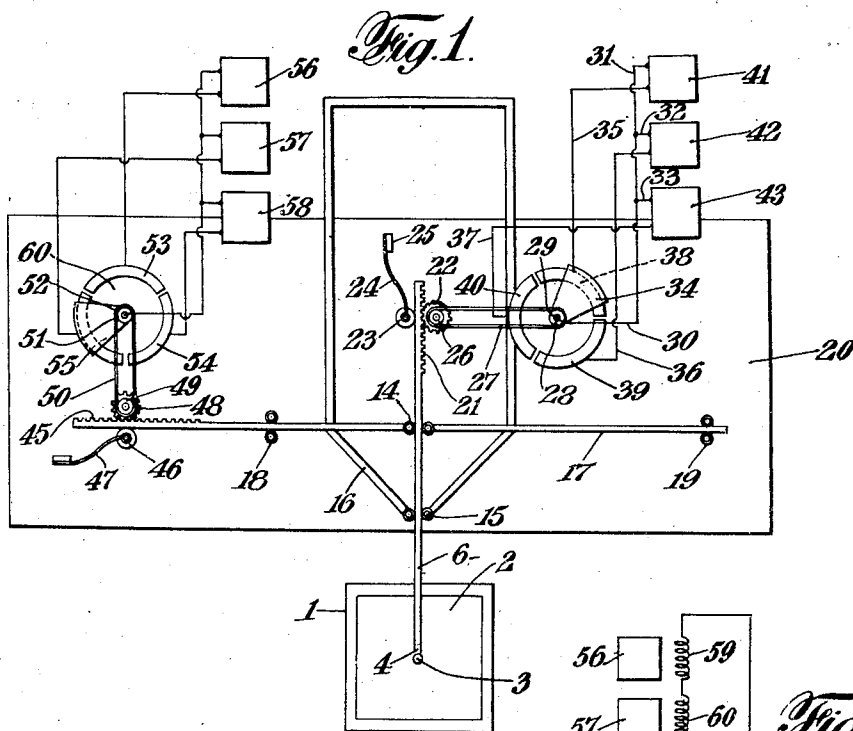
M. B. SLEEPER

1,800,760

APPARATUS FOR DISTANT ELECTRICAL CONTROL

Filed April 11, 1929

2 Sheets-Sheet 1



INVENTOR
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BY
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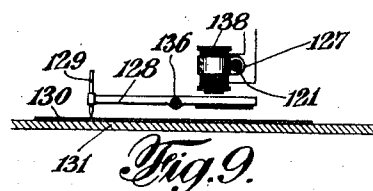
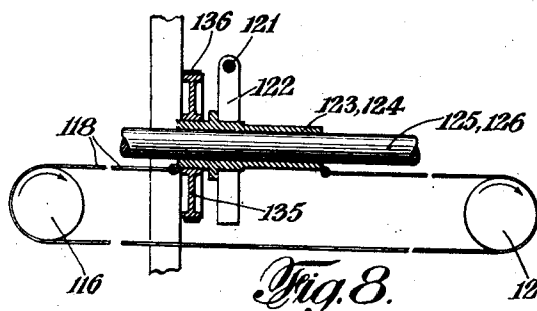
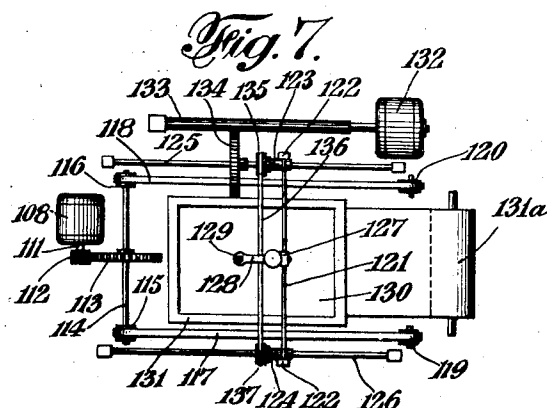
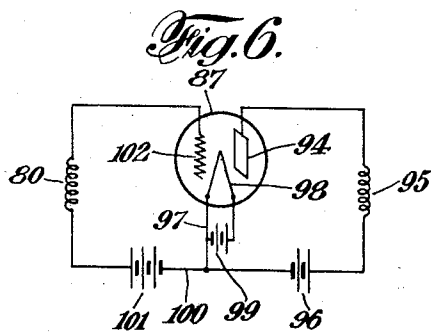
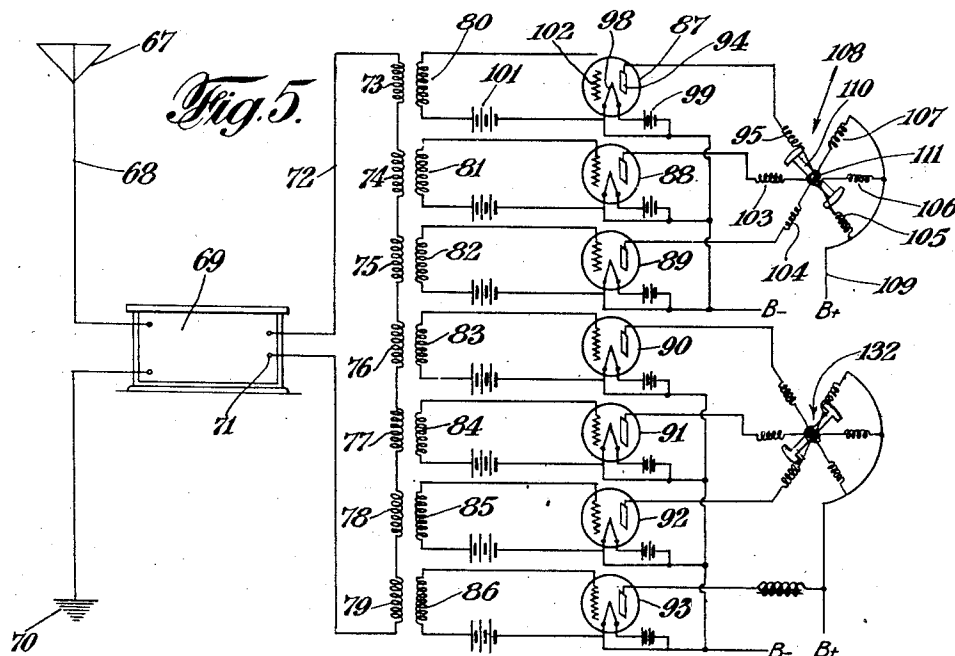
M. B. SLEEPER

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APPARATUS FOR DISTANT ELECTRICAL CONTROL

Filed April 11, 1929

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

MILTON BLAKE SLEEPER, OF NEW YORK, N. Y., ASSIGNOR TO SLEEPER RESEARCH LABORATORIES, INC., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

APPARATUS FOR DISTANT ELECTRICAL CONTROL

Application filed April 11, 1929. Serial No. 354,271.

My invention relates to an apparatus for distant control of devices of various kinds, although it has special application in the reproduction of graphic subjects of all kinds.

5 The object of my invention is to provide means whereby effective distant control electrically may be obtained in the operation of any desired type of apparatus. More particularly the object of my invention is to provide an apparatus whereby movements of any character may be reproduced at a distance in an exact, effective, and dependable manner, especially as, for example, in the reproduction of graphic subjects of all kinds.

15 The present application relates to an invention which is an improvement over the subject matter of the invention set forth in my copending application upon Electrical controlling apparatus, Serial No. 319,521, filed November 15, 1928.

In previous apparatus suggested for the purposes herein referred to, it has been found to be desirable to further eliminate the possibility of jagged or uneven lines in such graphic reproducing apparatus, particularly in order to avoid time intervals between successive electrical impulses, which may have had the result at times of delaying the action of the receiving apparatus in the reproduction of the particular subject. More particularly, I have found it desirable to eliminate large increments of movement, so far as the directional devices are concerned, so as to thereby entirely eliminate the delays such as referred to in successive impulses produced in connection with the apparatus.

In other words, in accordance with my invention, I am enabled to produce a distant control, as, for example, the reproduction of graphic subjects, by means of a continuous sequence of audio impulses by which I mean to include audio or audio-modulated radio impulses of successive frequencies, which impulses exactly duplicate the succession of continuous impulses transmitted, and as a result the mechanical or electrical actions which institute the transmitted impulses may be exactly duplicated by the received impulses.

Incidentally, my invention contemplates the operation of one or more motors from

the received impulses in such a manner as to be completely synchronized with a similar motor or motors which control the transmitted impulses. This is accomplished through the agency of transmitting switches and motors for receiving having oscillating armatures which are arranged to duplicate in the receiving motors the positions of the transmitting switches. By this means, furthermore, I am enabled to eliminate the use of rectifiers, in addition to the elimination of make and break contacts, thus greatly reducing the cost of manufacture of the apparatus, as well as the maintenance thereof.

Again, a further object is to provide such transmitted impulses which may, if desired, be transmitted over a part of the distance through telephone or telegraph wires, etc.

The apparatus made in accordance with my invention is, furthermore, of very high utility inasmuch as it is substantially unaffected by static as well as the changing intensity of the impulses.

Further objects of my invention will appear from the detailed description of the same hereinafter.

While my invention is capable of embodiment in many different forms, for the purpose of illustration I have shown only certain forms of the same in the accompanying drawings, in which—

Fig. 1 is a plan view of the transmitting devices, the motors being shown diagrammatically therein;

Fig. 2 is an elevation of the graphic actuating means provided at the transmitting station;

Fig. 3 is a representation of the circuit connecting the said apparatus to an audio frequency transmission of any desired type;

Fig. 4 is an enlarged detail of the armature used in connection with these motors;

Fig. 5 is a diagrammatic representation of the circuit arrangement for the receiving devices;

Fig. 6 is a diagrammatic representation of the circuit arrangement of the audions used therein;

Fig. 7 is a plan view of the mechanical reproducing devices;

Fig. 8 is a vertical section through the same; and

Fig. 9 is a vertical section through a portion of the same enlarged.

In the drawings, I have shown transmitting devices for transmitting, for example, drawings, writings, etc., to distant points by audio frequencies, although it is to be understood that such transmission may, if desired, be partially or wholly over wires, such for instance as telephone or telegraph wires, inasmuch as the audio frequencies which I utilize preferably range from 600 to 2400 cycles. Accordingly, I have provided a support 1, on which there is adapted to be held a sheet of paper 2 by any desired means. A pointer, pencil, or other graphic instrument 3 is arranged so as to be pressed down upon the paper 2 when it is desired to operate the apparatus for the reproduction of the desired graphic subject. For this purpose the pointer 3 is carried upon a spring arm 4, which normally moves the pointer upwardly out of contact with the paper 2, said spring being supported on an insulating block 5 carried by a slidable rod 6. The spring arm 4 carries an electric contact 7, which cooperates with an electric contact 8 on the slidable rod 6, so that, when the pointer 3 is pressed downwardly into contact with the paper 2, the circuit between contacts 7 and 8 is broken, thus causing audio frequency impulses of a definite wave length to be sent out from a coil 8a located in a circuit including a source of current 9 having one terminal connected by a wire 10 to the slidable arm 6 and the other terminal 11 leading to the coil 8a, which in turn is connected by a wire 12 to the switch arm 4, a short-circuiting wire 13 being provided from said switch arm 4 to a point between the coil 8a and the source of current 9. The said slidable arm 6 is supported between two sets of rollers 14 and 15, both of which are carried on a framework 16 supported for movement upon a cross-rod 17, which in turn is supported upon two sets of rollers 18 and 19 carried upon a base 20 in fixed position thereon. The rear end of the rod 6 has thereon a rack 21, which is pressed into contact with a gear 22 by means of a roller 23 on a spring arm 24 having a fixed connection 25 to the base 20. On the same pivot with the gear 22 there is, furthermore, provided a pulley 26 connected by a belt 27 to a pulley 28 on a shaft 29 of a rotary switch arm or brush 34 which is rotated by the pulley 28. Leads 35, 36 and 37 are connected, respectively, to contact sectors 38, 39 and 40 over which the rotary switch arm 34 operates. Also, in the circuits energized through the contacts 38, 39 and 40, and which include the wires 35, 36 and 37, as well as a wire 30 leading to the switch arm 34, and branch wires 31, 32 and 33 leading by means of any desired oscillator equipment to a series of oscillators, there are oscil-

lators 41, 42 and 43, which are actuated, respectively, thereby, in any of the usual well known ways and with the aid of any known type of equipment, so as to modulate the transmitted wave at these different audio frequencies so that a different audio frequency will be produced for each of said circuits, and which are different also from the audio frequency produced from an oscillator 44 energized through the agency of the coil 8a already described. In case of wire transmission the audio impulses are transmitted without the necessity of modulating a carrier wave.

In order to account for the changes in the position of the pointer 3 in the directions across the paper 2, the rod 17, supported on the rollers 18 and 19, is provided. One end of this rod 17 has thereon a rack 45, which is pressed by a spring supported roller 46, carried on a support 47 on the base 20, into contact with a gear 48. The gear 48 has on the same shaft therewith a pulley 49, which operates a belt 50 leading to another pulley 51 on a shaft 52 of a second series of segmental contacts 53, 54 and 55, which lead respectively to oscillators 56, 57 and 58 in the manner referred to previously in relation to the oscillators 41, 42 and 43, adapted to produce three other audio frequencies, so that the oscillators 56, 57, 58, 41, 42, 43 and 44 send out different audio frequencies, respectively, but all of which are preferably within the range of 600 to 2400 cycles, as above referred to. This series of oscillators for this purpose energizes, respectively, coils 59, 60, 61, 62, 63, 64 and 65, connected in series in a circuit 66, which is adapted to be plugged into the socket usually provided for the broadcast microphone, and which is connected in turn to the usual audio frequency broadcast transmission apparatus.

These audio frequencies may be received wherever a radio receiving apparatus is situated. For this purpose there may be provided an aerial 67 of the usual type, connected by a lead 68 to a radio receiving apparatus 69 of the usual type, having a ground 70 connected thereto. The internal construction of this radio receiving apparatus may be of any desired character, but, for example, may be the same as set forth in Fig. 6 of my co-pending application hereinabove referred to. The usual loud speaker socket 71 is provided on the receiver 69. The receiving apparatus used in accordance with my invention and in connection with the radio receiver 69 is adapted to be plugged into the socket 71. This comprises a circuit 72 leading to the energizing coils 73, 74, 75, 76, 77, 78, 79 of seven tuned filters of any desired type, which are designed to separate out, respectively, the frequencies produced by the oscillators 56, 57, 58, 41, 42, 43 and 44, tuned secondary coils 80, 81, 82, 83, 84, 85 and 86 being provided corresponding, respectively to the coils 73, 74, 75, 76, 77, 78

and 79. The coils 80, 81, 82, 83, 84, 85, and 86 are connected in circuit with vacuum tubes 87, 88, 89, 90, 91, 92 and 93, respectively, the circuit arrangements being the same in each instance. This circuit arrangement is shown particularly in Fig. 6, for example, as applied to the circuit including the coil 80, which is in the circuit with the audion 87. Such audion 87 is provided with the usual plate 94, which, however, in this instance, in the output circuit contains a motor magnet 95, which circuit includes the usual B-battery 96, the minus terminal of which is connected by a lead 97 to the audion filament 98, arranged to be heated in the usual way by an A-battery circuit 99. The lead 97 also has connected thereto an input circuit 100, containing a battery 101, as well as the coil 80 and a grid 102 to give a negative bias to the output circuit normally.

When a voltage is set up across the coil 80, due to the operation of my apparatus, the negative bias is lessened and electrons pass from the filament 98 to the plate 94, thus allowing a current to flow in the motor magnets 95 and 105. The three audions 87, 88 and 89 are thus connected, respectively, to three pairs of magnets comprising, respectively, 95, 103, 104, 105, 106, 107 of a self synchronizing motor such as a Selsyn motor 108. This motor has a rotatable permanent magnet or armature which may be provided with any suitable windings for this purpose, the armature being arranged to be rotated and, therefore, caused to occupy a definite radial position, by reason of actuation from three pairs of field magnets. As will be seen from the diagram in Fig. 5, the three pairs of magnets are in fact connected together by a single lead 109, which leads to a pole of the same battery 96. This Selsyn motor 108 has a rotatable magnet or armature 110 which is caused to take different positions according to which pair of the coils in the motor is energized, it being understood that at certain positions thereof adjacent pairs of such coils will be simultaneously energized. The armature 110 is carried on a shaft 111, which is provided with a gear 112 meshing with a gear 113 carried by a shaft 114 provided with pulleys 115 and 116 at the two ends thereof. Said pulleys are provided for the purpose of operating belts 117 and 118, respectively, the other ends of which are carried over idler pulleys 119 and 120. These belts 117 and 118 are provided for the purpose of moving a transverse bar 121, which is supported in uprights 122 carried on sleeves 123, 124, which are connected, respectively, to the belts 117 and 118, as shown particularly in Fig. 8. The sleeves 123 and 124, respectively, are arranged to slide upon rods 125 and 126. On the transverse rod 121 there is provided a slidable carriage 127, having an arm 128 thereon, carrying a pointer or graphic instrument such as a pencil 129, arranged to write or draw upon

a sheet or band of paper 130 supported from any suitable base 131, and which may be fed from a roll of paper 131a.

The audions 90, 91 and 92 in turn operate a second Selsyn motor 132, in the same way in which the motor 108 is operated. However, the motor 132 has thereon an elongated rod-like gear 133, which meshes with a gear 134 rotatably carried on the rod 125, and to which there is connected a pulley 135, having thereon a belt 136 leading to another pulley 137, which is similarly rotatably supported upon the rod 126. The belt 136 is connected to the writing arm 128.

In order to determine the writing or non-writing position of the arm 128, a magnet 138 is provided, which is in circuit with the audion 93 in a circuit arranged the same as shown in Fig. 6, so that, when the magnet 138 is energized, the lever arm 128 is brought into contact with the sheet of paper 130.

In the operation of my invention, assuming that some drawing, such for example as a picture or sketch, or a writing is to be transmitted, it will be understood that, when the same is drawn upon the paper 2, the resulting graphic subject will be exactly and completely reproduced at the receiving end, and in fact wherever such receiving apparatus is located, upon the sheet of paper 130. This will be accomplished with exactness and without jagged lines, particularly by reason of the reduced increments of movement, which may, for example, be 1/115 of an inch each, owing to the faster operation of the motors, which translate the positions from the switches of the transmission apparatus to the Selsyn motors of the receiving apparatus. Also, the time intervals between transmitted positions of the pointer 3 are eliminated.

Also, the armatures in the Selsyn motors of the receiving apparatus will be capable of continuous movement from one position to another by reason of the energizing of the succession of pairs of the motor magnets, the motors being so constructed that, in changing from one set of magnets to the next set thereof, both pairs of the adjacent magnets will be energized in the interval in passing from one pair to the other. Also, the sector-like shape of the switch arms causes the latter to overlies adjacent contacts or a single contact for like time intervals. Thus it will be seen that forward and backward directions of movement of the arm 6 will be accompanied by exactly reproduced forward and backward movements of the arm 128, and that crosswise movements of the said arm, due to the back-and-forth movement of the rod 17, will be correspondingly reproduced by back-and-forth movements crosswise of the arm 128. This is accomplished, furthermore, due to the fact that my construction utilizes completely synchronized switches and motors at the sending and receiving ends of the apparatus, re-

spectively. The perfection of the reproduction is made possible, also, owing to the fact that the apparatus will be substantially unaffected by static and variations in the intensity of the particular impulses of the frequencies utilized.

It will be understood that my invention is applicable to many different purposes, and, in fact, contemplates the operation of any desired kind of apparatus by radio impulses in which a location in the transmission apparatus may be exactly reproduced in the receiving apparatus at any given time.

Furthermore, by choosing or altering the gear ratio of the gears 22 and 48 and the gears 113 and 134, as compared with one another, the reproductions on the sheet 130 may be made larger or smaller than the original on the sheet 2, or to make distortions thereof.

While I have described my invention in detail above, it is to be understood, furthermore, that it is capable of many different changes without departing from the spirit of the same.

I claim:

1. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means actuated by said audio impulses for producing similar graphic recording movements.

2. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means actuated by said audio impulses for producing similar graphic recording movements by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies.

3. In combination, means for executing a sequence of movements to produce a graphic subject so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means actuated by said audio impulses for producing similar graphic recording movements to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies.

4. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means actuated by said audio impulses for producing similar graphic recording movements, comprising an oscillating motor.

5. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means actuated by said audio impulses for producing similar graphic recording move-

ments, comprising an oscillating motor, by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies.

6. In combination, means for executing a sequence of movements to produce a graphic subject so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means actuated by said audio impulses for producing similar graphic recording movements, comprising an oscillating motor, to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies.

7. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means actuated by said audio impulses for producing similar graphic recording movements by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies by means of which an oscillating motor is synchronized with the first-mentioned movements.

8. In combination, means for executing a sequence of movements to produce a graphic subject so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means actuated by said audio impulses for producing similar graphic recording movements to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies by means of which an oscillating motor is synchronized with the first-mentioned movements.

9. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means actuated by said audio impulses for producing similar graphic recording movements by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies by means of which an oscillating motor is synchronized with the first-mentioned movements, said motor having an armature arranged to assume a position in the motor according to the particular audio frequency transmitted.

10. In combination, means for executing a sequence of movements to produce a graphic subject so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means actuated by said audio impulses for producing similar graphic recording movements to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies

by means of which an oscillating motor is synchronized with the first-mentioned movements, said motor having an armature arranged to assume a position in the motor according to the particular audio frequency transmitted.

11. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, means actuated by said audio impulses for producing similar graphic recording movements, and devices for controlling by audio impulses of another frequency the starting and stopping of the said last-mentioned means.

12. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, means actuated by said audio impulses for producing similar graphic recording movements by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies, and devices for controlling by audio impulses of another frequency the starting and stopping of the last-mentioned means.

13. In combination, means for executing a sequence of movements to produce a graphic subject so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, means actuated by said audio impulses for producing similar graphic recording movements to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies, and devices for controlling by audio impulses of another frequency the starting and stopping of the said last-mentioned means.

14. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto comprising an oscillating motor, means actuated by said audio impulses for producing similar graphic recording movements, and devices for controlling by audio impulses of another frequency the starting and stopping of the said last-mentioned means.

15. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto comprising an oscillating motor, means actuated by said audio impulses for producing similar graphic recording movements by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies, and devices for controlling by audio impulses of another frequency the starting and stopping of the said last-mentioned means.

16. In combination, means for executing a

sequence of movements to produce a graphic subject so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto comprising an oscillating motor, means actuated by said audio impulses for producing similar graphic recording movements to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies, and devices for controlling by audio impulses of another frequency the starting and stopping of the said last-mentioned means.

17. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, means actuated by said audio impulses for producing similar graphic recording movements by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies by means of which an oscillating motor is synchronized with the first-mentioned movements, and devices for controlling by audio impulses of another frequency the starting and stopping of the said last-mentioned means.

18. In combination, means for executing a sequence of movements to produce a graphic subject so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, means actuated by said audio impulses for producing similar graphic recording movements to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies by means of which an oscillating motor is synchronized with the first-mentioned movements, and devices for controlling by audio impulses of another frequency the starting and stopping of the said last-mentioned means.

19. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, means actuated by said audio impulses for producing similar graphic recording movements by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies by means of which an oscillating motor is synchronized with the first-mentioned movements, said motor having an armature arranged to assume a position in the motor according to the particular audio frequency transmitted, and devices for controlling by audio impulses of another frequency the starting and stopping of the said last-mentioned means.

20. In combination, means for executing a sequence of movements to produce a graphic subject so as to produce a continu-

ous sequence of audio impulses of successive frequencies corresponding thereto, means actuated by said audio impulses for producing similar graphic recording movements to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies by means of which an oscillating motor is synchronized with the first-mentioned movements, said motor having an armature arranged to assume a position in the motor according to the particular audio frequency transmitted, and devices for controlling by audio impulses of another frequency the starting and stopping of the said last-mentioned means.

21. In combination, means for executing a sequence of movements in a single plane so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means actuated by said audio impulses for producing similar graphic recording movements in a single plane.

22. In combination, means for executing a sequence of movements so as to produce audio impulses of different frequencies, a motor armature controlled by said audio impulses so as to move the armature into a given position determined by the frequency of the audio impulses.

23. In combination, means for executing a sequence of movements to produce a graphic subject so as to produce a continuous sequence of electrical impulses of successive frequencies corresponding thereto, and means actuated by said electrical impulses for producing similar graphic recording movements to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies.

24. In combination, means for executing a sequence of movements to produce a graphic subject so as to produce a continuous sequence of electrical impulses of successive frequencies corresponding thereto, and means actuated by said electrical impulses for producing similar graphic recording movements, comprising an oscillating motor, to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies.

25. In combination, means for executing a sequence of movements to produce a graphic subject so as to produce a continuous sequence of electrical impulses of successive frequencies corresponding thereto, and means actuated by said electrical impulses for producing similar graphic recording movements to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies by means of which an os-

cillating motor is synchronized with the first-mentioned movements.

26. In combination, means for executing a sequence of movements to produce a graphic subject so as to produce a continuous sequence of electrical impulses of successive frequencies corresponding thereto, and means actuated by said electrical impulses for producing similar graphic recording movements to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies by means of which an oscillating motor is synchronized with the first-mentioned movements, said motor having an armature arranged to assume a position in the motor according to the particular electrical frequency transmitted.

27. In combination, means for executing a sequence of movements to produce a graphic subject so as to produce a continuous sequence of electrical impulses of successive frequencies corresponding thereto, means actuated by said electrical impulses for producing similar graphic recording movements to reproduce a graphic subject by a similar sequence of electrical impulses of successive frequencies corresponding to the first-mentioned frequencies, and devices for controlling by electrical impulses of another frequency the starting and stopping of the said duplicating means.

28. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means actuated by said audio impulses for producing similar graphic recording movements, comprising an oscillating motor for duplicating the movements in one direction and another oscillating motor for duplicating the movements in another direction.

29. In combination, means for executing a sequence of movements so as to produce a continuous sequence of audio impulses of successive frequencies corresponding thereto, and means controlled by said audio impulses for producing similar graphic recording movements, comprising a paper band carried in the form of a paper roll.

30. In combination, mechanism for executing a sequence of movements, mechanism for producing similar graphic recording movements, and devices for producing synchronous movement of the said mechanisms through the medium of electrical impulses on the same scale of successive frequencies.

31. In combination, mechanism for executing a sequence of movements, mechanism for producing similar graphic recording movements, and devices for producing synchronous movement of said mechanisms, involving a movement in said second mechanism a plurality of directions, by the constant-

amplitude modulation of a radio frequency wave.

32. In combination, mechanism for executing a sequence of movements, mechanism for producing similar graphic recording movements, and devices for producing synchronous movement of the said mechanisms to accomplish any particular direction of movement through the medium of electrical impulses of a plurality of selected frequencies.

In testimony that I claim the foregoing, I have hereunto set my hand this 15th day of March, 1929.

MILTON BLAKE SLEEPER.