July 3, 1951 W. A. DOUGHERTY 2,558,718

CODE TRANSMITTER

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FIG. 1.

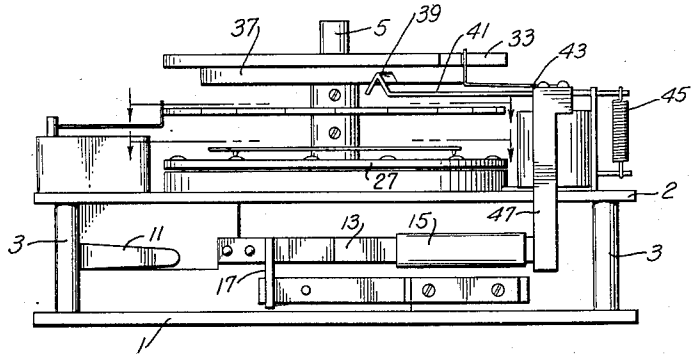


FIG. 2.

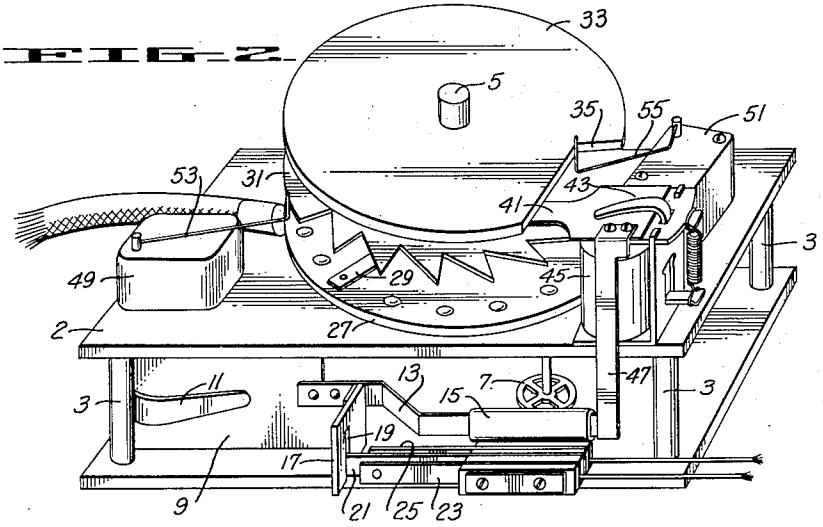
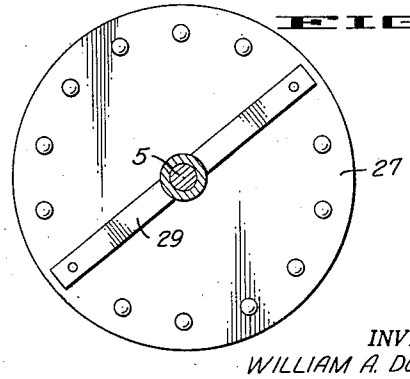


FIG. 4.



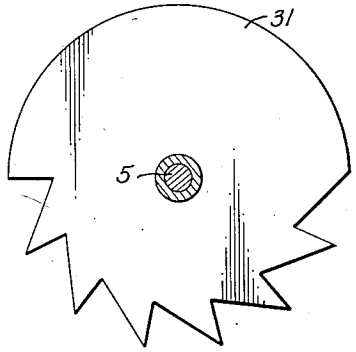


FIG. 3.

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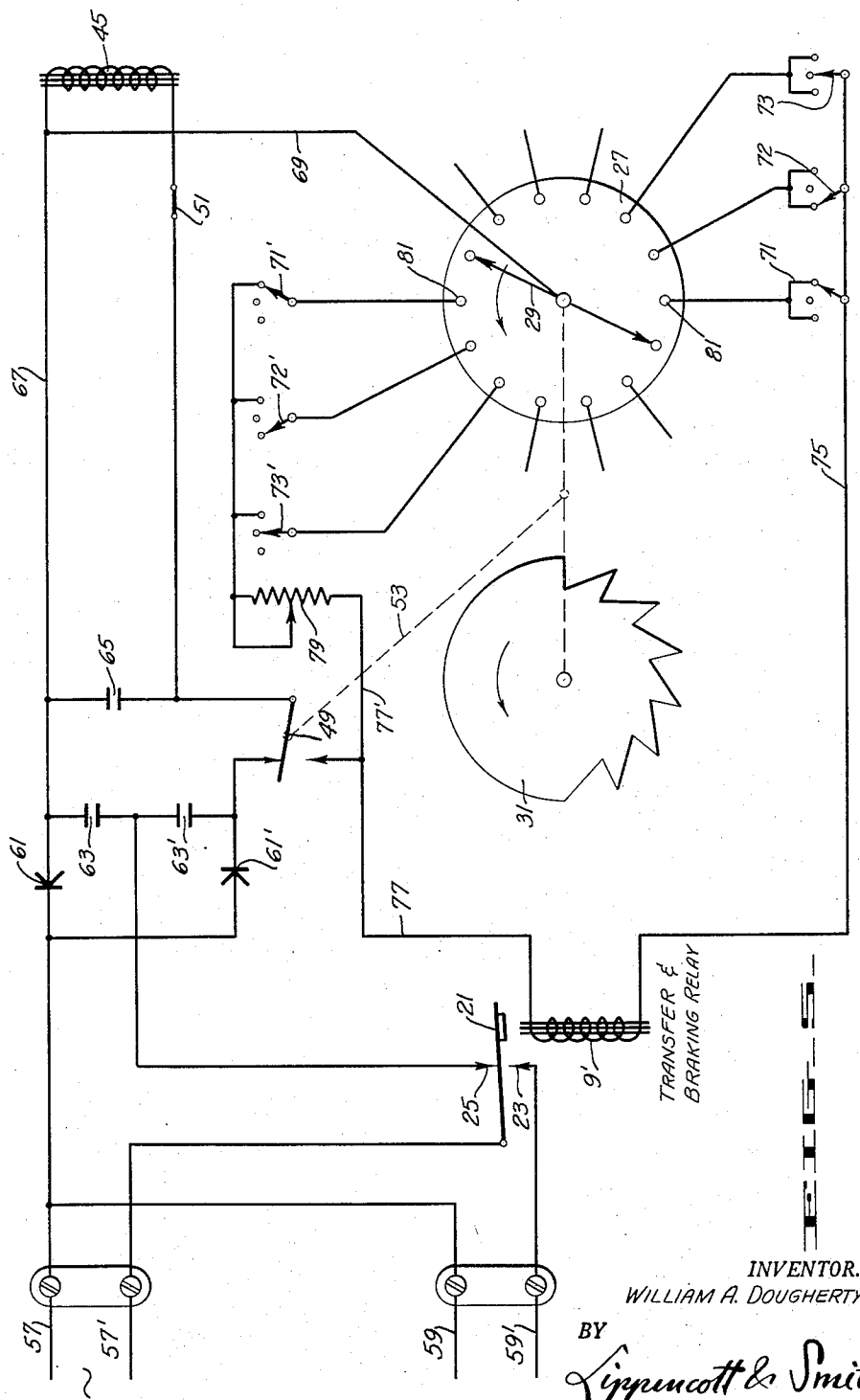
BY

Lippincott & Smith.
ATTORNEYS

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CODE TRANSMITTER

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CODE TRANSMITTER

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3 Claims. (Cl. 177—380)

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This invention relates to automatic transmitters for sending preselected signals consisting of long and short impulses. Code signals of this character are most generally familiar as used for calling the various parties on a multi-party rural telephone line. A much more specialized use, and one requiring a much higher degree of accuracy in transmitting the codes is one wherein the impulses are used to actuate, selectively, remote control equipment of various types. One such application is in connection with power lines, where the codes may be used to initiate remote switching operations such as the starting or stopping of irrigation motors or other like duties. In large rural electrification areas there may be many such operations to be performed, and it is seldom that they are to be performed simultaneously since, in the case of irrigation systems, the water is usually shared upon a time basis.

In installations of this character the coded impulses are frequently sent along the power lines themselves, and while it might be expected that in such a system there would be ample energy available to operate code transmitters electrically from the transmission lines this is not always the case; the power is there, but to supply it at voltages which would be safe to handle in signalling would require a large investment in stepdown transformers and other auxiliary equipment. In such instances it is advisable to revert to early telephone practice and use a magneto signalling system.

Many stations exist, therefore, where the code signals are transmitted by cranking a magneto in longs and shorts to operate selectors where the actual switching is to occur. On small systems, where it is possible to use a very limited number of codes and where, accordingly, the selectors may be set with wide tolerances hand cranked codes are usable, but when the number of codes to be transmitted becomes large such systems break down. Furthermore, as the codes to be transmitted become more numerous and more complicated the operators become more and more prone to make mistakes. In a code of six symbols, for example, the operator may forget whether he has transmitted four or five "long" impulses and may end the code with the sequence incomplete and since what has been done is registered only in the operator's memory there is no means of checking what has occurred. Furthermore it is difficult to train an operator to crank a magneto constantly at the same speed and to make his long and short signals of equal duration and

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if they are not of equal duration the system again breaks down.

There is therefore a need for a simple type of transmitter which will permit the presetting of codes before they are transmitted, so that the transmission can be checked for accuracy before it begins, and which, once the transmission has started, will send out complete trains of signals of the proper length and in proper order to accomplish the required result.

The broad object of this invention is to supply such need, and, pursuant to such object, to provide a code transmitter requiring no source of power beyond the magneto itself and the operator to use it; to provide a code sender whereon the codes may be set up by manipulating keys which, by their position, indicate the succession of long and short signals, and to provide a transmitter wherein once the signals have been set up the operation of the magneto will automatically transmit the present code in impulses whose lengths are best adapted to operate the selecting device at the switching end of the system. It is also an object of this invention to provide a code sender which can be used in magneto telephone exchanges to transmit the proper codes for party-line signalling.

In general terms the sender of my invention comprises a motor which may be either electrical or, more usually, of the clockwork or spring-operated type. Driven by this motor is a rotary switch which may conveniently be a multi-pole switch bridging pairs of contacts equal in number to the maximum number of code symbols to be transmitted in any code group. Operation of this switch connects successively to a succession of keys or other switches which are preferably arranged in a bank in the same order in which they are contacted by the rotary switch, so that by setting them in one of a number of positions, such as "up," "down," or "neutral," they represent by their positions long, short, or space signals. A line is provided for connection to the magneto and this line is normally connected (that is, when the device is in the quiescent state) to a rectifier and condenser network whereby the condenser is charged by rectified current from the magneto. When a code group is to be transmitted the motor, if of the clockwork type, must of course be wound first and this may be accomplished by giving, say, one-half turn to a winding lever provided for the purpose. In this case there is also provided braking means to prevent premature rotation, and a relay is provided and connected for actuation by current from the

rectifier-condenser network for releasing the brake, or, in the case of electric motors, for closing the motor circuit. Once the motor has started the contacting of successive points on the rotary switch, or, if desired, an auxiliary switch operated in synchronism therewith, transfers the condenser which has been charged through the rectifiers from the magneto to a relay having a relatively high impedance winding. Actuation of this relay transfers the magneto circuit from the condenser network to the outgoing signal line and at the same time stops the motor, preferably applying a brake thereto to prevent overrunning. The connection of the condenser to the relay is accomplished through the rotary switch and the key or selector switches to which the latter is momentarily connected. If a long signal is to be transmitted in this particular position of the code group only the relay is connected in series with the condenser, and the relay is held closed until the condenser has fully discharged through its high impedance winding, which may be a period of five seconds or more. If a short signal is to be transmitted the selector switches or keys connect a leak path in parallel with the relay winding, and by adjustment of the resistance of this leak path the short signal may be made as brief as is desired. Once the condenser has discharged the relay releases, and the condenser recharges, the brake on the motor is released and it carries the rotary switch to the next contact, the operation repeating until the entire code group has been sent. At the end of the code group the motor is stopped until the device is reset for the transmission of the same or a different code group.

The invention will better be understood from the detailed description which follows, taken in connection with the accompanying drawings wherein Figure 1 is a side-elevation of a preferred form of the code-sender of this invention embodying the clockwork type of drive;

Figure 2 is a perspective view of the device of Figure 1 as shown from the same general direction as the first figure;

Figure 3 is a plan view of a cam which may be used to operate the switch transferring the magneto circuit from the condenser charging connection to the signalling line;

Figure 4 is a plan view of the rotary switch as used in the embodiment of Figures 1 and 2; and

Figure 5 is a schematic diagram of the electrical circuits embodied in the device as shown.

As shown in Figures 1 and 2 a base 1 carries a plate 2 on a plurality of supporting struts 3. The gearing of the clockwork motor is pivoted between the base 1 and plate 2, in the customary manner. The details of this motor are not shown; it may be a purely conventional type and to depict it in detail would merely confuse the drawing. It is considered sufficient to state that it need not be provided with any type of escapement and that such escapement would ordinarily be disadvantageous since it may require external starting. There is shown, therefore, merely the main drive shaft 5 and a high-speed wheel 7 which is geared up so that a very small braking force applied against it will block the movement of the motor.

Since, in the case shown, the main drive shaft is required to make only one-half revolution between rewindings, sufficiently accurate speed control may be provided merely by the inertia of the parts, taken in connection with the substantially constant tension on the spring, but if such control is not considered sufficient an air vane will provide all that is necessary. It is to be noted that in equipment of the present type the response of the selector at the receiving end is usually primarily dependent upon the length of the pulses rather than upon their separation. In cases where the code groups include spaces as well as longs and shorts the higher degree of accuracy is preferable. Ordinarily a sufficient number of codes may be provided without including spaces, although provision for interposing spaces in the groups is shown for the sake of completeness in the present embodiment of the invention.

Also mounted between the base 1 and plate 2 is a relay the main winding of which is not shown in the figure, since it is of perfectly conventional construction. The relay is provided with a pivoted armature 9 which is normally held away from the relay pole by the usual spring acting through a lever arm 11. The armature carries a resilient brake arm 13, the end of which is provided with a friction sleeve or pad 15, this sleeve contacting the high speed wheel 7 of the motor to block the latter when the relay armature 9 is attracted.

A small block of insulating material 17 is also fastened to the armature 9. This block is provided with a slot 19 through which there projects the contact leaf 21 of a leaf-switch having two other leaves 23 and 25. When the relay armature 9 is in its retracted position the leaf 21 completes a circuit to leaf 23; upon actuation of the relay this contact is transferred to leaf 25 during the period when the motor is blocked by the brake pad 15.

Above the plate 2 there is mounted a circular plate 27 which carries as many pairs of contacts as the maximum number of signals to be transmitted in any code group, plus an extra pair for the final position of the switch when the transmission of the code group is completed. These pairs of contacts are bridged by a rotary arm 29 mounted on the shaft 5 of the motor. This shaft also carries a cam 31 provided with as many operating faces as there are symbols to be transmitted in the code and an additional cam 33 having a single operating face 35 which comes into action only when the device is in fully wound position and ready to transmit a code group.

Mounted on the underside of cam 33, and, if desired, integral therewith, is a face type cam 37 in the form of an annulus with two oppositely disposed notches 39. The follower for this latter cam is a resilient arm 41 which is secured to the armature 43 of a relay 45. Also secured to the armature 43 is a downwardly depending arm 47 which contacts a beveled end on the relay arm 13 in such manner that when the follower 41 is in engagement with the notch, as is shown in Fig. 1, the arm 47 depresses the end of the arm 13 and forces the brake pad 15 into contact with the wheel 7, thus blocking the motor. The notches 39 are so disposed that this action occurs at the beginning and the end of the transmission of the code symbols, so that in these two positions the motor is stationary unless the relay 45 is activated, but in other positions the relay has no control over rotation. Fig. 2 shows the position of the arms 13 and 47 at the instant of activation of relay 45, before appreciable rotation of the motor has occurred.

A pair of microswitches, designated respectively by the reference characters 49 and 51, are mounted on plate 2. The operating arm 53 of switch 49 is so positioned that when the motor

is fully wound and ready to transmit, as shown in Figure 2, the arm will be in the position shown and ready to contact in succession the various operating switches of the cam 31 as these are carried past it. The operating arm 55 of switch 51 is, in the position shown, just ready to engage the operating face 35 of cam 33. In this position microswitch 51 is closed. This switch is connected in series with relay 45, so that it is in condition to operate. It will be seen that an impulse having been transmitted to the relay circuit armature 43 is retracted, disengaging the end of arm 47 from the end of the brake arm 13 and thus permitting the motor to start. As soon as the motor has started the cam face 35 engages the microswitch arm 55 and opens the relay circuit, but the same rotation carries the cam 37 around so that its follower 41 prevents the return of armature 43 to its original position and thus keeps the depending arm 47 out of contact with the brake arm 13 so that the motor may continue to operate until the follower 41 engages the diametrically opposite notch at the completion of the operation.

The operation of the device may best be appreciated by reference to Figure 5, wherein the various switches which have already been described are represented in symbolical form, together with the accompanying circuitry, like parts being designated by like reference characters in both the pictorial and the symbolical representatives of these devices. As in the case of Figure 1, all switches and other elements are shown in the diagram in the fully-wound or "ready-to-operate" position.

In the figure the leads 57—57' are provided for connection to the magneto or other source of signalling current. Leads 59—59' connect to the line over which the signalling is to be effected. Lead 57 is permanently connected to lead 59 and to a pair of oppositely poled rectifiers 61 and 61'. Lead 57' connects through leaves 21 and 25 of the switch operated by the relay 9', only the armature 9 of which is shown in Figs. 1 and 2, to the midpoint of a pair of series condensers 63—63' which are connected between the two rectifiers 61—61' so as to be charged thereby to double the voltage supplied by the magneto. Rectifier 61 and one end of condenser 63 are permanently connected to one side of a main condenser 65 and to one side of starting relay 45 through a lead 67, the circuit being completed through the relay and through microswitch 51 back to the other side of condenser 65 and thence to condenser 63' and rectifier 61' through microswitch 49.

From the lead 67 an additional connection 69 is provided to the contact arm 29 of the rotary switch. In the form of the device here shown the various pairs of opposite contacts on this switch connect to a succession of code-setting switches 71—71' to 73—73', similar switches, not shown, being connected to the remaining points. The switches 71—71' are shown as independent in the circuit diagram, purely for convenience; in the actual case they are preferably the two halves of a cam-operated telephone key of the usual type, and both switches are operated by the throw of a single key lever. The particular type of key here preferred is one having three positions, in one of which all circuits are open, while in the other two, one or onother of two possible circuits may be closed. It will be clear that any type of double-pole double-throw switch may be substituted for the telephone keys. These switches are so connected that when the fixed circuits are connected to them through the lead 69 and arm 29 a circuit will be completed through them to a lead 75 when the circuit is closed by motion of the switch key in either direction. Lead 75 connects to the relay 9', and the circuit continues through a lead 77 to a second contact on the double-throw microswitch 49. From this point the circuit may be continued through lead 77' and a resistor 79 to one of the second sets of contacts on the key switches which are engaged by the leads 71' to 73'. The other contacts on these portions of the key switches are left open.

Considering the microswitch 49 and the lead 69 as the sources of supply for this portion of the circuit, it may be traced from the switch arm 29 through switch 71, relay 9' and lead 77 to microswitch 49. There is also a parallel path through switch 71', resistor 79, and lead 77 back to microswitch 49. This parallel path is, however, open when the key switches are in the position shown in the case of either switch 72' or 73'.

The operation of the device as a whole may now be traced. When it is desired to transmit a code group the motor is first wound so that all switches are in the positions shown in Fig. 5. If a hand-crank generator is used the operation is started merely by starting operation of the magneto, the circuit from which can then be traced from line 57, through rectifiers 61 or 61' and condensers 63 and 63' back through contact leaves 25 and 21 to line 57'. The rectifier-condenser network provides a double rectified voltage which is applied through microswitch 49 and lead 67' to charge the condenser 65 and the latter is simultaneously discharged through the relay winding 45, releasing the brake through arms 47 and 13 and thus starting the motor. Cam face 35 then immediately opens microswitch 51, so that the discharge through the relay coil 45 is removed from the circuit. Continued operation of the magneto promptly recharges condenser 65, this charging continuing while the motor continues to rotate and contact arm 29 engages with the switch points 81 and 81' connecting with key switches 71 and 71' respectively. Due to the breadth of the switch arm 29 this contact is maintained over an appreciable arc, so that it still obtains at the point when the cam follower or operating arm 53 of microswitch 49 transfers the condenser 65 from the charging position (connected to the rectifier circuit) to the lead 77 and thence through the relay coil 9'. Actuation by the coil of the relay transfers the connection of the switch leaf 21 from the leaf 25 to the leaf 23, switching the magneto from the condenser-charging network directly on to the signalling line. At the same time the brake arm 13 is operated and the motor is stopped for as long a period as relay 9'' remains excited.

How long this excitation obtains depends upon the positions of the switches 71—71' through 73—73'. Switch 71—71' is shown in position such that the resistor 79 is connected in parallel with the relay winding, thus providing a leakage path which discharges the condenser rapidly and thereby transmits a short signal or dot. As soon as the charge on condenser 65 is pulled down to some definite level the relay 9' will release the armature 9 and the brake arm 13 so that the motor again starts to rotate. The cam 31 thereupon releases its follower 53, retransferring the magneto to the condenser 65 and storing

a charge there which remains until rotary switch arm 29 makes contact with points 82—82' connecting the switch 72—72' and the operation repeats through the latter switches. In this case, however, the connection is shown through the relay winding 9' only and not through the parallel path including resistor 79 and the relay therefore holds for a much longer period which is determined by the capacity of condenser 65 and the combined inductance and resistance of the relay winding 9'.

In one practical case the device was set so that the transfer relay and brake remained operated for a period of five seconds when no parallel path was provided and a period of one second when the resistor 79 was connected in circuit. By making the latter resistor adjustable, as shown, the length of the short signal can be adjusted through a wide range. The period of the long signals is determined by the constants of the winding 9' and the capacity of the condenser 65. Normally it will be the condenser which is varied to give the correct holding time, and this can be adjusted through several orders of magnitude if desired, the length of the longs and shorts being separately variable as has been described. In case a space is to be transmitted the key switches are set for the neutral position as is shown in the case of switches 73—73'.

It should be apparent that the device can be somewhat simplified by connecting the two halves of the switches 71—71' together directly and by utilizing the spare set of contacts on the multipoint switch 27 to accomplish the function of the microswitch 49. It is much easier, however, to make the time of operation of the cam 31 and the microswitch 49 uniform than it is to make the instant of contact of the contact arm on a point switch equally exact, and therefore the form shown is preferred. Whether this additional accuracy of operation is warranted depends upon the rapidity with which it is desired to send code groups and the selectivity and speed of operation of the selectors used at the receiving end.

It will be apparent, moreover, that where power is available for driving an electric motor, the latter can be used instead of a spring motor and the relay 9 can be used to open a circuit instead of relying entirely upon a brake. The actual form of the device may, in other words, vary quite widely in different applications and therefore it is desired to protect the invention as broadly as defined by the following claims.

I claim:

1. A code sender comprising an input circuit for connection to a power source and an output circuit for connection to a line, an energy storage circuit, a transfer relay connecting said input circuit to said storage circuit when unexcited and to said line when excited, a motor, means for activating said motor when said transfer relay is unexcited and stopping said motor when said transfer relay is excited, a multipoint switch to make connection successively to a plurality of code selecting circuits, an exciting circuit for said transfer relay connecting to all of said code-selecting circuits in series with said multipoint switch, switching means in each of said code-selecting circuits, a leakage path connectable across said exciting circuit through said switching means, and means actuated by said motor for connecting said exciting circuit across said energy storage circuit within the intervals when said multipoint switch is making contact, thereby actuating said transfer relay and stopping said motor during the time required for said energy storage circuit to discharge.

2. A sender in accordance with claim 1 wherein said energy storage circuit comprises at least one condenser and rectifying means for charging said condenser.

3. A sender in accordance with claim 1 wherein said motor is clockwork driven, and including means for restraining said motor when said clockwork is fully wound and means actuated by application of power from said source for releasing said restraining means.

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