United States Patent

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[54] **ELECTRICALLY OPERATED SIGNAL RECORDING DEVICE FOR PROTECTIVE SYSTEMS**
6 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **346/50,** 346/79, 340/286
[51] **Int. Cl.** **G08b 25/00**
[50] **Field of Search** 346/79, 59, 60, 136, 34, 50; 340/292; 178/4.1; 179/5

[56] **References Cited**

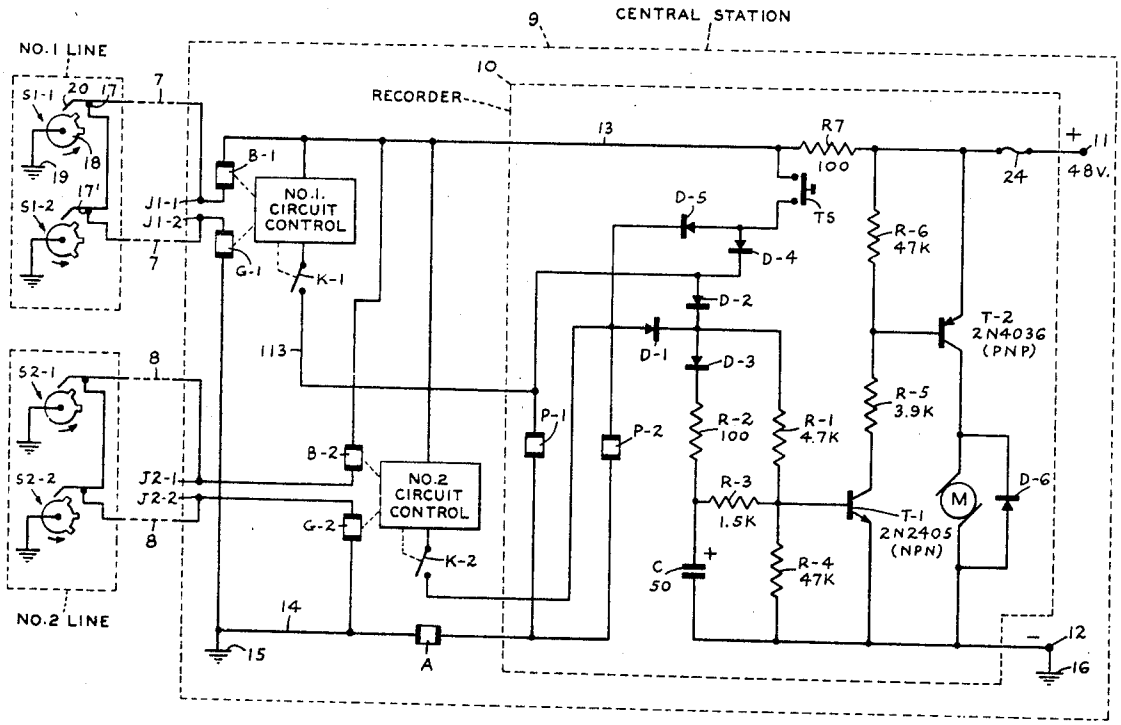
UNITED STATES PATENTS

2,392,876	1/1946	Potter et al.	346/79
3,004,817	10/1961	Wapner	346/50 X
3,154,775	10/1964	Ghersi	340/292

Primary Examiner—Joseph W. Hartary
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ABSTRACT: The present invention comprises a completely electrically operated signal recording device for use with central station electrical protection systems of the McCulloh type. Means are provided to ensure fast starting of the recorder upon the receipt of an incoming signal, to allow for a period of tape runout upon the completion of the signal, to permit the receipt of signals from two protection circuits simultaneously without interference and to allow the concurrent testing of both recorder signal channels.

All of the feature of the prior art mechanically driven signal recorders have been retained in a design both simple and inexpensive to manufacture and maintain.



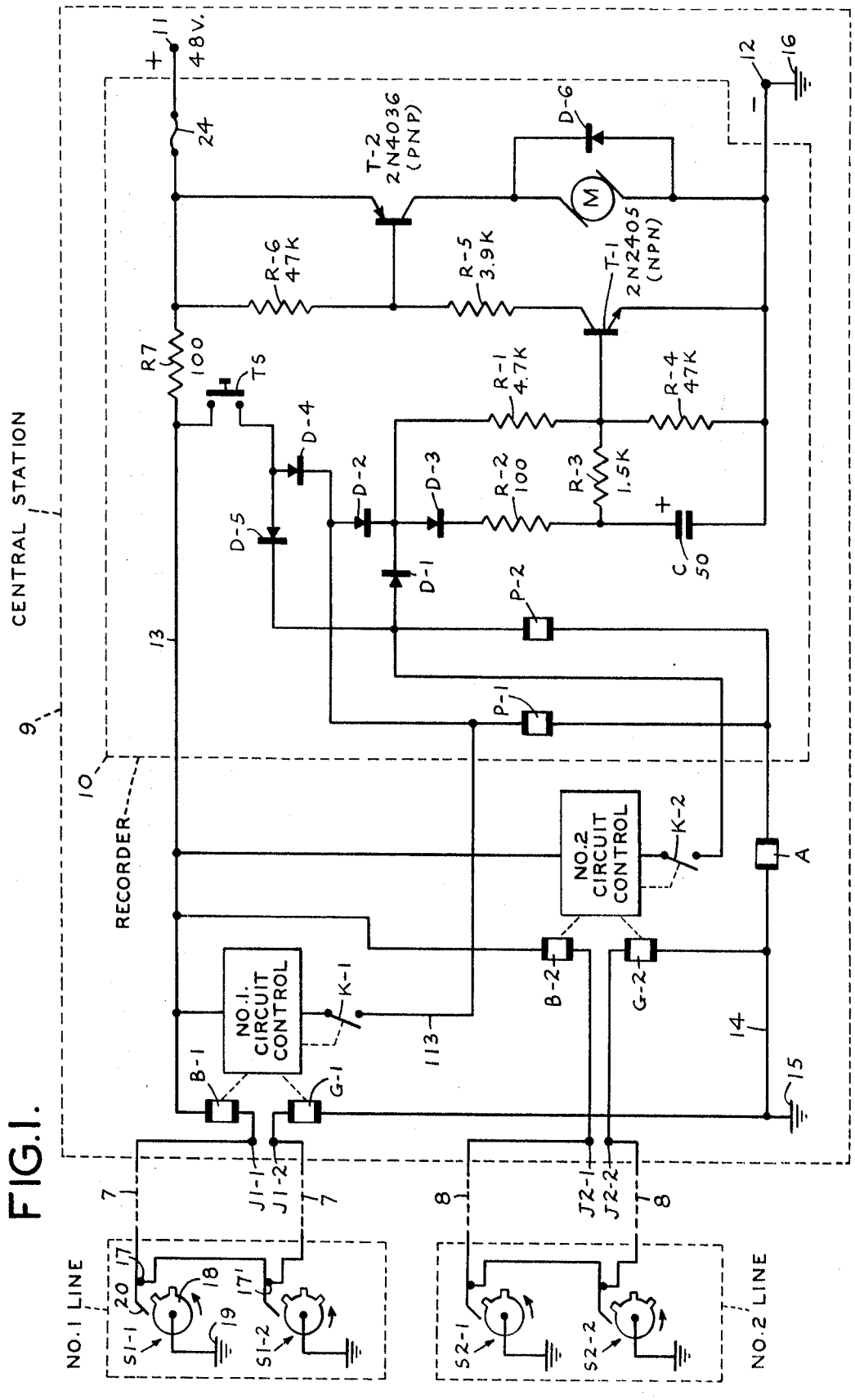

CENTRAL STATION
9
10
RECORDER
+ 11
48V.
12
16
24
T-2 2N4036 (PNP)
D-6
M
T-1 2N2405 (NPN)
R-6 47K
R-5 3.9K
R7 100
TS
R-1 4.7K
R-4 47K
D-4
D-2
D-3
R-2 100
R-3 1.5K
D-5
D-1
C 50
P-2
P-1
13
NO.2 CIRCUIT CONTROL
K-2
A
NO.1. CIRCUIT CONTROL
K-1
B-2
G-2
B-1
G-1
113
14
15
J1-1
J1-2
7
7
J2-1
J2-2
8
8
NO.1 LINE
S1-1
S1-2
17
18
17'
19
20
S2-1
S2-2
NO.2 LINE

FIG.1.

FIG.2.

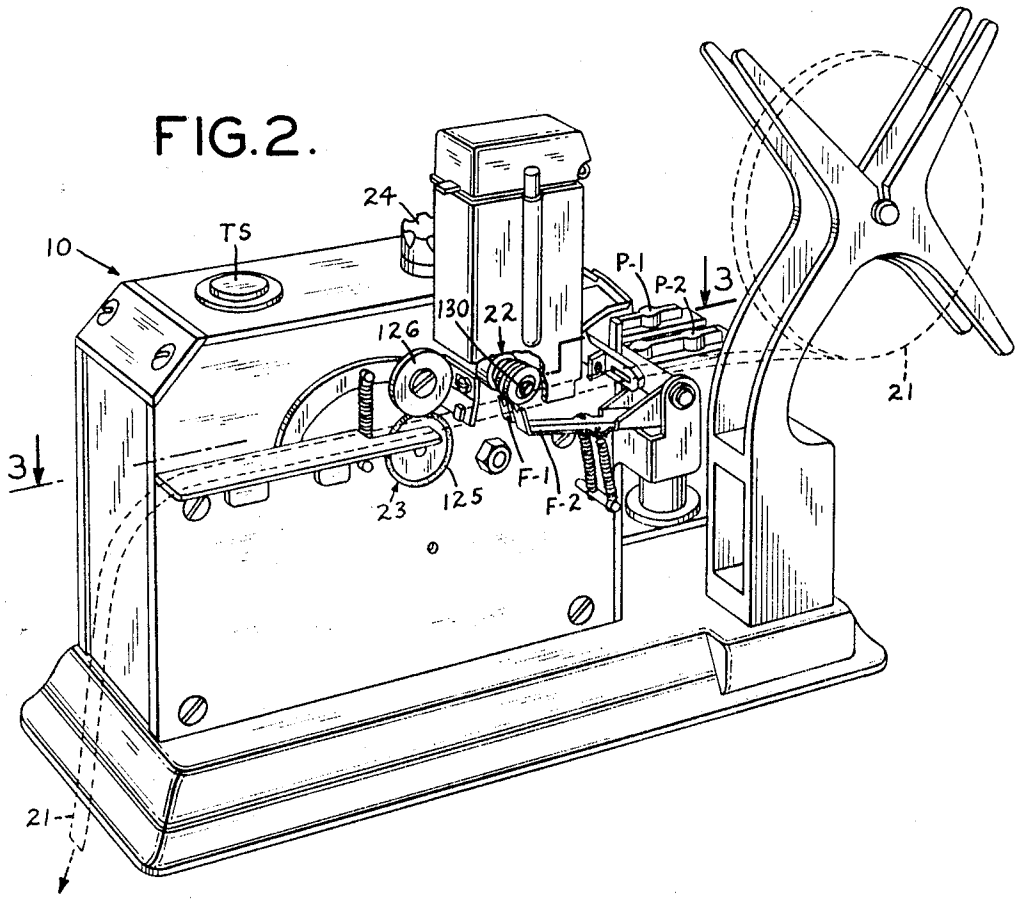
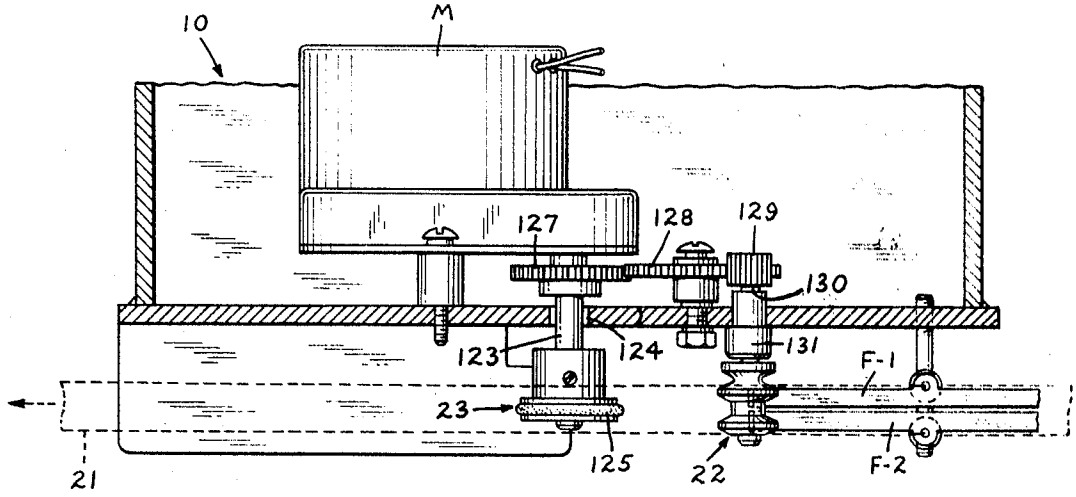

24
10
TS
P-1
P-2
3
130
22
126
21
3
F-1
23
125
F-2
21

FIG.3.


10
M
127
128
129
130
123
124
131
F-1
23
125
22
F-2
21

ELECTRICALLY OPERATED SIGNAL RECORDING DEVICE FOR PROTECTIVE SYSTEMS

BACKGROUND OF THE INVENTION

Electrical protection systems have been in widespread usage for many years to protect property against fire, burglary and a variety of local circumstances which have a direct effect on the incidence of fire or burglary. Thus, in the case of fire, the premises to be protected may be provided with automatic fire detection devices as well as manually operated fire alarm boxes which may be used to summon assistance when a fire is discovered. Corollary thereto, since most modern buildings are equipped with sprinkler systems for the control of fire, there will be provided special devices to detect a flow of water in the pipes of the sprinkler system which is an indication of either the occurrence of a fire or a serious leak in the hydraulic system requiring prompt attention. Furthermore, other devices may be provided to supervise the temperature and level of the water in the storage tanks that supply the sprinkler system, the pressure at critical points in pressurized sprinkler systems, the availability of power at fire pumps and the position (open or closed) of the valves connecting the sprinkler system to the water supply. In the case of burglary protection systems, it is customary to provide the premises with relatively simple devices capable of detecting the opening of doors, windows and other building entry points as well as sophisticated apparatus designed to detect the motion within the premises of an intruder who has managed to evade the entry detection devices or concealed himself within the area before the protection system is activated for the night.

In addition, temperature and pressure responsive devices are often employed to supervise industrial process equipment and building heating systems. The activities of watchmen are also supervised by requiring them to originate signals in accordance with a prescribed program, whereby the absence of an expected signal may indicate that the watchman has been taken ill, been injured in some way or captured by intruders.

In some instances, the signals generated by certain of the devices enumerated above are employed to operate a bell or other warning device located at the premises with the intent that notice will be taken thereof by patroling police or passersby who will notify the proper authorities. Generally, however, it is considered preferable to have the signal transmitted to a common point which is attended at all times by trained personnel who can be relied upon to promptly initiate the proper action indicated by the circumstances. At large premises, such as an industrial complex where many signaling devices are employed, a signal receiving station may be provided on the grounds and manned by the owner's employees. Such electrical protection systems are known as "proprietary" systems. Alternatively, in locations where there are a number of individual small premises requiring electrical protection services, a "central station" will be established by an independent company specializing in the rendering of such services and the various subscribers thereto will be connected to the central station, usually by telephone lines leased for that purpose.

There are two types of signal transmission in broad usage. In one, the "direct wire," each subscriber or a particular portion of a subscriber's premises is connected to an individual signal receiving device at the central station or proprietary system station or control point. Obviously so doing requires many individual wire runs to the signal originating points and a multiplicity of signal receiving devices and the expense thereof limits the direct wire type of service to such installations as merit such an investment. Usually these are found to be burglary and holdup alarm systems connected to banks, jewelry stores, government establishments wherein security considerations are involved, and the like where there are high concentrations of value at a single location.

A more economical signal transmission means, employed by both central station and proprietary systems, combines a number of signal originating devices on a single wire circuit connected to a single signal recording device. Since signals from a number of originating points are received by a single device, a means must be provided to identify each signal received. The usual method employed is to arrange each signal originating device to produce a distinctive numerical code, when operated, in the form of electrical impulses on the wire connecting the device to the signal receiving point. The signal recording device translates the pulses into markings on a paper tape which correspond to the code number of the originating device and thereby enable the operator to identify the source of the signal.

Such devices for the receipt of coded signals are old and are, in fact, descendants of the apparatus used in the early days of telegraphy. As such, the devices in current widespread use are essentially mechanical in nature. That is, the tape feed and inking mechanism are mechanically driven and controlled by a hand-wound spring clockwork released by the receipt of an incoming signal pulse. U.S. Pat. No. 2,392,876 issued Jan. 15, 1946 to Potter et al. provides a detailed description of a typical mechanically driven signal recording device employed in the electrical protection services.

The mechanical nature thereof gives rise to certain disadvantages. For one, there is the recurring need to manually rewind the spring motor with the obvious danger of failure to record a signal should rewinding be neglected. Furthermore, the need for a rather elaborate gear train and tape runout control mechanism results in high manufacturing costs and a multitude of parts subject to wear in service which ultimately result in maintenance problems. Accordingly, the principal object of the present invention has been the provision of an electrically driven signal recording device that will provide all the features of the previous mechanical design simply and inexpensively.

A common problem in the design of signal recording devices of all types is the need for fast starting. In the electrical protection signaling service, an electrical impulse to be recorded may have a duration on the order of only 75 milliseconds and, unless the recorder responds promptly thereto by moving the paper tape forward, succeeding impulses may be superimposed thereon resulting in an illegible signal readout. Also, it is desirable that when signal transmission is completed, the tape continues to run forward for several inches so that the recorded signal will be in plain view of the operator. Another object of the invention has been the provision of a simple, electronic circuit to ensure rapid starting, provide the desired tape runout period and further provide a means of maintaining the driving means of the recorder in operation during the intervals between the pulses of an incoming signal.

For reasons of space economy in central stations and other signal receiving points, it has been customary to arrange each recorder to receive signals from two separate detection device circuits. While maintaining the desired separation between circuits within the recorder is rather simple in the mechanical design, electrical operation presents certain problems and a simple solution thereof is a feature of the present invention.

Another feature of the invention is the provision of means for testing the operation of both circuits of a recorder simultaneously by a single test switch.

Other and further objects, features and advantages of the invention will be apparent from the following description of the invention.

BRIEF DESCRIPTION OF THE INVENTION

The invention comprises the use of an electrical motor instead of the mechanical clockwork and escapement mechanisms of the prior art recorders together with the provision of an electronic control circuit which ensures fast starting of the motor upon the receipt of an incoming signal pulse, and

includes energy storage means to allow continued running of the motor during the intervals between the receipt of signal pulses and to provide for a tape runout period at the conclusion of the signal

In addition, a diode network has been provided for the dual purposes of obtaining the necessary separation between the two signal circuits serviced by a single recorder and to permit the simultaneous testing of the two signal recording channels by means of a single test switch.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in greater detail with reference to the appended drawings in which:

FIG. 1 is a schematic electrical diagram showing the inclusion of the present invention in an electrical protection system,

FIG. 2 is a perspective view illustrating the mechanical configuration of the recorder of the present invention, and

FIG. 3 is a fragmentary horizontal sectional view taken generally along the line 3–3 in FIG. 2

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Referring now to FIG. 1, dashed line **10** encloses the circuit diagram of a recorder embodying the invention. Two signaling circuits are enclosed within dashed lines and are identified as No. 1 Line and No. 2 Line respectively. The recorder **10** is located at a central station or at the station or receiving point of a proprietary system enclosed within a dashed line **9** which also encloses diagrammatic representations of conventional equipment in such a station. The individual detecting devices which comprise the No. 1 and No. 2 Lines are respectively series connected and may be a number of miles distant from the station **9**. The detecting devices may be widely separated from each other on a given line as they will usually be located on the premises of individual subscribers having no relation to each other. In such event the No. 1 Line and No. 2 Line may be connected with station **9** as by telephone lines **7,7** and **8,8** respectively, leased for the purpose. The telephone lines **7,7** and **8,8** are brought into station **9** as by jacks **J1–1, J1–2** and **J2–1, J2–2**, respectively.

Typical values for the resistors and capacitor are shown on FIG. 1 in ohms and microfarads respectively as well as the identification of the various standard solid state components except the diodes which may all be of the IN2070 type. This information as well as the operating voltages and currents mentioned in the following description are for illustrative purposes only and are not to be interpreted as limitations of the invention.

At the place where the signals are to be received there is provided a source of potential, which might be **48** volts DC, having a positive terminal **11** and a negative terminal **12** which is grounded at **16**. Positive terminal **11** is coupled through a resistor **R–7** and a conductor **13** to the detecting devices of No. 1 and No. 2 Lines and the return to the negative terminal **12** is by means of a conductor **14** which is grounded at **15**.

The electrical protection system of FIG. 1 is of the so-called McCulloh type having electrical control features that permit the receipt of signals from the detecting devices under such line fault conditions as opens, grounds or some combination of these fault conditions. Under normal conditions, a monitoring current flows from the positive conductor **13** to the No. 1 Line through the winding of a normally energized relay **B–1** arranged to respond to a decrease in current flow as would be caused by a break in the line. From the winding of relay **B–1** the current flows through jack **J1–1** and one side of a telephone line **7,7** through the normally closed contact **17** of the first detecting device **S1–1**, the normally closed contact **17'** of the second detecting device **S1–2**, then, through the other side of telephone line **7,7** back to the station or signal receiving place **9**. The current then flows through a normally energized relay **G–1**, also arranged to respond to a decrease in current, to the grounded negative conductor **14**. To simplify the drawing only two detecting devices have been shown in the No. 1 Line, however in practice there may well be a dozen or more and the signals originated therefrom will all be received and printed on a single channel of the recorder **10**. The No. 2 Line is connected through telephone line **8,8** and relay windings **B–2** and **G–2** between conductors **13** and **14**. The No. 2 Line may be identical with the No. 1 Line in all respects except possibly the number of detecting devices connected thereto and the fact that the signals therefrom will be recorded on the other channel of recorder **10**. Two detecting devices in the No. 2 Line are identified as **S2–1** and **S2–2**.

When some condition occurs which results in the operation of a detecting device, say **S1–1**, a metallic wheel **18** which is grounded at **19** is caused to rotate in the direction of the arrow. The periphery of wheel **18** is provided with a number of projections or teeth arranged to come into contact with the operating member **20** of contact **17** as the wheel rotates. The teeth on wheel **18** are so spaced as to form a numerical code and it will be evident that each detecting device on a particular line will have a different code for identification purposes. When a tooth first touches the operating member **20**, ground is applied to the line at **19**; the relay **G–1** is thereby shunted and released. As wheel **18** continues to rotate, the operating member **20** rides up the leading edge of the tooth and eventually contact **17** is opened resulting in the release of relay **B–1**. When the operating member **20** falls off the back edge of the tooth, the circuit and relays **G–1** and **B–1** are returned to normal until the next tooth is presented. As a consequence, the code from each detecting device is presented both in the form of a series of ground impulses and a similar series of break impulses by means of the associated G and B relays.

In accordance with the McCulloh principle, a modern version of which is described in U.S. Pat. No. 3,154,775 issued Oct. 27, 1964 to Ghersi, when a fault occurs on a line, switches (not shown) are operated either manually or automatically to apply current to both ends of the line. Thereafter, break impulses may be received from a grounded section of line and ground impulses from an open section of line. Since the McCulloh circuit is well known in the art and forms no part of the present invention, no further description is required herein. It is sufficient for an understanding of the present invention to know that under all line conditions, a code wheel in either No. 1 Line or No. 2 Line (wheel **18** for example) acting in conjunction with the closing and releasing of the B and G relay contacts and other control elements contained in the boxes identified in FIG. 1 as the No. 1 and No. 2 Circuit Controls, will cause the associated coding contacts **K–1** or **K–2** to operate in repetition of the transmitted coded signal.

When contacts **K–1** are closed current will flow from positive conductor **13** through No. 1 Circuit Control, contacts **K–1** and conductor **113** to the winding of printing magnet **P–1** and thence through an annunciator A to the ground conductor **14**. When contacts **K–2** are closed current will similarly flow through the winding of printing magnet **P–2** and annunciator A to ground. The printing magnets **P–1** and **p–2** are parts of the recorder **10** as will now be described.

Turning now to FIGS. 2 and 3 the recorder **10** is provided with a roll of paper tape **21** which is drawn under an inking roller **22** by the drive wheel **23**. The two printing magnets **p–1** and **P–2** are provided with printing fingers **F–1** and **F–2** respectively which, when the associated printing magnet is energized, press tape **21** against the inking roller **22**. The inking mechanism for roller **22** is not shown. Both the drive wheel **23** and inking roller **22** are driven by an electric motor M which is started when either of the printing magnets is energized. The surface of drive wheel **23** moves somewhat faster than the surface of inking roller **22** to avoid any tendency for the tape **21** to form a loop between the drive wheel and the inking roller and also to provide some slippage between the tape and the inking roller which facilitates the transfer of ink to the paper.

In FIG. 3 the motor M, which may be of the reduction gear type, is mounted inside the case of recorder **10** and has a shaft **123** extending outwardly through an opening **124** in the case. The drive wheel **23** is mounted on shaft **123** and, preferably, is provided with a rubber tire **125**. A spring pressed idler roller **126** (see FIG. 2) is arranged to hold the paper tape **21** in driving engagement with tire **125** on drive wheel **23**. A gear **127** fixed to shaft **123** drives an idler gear **128** meshing with a gear **129** fixed to a shaft **130** which extends through a bearing **131** to carry the inking roller **22**. The ratios of the gears just described are so related with the diameters of the drive wheel **23** and inking roller **22** as to provide the higher surface speed of drive wheel **23** described above.

As shown in FIG. **1**, recorder **10** is connected on the positive side to terminal **11** through a fuse **24** which might be of 0.75 ampere rating and to conductor **13** through the current limiting resistor R–7. On the negative side, recorder **10** is connected to the ground at terminal **12** and through the ground to conductor **14**. Between the positive and negative sides there are a number of parallel branch circuits, one of which comprises the series combination of a PNP transistor T–2 whose emitter is connected to positive terminal **11** and whose collector is connected to negative terminal **12** through the winding of the electric motor M. Motor M is shunted by a diode D–6 provided to protect transistor T–2 from inductive voltage surges caused by the motor. Another branch circuit consists of the series combination of resistors R–6, R–5 and the collector-emitter circuit of an NPN transistor T–1 whose emitter is connected to the negative terminal **12**. The junction of resistors R–6 and R–5 is connected to the base of transistor T–2.

Still another branch circuit starts at the junction of conductor **13** and resistor R–7 and, after passing through a normally open pushbutton test switch TS, divides into two paths. One path consists of the series combination of diodes D–4, D–2, D–3, resistor R–2 and capacitor C and it leads to ground **16** at negative terminal **12**. Connected in parallel with diode D–3, resistor R–2 and capacitor C are the series connected resistors R–1 and R–4 whose junction is connected to the base of transistor T–1 and also is connected through resistor R–3 to the junction of the positive side of a capacitor C and a resistor R–2. The other path from the test switch TS comprises the series combination of diode D–5, the windings of printing magnet P–2 and annunciator relay A and thence, via conductor **14** to ground at **15**. The positive end of the winding of printing magnet P–2 is connected by one path through diode D–1 to the junction of diodes D–2 and D–3 and by another path, as described above, through the normally open coding contact K– 2 and the No. 2 Circuit Control to positive conductor **13**. The positive end of the winding of printing magnet P–1 is connected by one path through coding contact K–1 and the No. 1 Circuit Control to the positive conductor **13** and by a second path to the junction of diodes D–4 and D–2. The negative ends of the windings of printing magnets P–1 and P–2 are both connected through annunciator relay A to the ground as above described.

OPERATION OF THE EMBODIMENT SHOWN IN FIG. 1

When a detecting device on the No. 1 Line operates, the McCulloh features of the system function as hereinbefore described so that the coding contact K–1 follows the code cut on signal wheel (**18** for example). Closure of contact K–1 permits current to flow through the windings of printing magnet P–1 and annunciator relay A the latter serving to operate visual and audible signals (not shown) to call the operator's attention to the fact that a signal is being received. Energization of the winding of printing magnet P–1 causes the associated printing finger F–1 (see FIG. 2) to press the paper tape **21** against the inking roller **22**.

Simultaneously, current also flows via diodes D–2, D–3 and resistor R–2 to the capacitor C which is of relatively high capacity such as 50 microfarads, and which charges very quickly (a few milliseconds) since the combined resistance of diodes D–2, D–3 and resistor R–2 is relatively low. The diodes D–1 and D–4 serve at this time to prevent the energizing of the winding of the printing magnet P–2. While capacitor C is charging, the potential drop across diode D–3 and resistor R–2, assisted by the drop across resistor R–1, provides a small but sufficient base current for transistor T–1 which becomes conductive. The current flow through the collector-emitter circuit of transistor T–1 and resistors R–5 and R–6 in like manner causes transistor T–2 to become conductive and to allow current to flow from the positive terminal **11** to the motor M which starts to rotate the inking roller **22** and drive wheel **23** thereby advancing the paper tape **21**. During the intervals between the pulses of a coded signal, the coding contact K–1 will open. However, capacitor C will then start to discharge relatively slowly via a resistive circuit comprising resistors R–3 and R–4 providing base current to keep transistor T–1 conductive and thus to prevent motor M from stopping. Diodes D–3, D–2 and D–1 prevent discharge of capacitor C through other paths of lower resistance. After the last pulse of a coded signal, the charge on capacitor C is sufficient at its slow rate of discharge to keep motor M running long enough to advance the paper tape **21** a predetermined distance, say about five inches, so that the signal printed thereon will be in plain view of the operator.

When a signal is originated on the No. 2 Line, contact K–2 is closed to energize the windings of the printing magnet P–2 and the annunciator A to perform functions similar to those described in conjunction with the No. 1 Line. Current also flows via the diode D–1 and components described above to the capacitor C thereby starting and continuing the operation of Motor M for the printing of the signal and extended tape runout as described above. Concurrently, the diodes D–2 and D–5 prevent the operation of printing magnet P–1. Since the printing magnet circuits are completely independent of each other and each is able to control the motor M for the duration of the incoming signal, it is possible to receive signals concurrently from both line circuits without interference. That is, if a signal arrives on the No. 2 Line while a signal is being recorded from the No. 1 Line, the completion of the No. 1 signal will not cut off the motor for the No. 2 signal.

During periods of inactivity, it is of course desirable to test the operative condition of the motor, printing means and the electronic switching means including the resistance-capacitor means just described. In the mechanical recorders of the prior art, such testing was readily accomplished by manually depressing the printing magnet armatures (thus simulating the receipt of signal pulse) thereby starting the clockwork motor by means of a simple mechanical linkage and causing the printing fingers to press the tape against the inking roller. In the case of the present invention, manual depression of the printing magnet armatures will move the printing fingers but will not start the motor. Therefore the push button test switch TS has been provided.

Operation of switch TS allows current to flow from conductor **13** via diodes D–4, D–2, D–3 and resistor R–2 to capacitor C thereby starting the motor which will run for a period after the switch TS is released until capacitor C discharges if the electronic switching means is operative. Concurrently, current will flow from the test switch TS via the diode D–5 to energize the winding of printing magnet P–2 and via diode D–4 to energize the winding of printing magnet P–1. Printing fingers P–1 and P–2 will both press the paper tape **21** against the inking roller **22** for as long as the switch TS is held closed to produce printed test signals demonstrating that the recorder is in proper operating condition.

Those skilled in the art will recognize that under certain conditions it will be preferable to employ a positive grounded power supply and that the circuit shown in FIG. **1** may be readily converted for such operation by reversing the polarity of all diodes and the capacitor, replacing the NPN transistor T–1 with a suitable PNP transistor and replacing the PNP transistor T–2 with a suitable NPN transistor.

While the invention has been described in conjunction with a specific embodiment thereof and in a specific use, various modifications thereof will occur to those skilled in the art without departing from the spirit and scope of the invention as set forth in the appended claims.

What I claim is:

1. In a recorder for use in electrical protective systems and adapted to make a visible record of signals in the form of electrical pulses originating in either of two separate signaling circuits, said recorder having a supply of tape, two printing magnets one responsive only to signals originating in one of said circuits and the other responsive only to signals originating in the other of said circuits, two printing fingers associated respectively with said magnets and so positioned as to strike and cause the formation of a visible mark upon said tape upon energization of the associated magnet, the improvement which comprises tape advancing means including an electric motor for advancing said tape relative to said printing fingers during any time that at least one of said magnets is energized whereby the printing finger associated with a magnet so energized is effective to form said visible mark as said tape is so advancing, electronic switching means including transistor means and resistance-capacitor means for starting said motor upon the energization of at least one of said magnets and for causing said motor to continue running for a predetermined period of time commencing at any time that both of said magnets become deenergized and manually operable switching means for testing the operative condition of said magnets, said printing fingers, said electronic switching means and said tape advancing means.

2. A recorder in accordance with claim 1 in which said manually operable switching means comprises a normally open switch, means including a plurality of diodes connecting said switch with both of said printing magnets and so oriented as to cause energization of both of said magnets and of said electronic switching means upon the closing of said normally open switch, and further diode means so oriented as to isolate each of said printing magnets for individual energization in response to signals when said normally open switch is in open position.

3. A recorder in accordance with claim 1 in which said electronic switching means includes a first transistor connected in series with said motor and a source of potential for energizing said motor when said first transistor is in a conductive state, a second transistor connected in series with resistive means and said source of potential for deriving a potential to maintain said first transistor in conductive state as long as said second transistor remains in conductive state, a capacitor, means effective upon the energization of at least one of said printing magnets to charge said capacitor and simultaneously to place said second transistor in conductive state, and a resistive circuit effective at any time that both of said printing magnets become deenergized to gradually discharge said capacitor over a predetermined period of time during which the decreasing charge in said capacitor is effective to maintain said second transistor in conductive state.

4. A recorder in accordance with claim 2 in which said electronic switching means includes a first transistor connected in series with said motor and a source of potential for energizing said motor when said first transistor is in a conductive state, a second transistor connected in series with resistive means and said source of potential for deriving a potential to maintain said first transistor in conductive state as long as said second transistor remains in conductive state, a capacitor, means effective upon the energization of at least one of said printing magnets to charge said capacitor and simultaneously to place said second transistor in conductive state, and a resistive circuit effective at any time that both of said printing magnets become deenergized to gradually discharge said capacitor over a predetermined period of time during which the decreasing charge in said capacitor is effective to maintain said second transistor in conductive state.

5. A recorder in accordance with claim 3 in which said second transistor is connected with said source of potential through diode means so oriented as to prevent the discharge of said capacitor through any path having a lower resistance than that of said resistive circuit.

6. A recorder in accordance with claim 4 in which said second transistor is connected with said source of potential through diode means so oriented as to prevent the discharge of said capacitor through any path having a lower resistance than that of said resistive circuit.