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GAS PRESSURE ALARM SYSTEM FOR CABLES

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FIG. 1

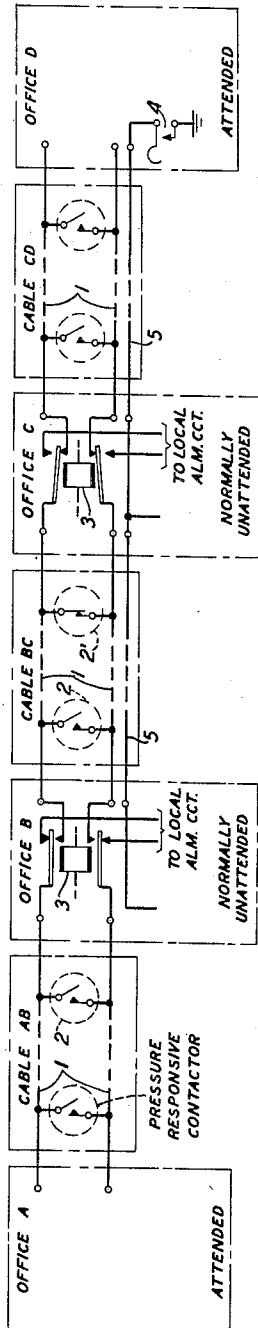
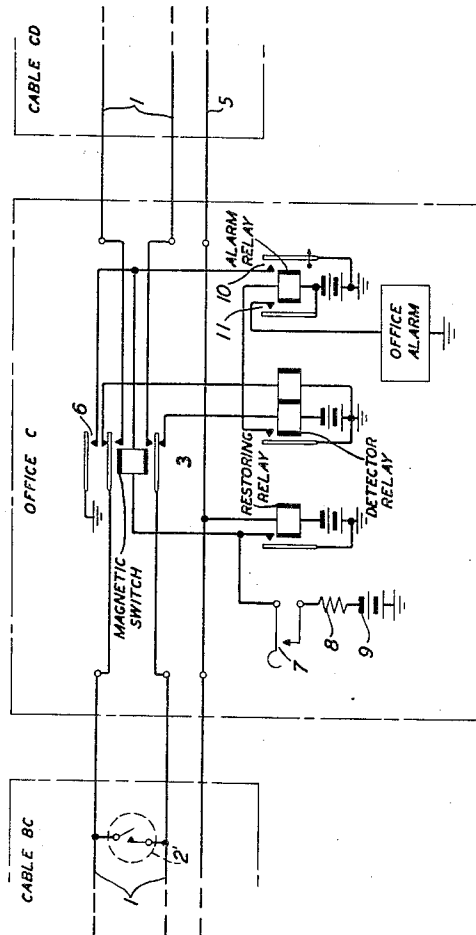


FIG. 2



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GAS PRESSURE ALARM SYSTEM FOR CABLES

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10 Claims. (Cl. 177—311)

This invention relates to indicating means and more particularly to arrangements of apparatus and circuits for indicating at which one of a number of fixed points a pair of conductors has been short-circuited.

Long cables, particularly toll cables, are frequently kept under gas pressure to prevent the entrance of moisture into the cables and to permit the rapid location of sheath openings before the occurrence of insulation trouble. Leakage through the cable sheath causes a reduction in gas pressure which may be detected by means of a contact making pressure gauge such as disclosed in United States Patent 1,904,226 granted April 18, 1933, to T. C. Henneberger and 1,936,194 granted November 21, 1933, to T. C. Henneberger and V. B. Pike. A rapid means for determining the exact location of the contact making pressure gauge which has operated is shown by United States patents, 1,855,321 granted April 26, 1932, to S. P. Shackleton and 1,904,227 granted April 18, 1933, to T. C. Henneberger.

Experience has shown that for cable sections longer than fifty miles false alarms may be troublesome and in the event of a magnetic storm the gas pressure alarms may be rendered inoperative. In the operation of such systems it is desirable to have attended offices two hundred miles or more apart with a series of intermediate unattended offices distributed therebetween. In order to successfully operate such a system it is essential that some means be provided for locally detecting gas pressure failures over lengths of cable not greater than fifty miles and for relaying them on to one of the adjacent attended offices.

It is therefore the object of this invention to provide a switching arrangement for toll cable gas pressure alarm systems to permit an unattended office to transfer its alarm signal to an adjacent attended office.

The foregoing object is attained by this invention which provides a switching system comprising in combination an alarm system for each cable section responsive to the operation of its own short-circuiting devices, a magnetic switch for each alarm system the operation whereof is adapted to disconnect the bridged conductors of its associated cable section from its own alarm system and connect them to the bridged conductors in an adjacent cable section, a circuit means included with each alarm system for operating its associated magnetic switch in response to the operation of the alarm system, and a lock-

ing circuit for locking the magnetic switch in its operated position.

The invention may be better understood by referring to the accompanying drawing in which:

Fig. 1 shows a schematic of a complete system in accordance with this invention; and

Fig. 2 shows the detailed circuit of one of the normally unattended repeater stations.

Referring now more particularly to Fig. 1 in which there is shown two attended repeater stations referred to as office A and office D; disposed between attended offices A and D are unattended offices B and C. All of these offices, A, B, C and D are interconnected by a series of cable sections AB, BC, and CD. While only two intermediate unattended offices are shown it is obvious that the invention is not limited to that number but that any number of such offices may be used. Each of the interconnecting cable sections contains a large number of conductor pairs and one of these pairs is bridged with a plurality of pressure responsive contactors 2. For illustrative purposes each of these cable sections shows only two of these pressure responsive contactors. However, in actual practice many more are actually used and spaced at frequent intervals along the length of each cable section.

It will be understood that upon the operation of any one of these pressure responsive contactors 2, for example, contactor 2' in cable section BC, the alarm circuit at the first office to the right will be caused to operate. In accordance with this invention if the office to the right is attended the alarm goes no further. However, in the event the office is unattended circuits will be set up to cause magnetic switch 3 to operate and transfer the shorted indication through the bridged conductors of the next intermediate cable section to the second office to the right. If this office is also unattended the process will be again repeated until the shorted condition reaches an attended office whereupon the alarm will be received in the usual manner and located by the circuits and methods shown in the patents mentioned above.

As previously stated, pressure responsive contactor 2' of cable section BC is shown closed thereby placing a short across their cable pair 1. This caused the operation of the local alarm circuit in office C which is the first office to the right. Since this is a normally unattended station, the local alarm circuit operated in a manner to be more particularly described in connection with Fig. 2 with the result that magnetic switch 3 in office C has operated as shown in

Fig. 1 to transfer the short through the conductor pair 1 of cable section CD to the attended office D.

Referring now to Fig. 2 it will be seen in detail how the circuits of this invention cause this transfer to take place. In Fig. 1 it was assumed that pressure responsive contactor 2' had operated and that this had ultimately caused the operation of magnetic switch 3 in office C. In Fig. 2 it is assumed that pressure responsive contactor 2' has not yet operated and that office C which is normally unattended is at present attended. While this office remains attended key 7 is left open so that magnetic switch 3 is unable to operate. This causes office C to operate in substantially the same manner as any ordinary attended office. Upon the operation of pressure responsive contactor 2' an obvious circuit is completed through the back contacts of magnetic switch 3 and through the coil of the detector relay causing this relay to operate and close its contacts. The operation of the detector relay completes an obvious circuit through the coil of the alarm relay causing both its contacts 10 and 11 to close. Contacts 10 merely place ground on one terminal of the coil of magnetic switch 3 but since key 7 is open the coil is not energized. Contacts 11 of the alarm relay close a local circuit through the office alarm and the procedure thereafter for locating the pressure responsive contactor which is operated may be substantially the same as that shown in the two above-mentioned patents, 1,855,321 and 1,904,227.

Now let it be assumed that the office is to be left unattended which, in accordance with this invention, is the intended normal operation of this office. Before leaving the office the attendant closes key 7. It will thus be seen that upon the operation of one of the pressure responsive contactors for example contactor 2' in cable section BC the detector relay in office C will be caused to operate as before which results also in the operation of the alarm relay and the office alarm. In this case, however, a circuit is completed from ground through contacts 10 of the alarm relay, through the coil of the magnetic switch, through key 7, resistor 8, battery 9 and back to ground, thereby causing the operation of magnetic switch 3. Magnetic switch 3 is locked in its operated position through its contact 6 which maintains ground on the one terminal of its coil. Also upon the operation of magnetic switch 3 the shorted condition produced by pressure responsive contactor 2' is removed from the detector relay causing its release along with the release of the alarm relay, thereby silencing the office alarm. The operation of magnetic switch 3 also causes a transfer of the shorted condition in cable section BC to conductor pair 1 in cable section CD through an obvious circuit including the front contacts of magnetic switch 3. This is the condition which is indicated at office C in Fig. 1. It will be understood that this shorted condition thus transferred to conductor pair 1 of cable section CD will cause the operation of the alarm circuit in attended office D as previously stated.

The attendant at office D tests for the location of the operated pressure responsive contactor in the manner disclosed in either of the two above-mentioned patents. Having completed this test he closes key 4 shown in the block for office D in Fig. 1. This places ground on conductor 5 which is carried through all of the cable sections to all of the normally unattended offices to the left of office D. Referring now to Fig. 2 it will be seen

that upon placing ground on conductor 5 it causes the operation of the restoring relay through an obvious circuit carried from ground through conductor 5 through the coil of the restoring relay, its associated battery and ground. Since one side of the coil of magnetic switch 3 is already grounded through its interlocking contact 6, this coil is short-circuited by reason of the operation of the restoring relay, the current from battery 9 being carried through resistor 8, key 7, the contacts of the restoring relay and back to ground. This causes the release of all of the magnetic switches 3 of all of the normally unattended offices which have been affected by the closure of one of the pressure responsive contactors 2.

Of course, it will be understood that if the shorted condition still exists after the operation of the restoring relay, that immediately upon releasing key 4 in the attended station, the alarm circuits and transfer conditions previously described will repeat themselves and the alarm in office C will again be operated. However, upon repairing the fault and restoring the gas pressure in the faulty cable section, the operation of key 4 in the attended office C will restore the sectionalized operation of the complete alarm system.

Referring now to the above noted faulty operation during a magnetic storm, it will be observed that with the circuits of this invention there will be at no time an alarm pair longer than one cable section standing open to permit the building up of excessive induced voltages. Until an alarm occurs the alarm pairs in the single sections will stand open and connected to their individual alarm circuits. These shorter, sectionalized circuits are not susceptible to the trouble during magnetic storms which has been experienced with longer alarm circuits. When an alarm does occur only those sections are connected together which are required to actuate the alarm at the attended office.

What is claimed is:

1. A switching means for an alarm circuit in a cable system of the type having a plurality of series-coupled cable sections, said switching means comprising for each cable section, a pair of conductors bridged by short-circuiting devices, a two-pole magnetic switch, front and back contacts for each pole, circuits connecting said two poles to the pair of bridged conductors of their associated cable section, a relay means, circuits connecting the back contacts to the relay means whereby said relay means is responsive to the operation of any of the short-circuiting devices of said associated cable section, circuits connecting said front contacts to the pair of bridged conductors of the adjacent cable section, an energizing circuit for said magnetic switch connected to said relay means and responsive to the operation thereof, whereby upon the operation of said magnetic switch the bridged conductors of the associated cable section may be disconnected from said relay means and connected to the bridged conductors of said adjacent cable section, and a locking circuit including contacts on said magnetic switch connected to said energizing circuit for locking the magnetic switch in its operated position.

2. A switching means for an alarm circuit in a cable system of the type having a plurality of series-coupled cable sections, said switching means comprising for each cable section, a pair of conductors bridged by short-circuiting devices, a two-pole magnetic switch, front and back con-

tacts for each pole, circuits connecting said two poles to the pair of bridged conductors of their associated cable section, a relay means, circuits connecting the back contacts to the relay means whereby said relay means is responsive to the operation of any of the short-circuiting devices of said associated cable section, circuits connecting said front contacts to the pair of bridged conductors of the adjacent cable section, an energizing circuit for said magnetic switch connected to said relay means and responsive to the operation thereof, whereby upon the operation of said magnetic switch the bridged conductors of the associated cable section may be disconnected from said relay means and connected to the bridged conductors of said adjacent cable section, a locking circuit including contacts on said magnetic switch connected to said energizing circuit for locking the magnetic switch in its operated position, and a circuit connected to said energizing circuit for restoring the magnetic switch to its unoperated position.

3. A switching means for an alarm circuit in a cable system of the type having a plurality of series-coupled cable sections, said switching means comprising for each cable section, a pair of conductors bridged by short-circuiting devices, a two-pole magnetic switch, front and back contacts for each pole, circuits connecting said two poles to the pair of bridged conductors of their associated cable section, a relay means including a detector relay and an alarm relay, circuits connecting the back contacts to the detector relay whereby said detector relay is responsive to the operation of any of the short-circuiting devices of said associated cable section, circuits connecting said front contacts to the pair of bridged conductors of the adjacent cable section, circuits connecting said alarm relay to said detector relay, whereby the operation of said alarm relay is responsive to the operation of said detector relay, an energizing circuit for said magnetic switch connected to said alarm relay and responsive to the operation thereof, whereby upon the operation of said magnetic switch the bridged conductors of the associated cable section may be disconnected from said detector relay and connected to the bridged conductors of said adjacent cable section.

4. A switching means for an alarm circuit in a cable system of the type having a plurality of series-coupled cable sections, said switching means comprising for each cable section a pair of conductors bridged by short-circuiting devices, a two-pole magnetic switch, front and back contacts for each pole, circuits connecting said two poles to the pair of bridged conductors of their associated cable section, a relay means including a detector relay and an alarm relay, circuits connecting the back contacts to the detector relay whereby said detector relay is responsive to the operation of any of the short-circuiting devices of said associated cable section, circuits connect-

ing said front contacts to the pair of bridged conductors of the adjacent cable section, circuits connecting said alarm relay to said detector relay, whereby the operation of said alarm relay is responsive to the operation of said detector relay, an energizing circuit for said magnetic switch connected to said alarm relay and responsive to the operation thereof, whereby upon the operation of said magnetic switch the bridged conductors of the associated cable section may be disconnected from said detector relay and connected to the bridged conductors of said adjacent cable section, and a locking circuit including contacts on said magnetic switch connected to said energizing circuit for locking the magnetic switch in its operated position.

5. A switching means for an alarm circuit in a cable system of the type having a plurality of series coupled cable sections, said switching means comprising for each cable section a pair of conductors bridged by short-circuiting devices, a two-pole magnetic switch, front and back contacts for each pole, circuits connecting said two poles to the pair of bridged conductors of their associated cable section, a relay means including a detector relay and an alarm relay, circuits connecting the back contacts to the detector relay whereby said detector relay is responsive to the operation of any of the short-circuiting devices of said associated cable section, circuits connecting said front contacts to the pair of bridged conductors of the adjacent cable section, circuits connecting said alarm relay to said detector relay whereby the operation of said alarm relay is responsive to the operation of said detector relay, an energizing circuit for said magnetic switch connected to the alarm relay and responsive to the operation thereof, whereby upon the operation of said magnetic switch the bridged conductors of the associated cable section may be disconnected from said detector relay and connected to the bridged conductors of said adjacent cable section, a locking circuit including contacts on said magnetic switch connected to said energizing circuit for locking the magnetic switch in its operated position, and a circuit connected to said energizing circuit for restoring the magnetic switch to its unoperated position.

6. The combination of claim 1 and a key in series with said energizing circuit for rendering the magnetic switch inoperative.

7. The combination of claim 2 and a key in series with said energizing circuit for rendering the magnetic switch inoperative.

8. The combination of claim 3 and a key in series with said energizing circuit for rendering the magnetic switch inoperative.

9. The combination of claim 4 and a key in series with said energizing circuit for rendering the magnetic switch inoperative.

10. The combination of claim 5 and a key in series with said energizing circuit for rendering the magnetic switch inoperative.

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