March 22, 1932. R. D. PAVLIK 1,850,412

SIGNALING DEVICE AND STOP MECHANISM FOR DITCHING MACHINES

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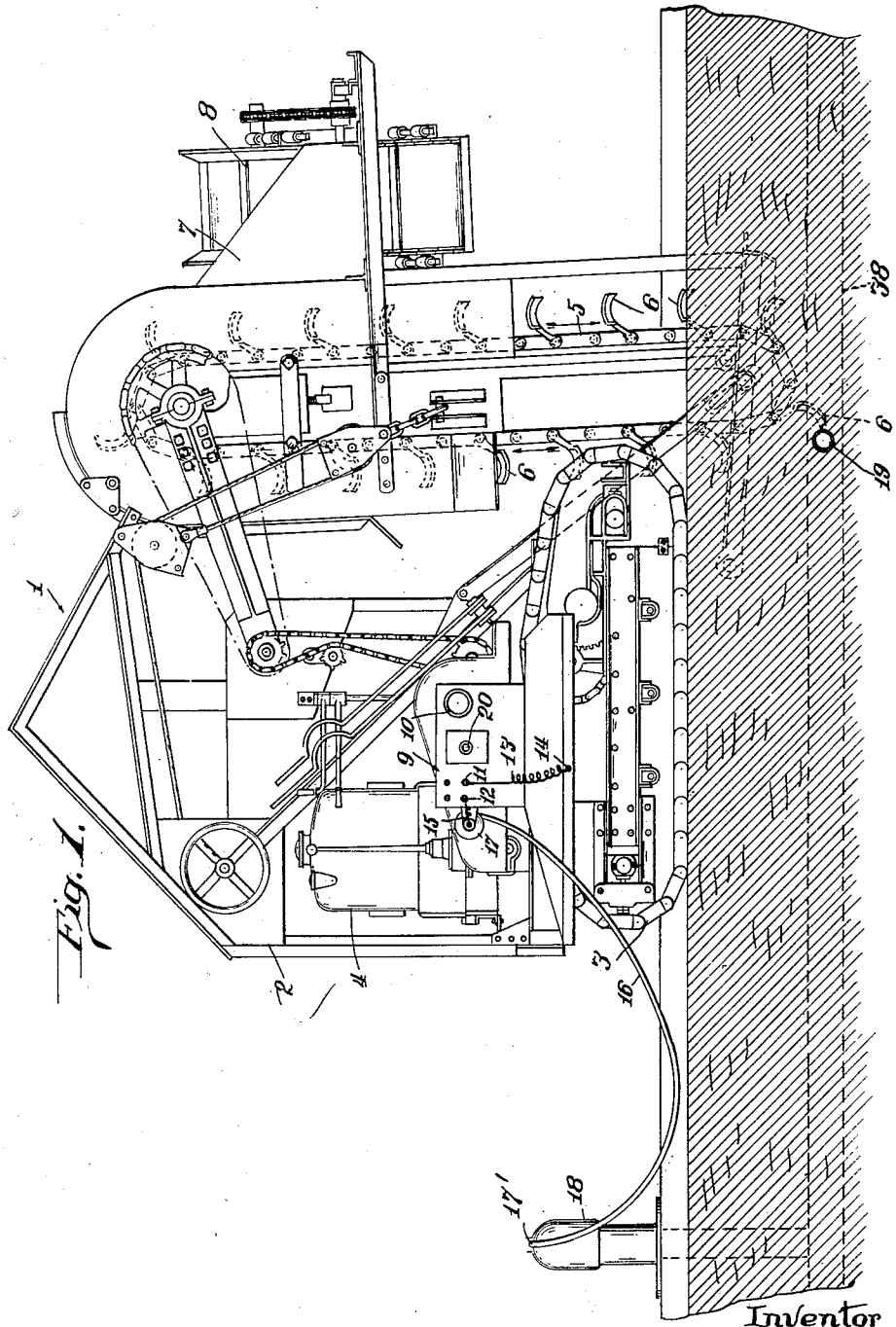

Fig. 1.

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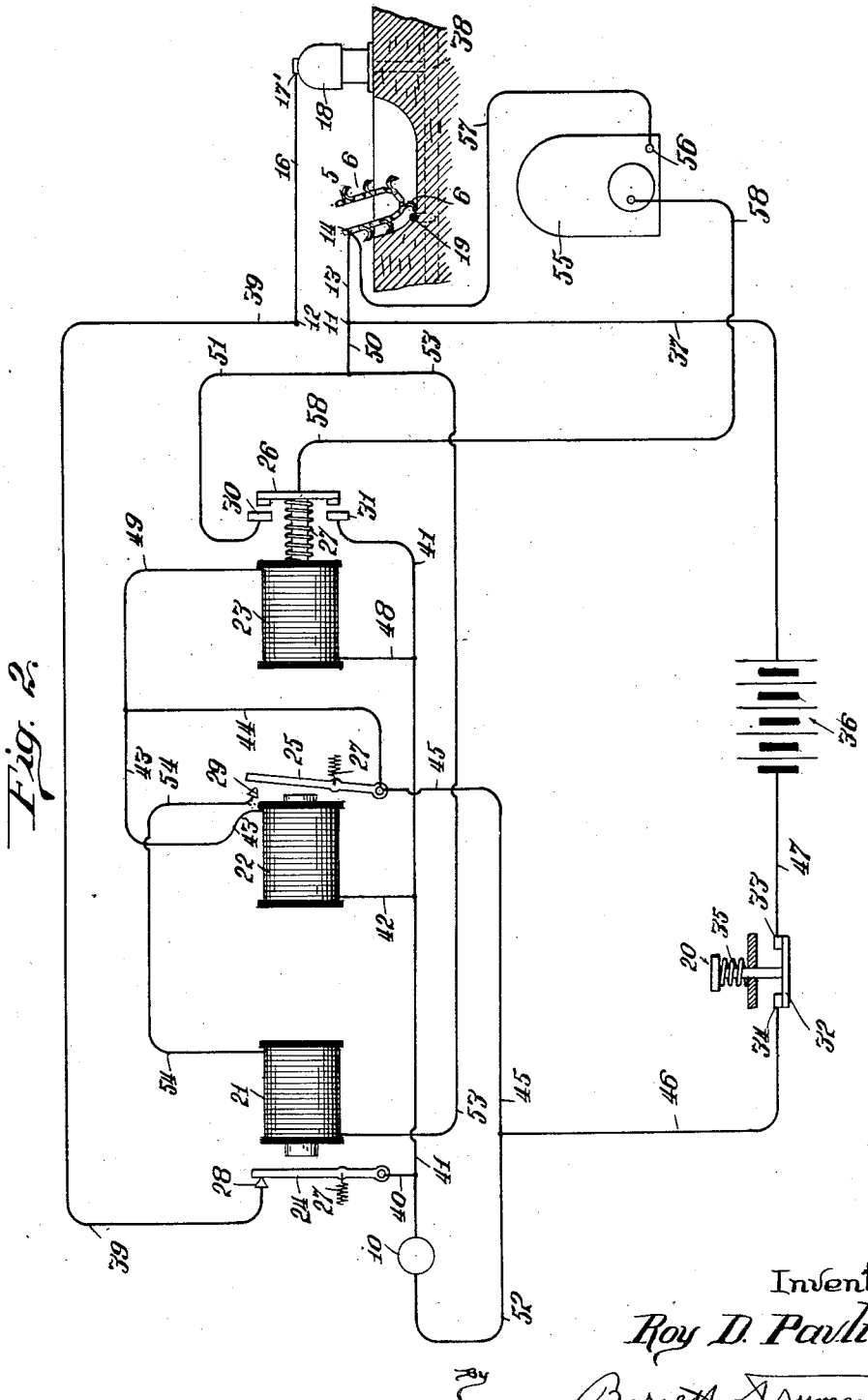

Fig. 2.

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UNITED STATES PATENT OFFICE

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SIGNALING DEVICE AND STOP MECHANISM FOR DITCHING MACHINES

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This invention relates to certain new and useful improvements in a signaling device and stop mechanism for ditching machines, and more particularly to an electrically operated control mechanism for safety apparatus designed to stop the digging operations or give a suitable warning when one of the digging members comes in contact with any portion of an underground piping system.

In the operation of ditching machines, or similar digging or excavating apparatus, the digging teeth or buckets or other digging members sometimes encounter underground pipes or other portions of underground metallic conduit systems, and the continued operation of the machine will cut or damage the pipes, resulting in financial loss and delaying the digging operations. The automatic control apparatus herein disclosed is designed to give a suitable warning so that the operation of the mechanical diggers may be stopped, or to automatically stop the operations of the digging machine. The control or safety apparatus includes a battery or other source of electric power and an electrically operated signal or stop mechanism. A normally open control circuit has one terminal grounded on the metallic structure of the digging machine and the other terminal is connected through an extensible cable or conduit with some convenient portion of the piping system, such as a water plug or similar device which projects above the ground in the vicinity of the place where the digging operations are taking place. When one of the metallic digging members comes in contact with an underground pipe, the control circuit will be completed, thereby actuating a series of relays or electro-magnetically operating devices which close, and maintain closed, the actuating circuit for the signaling device or stop mechanism. Immediately thereafter the control circuit is broken by the electromagnetic system. The signaling device or stop mechanism will continue to be actuated until the main circuit is broken by means of a push-button or other suitable type of circuit breaker, whereupon the circuits are all reset to the original condition. In case the digging mechanism is still in contact with the pipe, the control and operating circuits will again be re-established as soon as the push button is released.

The general object of this invention is to provide an improved control apparatus for excavating machinery, such as briefly described hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide an improved signaling mechanism for giving warning whenever a portion of a digging machine comes in contact with an underground pipe.

Another object is to provide an improved stop mechanism for digging machines which is automatically actuated when a portion of the digging apparatus comes in contact with an underground pipe.

Another object is to provide an improved control mechanism of the type hereinabove referred to which may be used to control any well known or standard type of excavating machinery.

Other objects and advantages of this invention will be more apparent from the following detailed description of one approved type of apparatus constructed and operating according to the principles of this invention.

In the accompanying drawings:

Fig. 1 is a side elevation, partly in section, showing the main features of a ditching machine of well known type with the improved control mechanism mounted thereon.

Fig. 2 is a wiring diagram illustrating the electrical connections for the control apparatus.

The ditching machine, indicated generally at 1, comprises an upper housing 2 supported on vehicle mechanism of the crawler or endless chain type 3. The engine or power plant 4 drives the excavating machinery which comprises the endless chain 5 carrying the teeth or diggers 6. These diggers move in the direction of the arrows, the excavated material being carried up and dumped into a hopper 7, from which it is carried away laterally by means of the conveyor 8. Suitable gearing connections are provided, of well known type, whereby the digging mechanism 5 and 6 may be raised or lowered, and the

entire apparatus transported from one position to another.

The improved control mechanism may be housed for the most part in a suitable casing, such as indicated at 9, (Fig. 1) and mounted in any convenient position on the digging machine, preferably adjacent the position of the operator. At 10 is indicated a suitable signal, such as an electric light, although an audible signal could be substituted. The electrical apparatus hereinafter described, such as the battery, relays and circuit breakers may be all housed within the casing 9, the control circuit having two terminals indicated at 11 and 12. With one of these terminals may be connected a wire 13, which is grounded as at 14, on any convenient portion of the metal structure of the digging machine. The other terminal 12 is connected as by means of wire 15, with an extensible cable or conduit 16, mounted on a reel 17 so that this cable may be paid out as necessary. The free end of cable 16 is electrically connected, as at 17', with some convenient portion of the underground piping system, for example the water-plug 18. At 19 is indicated an underground pipe which happens to be positioned in the path of one of the diggers 6. It will be understood that nearly all underground metallic piping systems have metallic connections one with another so that when one of the diggers 6 comes in contact with the pipe 19, the control circuit will be completed between terminals 11 and 12, as follows: from terminal 11 through wire 13, and connection 14, through the metallic structure of the digging apparatus to digger 6, pipe 19, the underground piping system, member 18, conduit 16, and connection 15 to the terminal 12. The completion of this control circuit will, through connections hereinafter described, cause the signal 10 to be actuated, thereby giving warning that the machine should be immediately stopped. The signal will continue in operation until the circuits are broken and the control mechanism reset by the manual operation of push-button circuit-breaker 20. In case an electrically operated stop-mechanism is used in place of or in addition to the signal 10, an additional wire connection or connections must be established between this control mechanism and the magneto or clutch or other portion of the power connections which are controlled or actuated.

Referring now to the wiring diagram shown in Fig. 2, parts already referred to are indicated by the same reference characters as used in Fig. 1. At 21, 22 and 23 are indicated three relays or electro-magnetically operated devices provided with the movable armatures 24, 25 and 26, respectively. These electro-magnetically operated switches or circuit breakers may be of any approved type. The armatures 24, 25 and 26 will normally be held (when the magnets are de-energized) in the positions indicated in Fig. 2 by means of the springs indicated diagrammatically at 27. Armature 24 will normally be held in contact with a fixed contact member 28, but this connection will be broken when magnet 21 is energized. Armature 25 is normally out of contact with a fixed contact member 29, but will be moved into electrical connection with this contact 29 when the magnet 22 is energized. Armature 26 is normally out of contact with the fixed contact members 30 and 31, but will be moved into bridging relation with these contacts when magnet 23 is energized. The push-button circuit breaker 20 includes a contact bridge 32 which normally engages the fixed contacts 33 and 34. The circuit may be broken by moving the contact 32 out of engagement with contacts 33 and 34 against the resistance of spring 35, the spring immediately closing the circuit at this point as soon as push-button 20 is released. At 36 is indicated the battery or other suitable source of electric energy of low voltage.

The control circuit is normally open, but when one of the diggers 6 comes in contact with a pipe, such as 19, this circuit will be completed as follows: from battery 36, through wire 37, terminal 11, wire 13, the digging machine including digger 6, pipe 19, the underground piping system, indicated in dotted lines at 38, plug 18, cable 16, terminal 12, wire 39, fixed contact 28, armature 24, wire 40, wire 41, wire 42, coil of magnet 22, wires 43, 44, 45 and 46, contacts, 34, 32 and 33 of the circuit breaker 20, and wire 47, back to the battery 36. At the same time a parallel circuit will be completed from wire 41 through wire 48, magnet 23 and wire 49 to the wire 44 and thence as before back to battery 36. The electro-magnets 22 and 23 will thus both be energized so as to attract their armatures 25 and 26, bringing these contacts respectively against the fixed contacts 29, 30 and 31. A main signal energizing circuit is now completed as follows: from battery 36 through wire 37, terminal 11, wire 50, wire 51, contact 30, armature 26, contact 31, wire 41, signal 10, wires 52 and 46 to circuit breaker 20, and thence through wire 47 to the battery 36.

The energization of magnet 22 to move armature 25 against contact 29 will complete a circuit through the circuit-breaking magnet 21 as follows: from wire 37 and terminal 11 through wire 50, wire 53, coil of magnet 21, wire 54, fixed contact 29, armature 25, and thence as before through wires 45, 46 and 47, back to the battery. The energization of magnet 21 serves to draw armature 24 away from fixed contact 28, thus breaking the originally established outside control circuit through the digging machine and piping system. At the same time a new holding circuit

for the magnets 22 and 23 is established within the apparatus as follows: from terminal 11, through wire 50, wire 51, contact 30, armature 26, contact 31, and thence through wires 42 and 48 through the magnets 22 and 23, and back to battery 36, as in the original control circuit.

It will thus be seen that when electrical contact is momentarily established between one of the diggers 6 and the pipe 19, the magnets 22 and 23, and immediately thereafter the magnet 21, will be energized and will remain energized even though the control circuit is broken by the digger 6 moving out of contact with the pipe 19. The control circuit is also broken by the armature 24 of magnet 21 being moved out of contact with the fixed contact member 28.

The parts will remain in these positions, and the signal 20 will continue to operate until the circuits are broken by operating the push-button 20. A momentary operation of the push-button 20 will break all of the circuits, and the armatures of the relays or electromagnets will all be returned to the normal positions shown in Fig. 2 by means of springs 27. If there is no longer any electrical connection between the digging apparatus and the pipe 19 (or another pipe or portion of the piping system), the parts will remain in this inoperative position. However, if the digger 6 is still in engagement with the pipe 19, the control circuit will again be completed and the magnets will again operate as first described to complete the actuating circuit for signal 10 and the holding circuits for the several magnets 21, 22 and 23.

In lieu of the signal 10, any suitable electrically operated stop-mechanism could be substituted whereby the power connections for operating the digging mechanism will be broken so as to instantly cease the movement of diggers 6. For example, an electrically operated clutch can be substituted for signal 10. As an example of another form of stop device, the magneto 55 of the power plant may be temporarily rendered inoperative, thus stopping the digging machine. As is usual, one terminal 56 of the primary circuit of the magneto is grounded on some suitable part of the metal structure of the machine as indicated diagrammatically by wire 57 running to the connection 14. A wire 58 leads from the other side of the magneto circuit to the armature 26, which in normal position has no other electrical connections and is insulated from the metal structure of the machine. When magnet 23 is energized, the wire 58 will be grounded through armature 26, contact 30, wires 51 and 50, terminal 11 and wire 13, which is also grounded on the machine at 14. In this manner both sides of the magneto circuit will be grounded on the machine so that the magneto will be short-circuited and will be inoperative.

If a high voltage power circuit (for example 110 volts) were used there would be danger of completing the control circuit through contact of the diggers with damp or metal laden soil in which case the apparatus might function falsely. For this reason a low voltage power circuit is preferable, for example a 6 volt storage battery, thus necessitating the completion of a metallic circuit of relatively low resistance before the apparatus will function. Nearly all underground piping systems have metallic connections one with another thereby affording a low resistance metallic conductor which completes the control circuit when one of the diggers contacts with one of the pipes of the system. If there is any doubt as to the metallic connections between different piping or cable systems that might be encountered by the digging apparatus, separate cables 16 can be grounded to each of these systems.

It will be apparent that either the signal 10 or a suitable stop-mechanism may be used, or both the signal and the stop mechanism may be simultaneously actuated by means of the circuits hereinabove described, or some obvious modification thereof.

In the general operation of this mechanism, none of the electrical circuits will be completed so long as the digging mechanism remains out of contact with the underground piping system. When such contact occurs, even though the contact is but momentary, the main signal or stop-mechanism energizing circuits will be established and will remain closed and in operation until the apparatus is reset by means of the push-button circuit breaker 20. If, at such times, the digging mechanism is still in contact with the piping system, the circuits will again be closed, as in the first instance, as soon as the push button is released. It will be apparent that if the digging machine were to continue in operation, the underground pipe or pipes would almost inevitably be cut or damaged, but by immediately stopping the digging operation, such damage may be avoided or minimized.

It will be apparent that other known forms of electrical contact mechanism could be substituted for many of the parts here shown by way of example, and other specific forms of operating circuits could be used, without departing from the broad principles of the invention as herein disclosed, and all such equivalents are considered as coming within the scope of the claims which follow.

I claim:

1. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a normally open electric circuit, one terminal of which is ground-

ed on the digging machine and the other terminal of which is connected with a portion of the piping system, and a signal which is operated when the circuit is closed.

2. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a normally open electric circuit, one terminal of which is grounded on the digging machine and the other terminal of which is connected with a portion of the piping system, and a stop device for the digger moving means which is operated when the circuit is closed.

3. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a normally open electric circuit, one terminal of which is grounded on the digging machine and the other terminal of which is connected with a portion of the piping system, and an electrically actuated control device which is operated when the circuit is closed.

4. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a normally open electric circuit, one terminal of which is grounded on the digging machine and the other terminal of which is connected with a portion of the piping system, a signal device, an electric circuit for operating the signal, and means for closing the signal circuit and maintaining the circuit closed when the first circuit is momentarily closed.

5. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a normally open electric circuit, one terminal of which is grounded on the digging machine and the other terminal of which is connected with a portion of the piping system, a signal device, an electric circuit for operating the signal, means for closing the signal circuit and maintaining the circuit closed when the first circuit is momentarily closed, and means for temporarily breaking both circuits to reset the mechanism.

6. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a normally open electric control circuit, one terminal of which is grounded on the digging machine and the other terminal of which is connected with a portion of the piping system, a circuit-breaker in this safety circuit comprising a normally closed switch and electro-magnetic means for opening the switch, a signal device, an operating circuit for the signal comprising a normally open switch, electro-magnetic means for closing this switch, and electrical connections including the electro-magnetic devices whereby the signal circuit will be closed and will remain closed when the control circuit is momentarily completed, and the control circuit will be thereafter opened and held open at the first mentioned switch.

7. In combination with a digging machine comprising digging members and means for moving the members into the the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a normally open electric control circuit, one terminal of which is grounded on the digging machine and the other terminal of which is connected with a portion of the piping system, a circuit-breaker in this safety circuit comprising a normally closed switch and electro-magnetic means for opening the switch, a signal device, an operating circuit for the signal comprising a normally open switch, electro-magnetic means for closing this switch, electrical connections including the electro-magnetic devices whereby the signal circuit will be closed and will remain closed when the control circuit is momentarily completed, and the control circuit will be thereafter opened and held open at the first mentioned switch, and a normally closed manually operable circuit breaker positioned in both circuits to momentarily break both circuits and reset the mechanism.

8. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a normally open electric control circuit, one terminal of which is grounded on the digging machine and the other terminal of which is connected with a portion of the piping system, a circuit-breaker in this safety circuit comprising a normally closed switch and electro-magnetic means for opening the switch, a stop mechanism, an operating circuit for the stop mechanism including a normally open switch, an electro-magnetic device for closing this latter switch, and electrical connections including the electro-magnetic device where-

by the stop circuit will be closed and will remain closed when the control circuit is momentarily completed, and the control circuit will be thereafter opened and held open.

9. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a normally open electric control circuit, one terminal of which is grounded on the digging machine and the other terminal of which is connected with a portion of the piping system, a circuit-breaker in this safety circuit comprising a normally closed switch and electro-magnetic means for opening the switch, a stop mechanism, an operating circuit for the stop mechanism including a normally open switch, an electro-magnetic device for closing this latter switch, electrical connections including the electro-magnetic device whereby the stop circuit will be closed and will remain closed when the control circuit is momentarily completed, and the control circuit will be thereafter opened and held open, and a normally closed manually operable circuit breaker positioned in both circuits to momentarily break both circuits and reset the mechanism.

10. A control mechanism for a digging machine comprising an electrically actuated control device, an energizing circuit for the device including a source of electric power, a normally open switch in the energizing circuit, and means for closing the switch including a control circuit, the control circuit being normally open and having one terminal grounded on the digging machine, and means for connecting the other terminal with a portion of an underground piping system.

11. A control mechanism for a digging machine comprising an electrically actuated control device, an energizing circuit for the device including a source of electric power, the energizing circuit being normally open, and means for closing the energizing circuit including a control circuit, one terminal of which is grounded to the digging machine, and means for connecting the other terminal of the control circuit with a portion of an underground piping system.

12. A control mechanism for a digging machine comprising an electrically actuated control device, an energizing circuit for the device including a source of electric power, a normally open switch in the energizing circuit, a control circuit also including the source of power and having two normally disconnected terminals, means for grounding one terminal on the digging machine, means for connecting the other terminal with a portion of an underground piping system, a normally closed switch in the control circuit, electro-magnetic means for closing the first mentioned switch and opening the second mentioned switch when the control circuit is momentarily completed by the digging machine encountering a portion of the piping system, and normally closed manually operable means for breaking both circuits whereby the mechanism may be reset.

13. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a source of electric power, a normally open control circuit, one terminal of which is grounded on the digging machine, an electric cable, one end of which is electrically connected with a portion of the piping system, the other end of the cable being connected with the other terminal of the control circuit, a reel on which the surplus cable is wound, an electrically actuated control device, and means for energizing this device from the source of power when the control circuit is closed.

14. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a source of electric power, a normally open control circuit, one terminal of which is grounded on the digging machine, an electric cable, one end of which is electrically connected with a portion of the piping system, the other end of the cable being connected with the other terminal of the control circuit, a reel on which the surplus cable is wound, an electrically actuated control device, a normally open actuating circuit for this device, and an electro-magnetically operated circuit-closure in this circuit, this circuit-closure including a magnet which is energized when the control circuit is completed.

15. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a source of electric power, a normally open control circuit, one terminal of which is grounded on the digging machine, an electric cable, one end of which is electrically connected with a portion of the piping system, the other end of the cable being connected with the other terminal of the control circuit, a reel on which the surplus cable is wound, an electrically actuated control device, a normally open actuating circuit for this device, an electro-magnetically operated circuit-closure in this circuit, this cir-

cuit-closure including a magnet which is energized when the control circuit is completed, a normally closed electro-magnetically operated circuit-breaker in the control circuit, and means for energizing this circuit-breaker to open the control circuit after the main operating circuit has been established.

16. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a source of electric power, a normally open control circuit, one terminal of which is grounded on the digging machine, an electric cable one end of which is electrically connected with a portion of the piping system, the other end of the cable being connected with the other terminal of the control circuit, a reel on which the surplus cable is wound, an electrically actuated control device, a normally open actuating circuit for this device, an electro-magnetically operated circuit-closure in this circuit, this circuit-closure including a magnet which is energized when the control circuit is completed, a normally closed electro-magnetically operated circuit-breaker in the control circuit, a second electro-magnetically operated circuit-closure which is energized when the control circuit is completed, this second circuit-closure functioning to complete an energizing circuit for the circuit-breaker, whereby the control circuit is broken, and connections for maintaining closed the energizing circuits for the two circuit-closures after the control circuit is broken.

17. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a source of electric power, a normally open control circuit, one terminal of which is grounded on the digging machine, an electric cable, one end of which is electrically connected with a portion of the piping system, the other end of the cable being connected with the other terminal of the control circuit, a reel on which the surplus cable is wound, an electrically actuated control device, a normally open actuating circuit for this device, an electro-magnetically operated circuit-closure in this circuit, this circuit-closure including a magnet which is energized when the control circuit is completed, a normally closed electro-magnetically operated circuit-breaker in the control circuit, means for energizing this circuit-breaker to open the control circuit after the main operating circuit has been established, and manually operable means for temporarily breaking all of the circuits whereby the parts are reset to the original inoperative positions.

18. In combination with a digging machine comprising digging members and means for moving the members into the ground to excavate material, a control mechanism adapted to function when one of the digging members encounters a portion of a piping system, said mechanism comprising a source of electric power, a normally open control circuit, one terminal of which is grounded on the digging machine, an electric cable one end of which is electrically connected with a portion of the piping system, the other end of the cable being connected with the other terminal of the control circuit, a reel on which the surplus cable is wound, an electrically actuated control device, a normally open actuating circuit for this device, an electro-magnetically operated circuit-closure in this circuit, this circuit-closure including a magnet which is energized when the control circuit is completed, a normally closed electro-magnetically operated circuit-breaker in the control circuit, a second electro-magnetically operated circuit-closure which is energized when the control circuit is completed, this second circuit-closure functioning to complete and energizing circuit for the circuit-breaker, whereby the control circuit is broken, connections for maintaining closed the energizing circuits for the two circuit-closures after the control circuit is broken, and manually operable means for temporarily breaking all of the circuits whereby the parts are reset to the original inoperative positions.

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