

Feb. 20, 1934.

W. C. SHUNK

1,947,503

MEANS FOR PROTECTING TRAILING CABLES

Filed Jan. 20, 1932

3 Sheets-Sheet 1

Fig. 1.

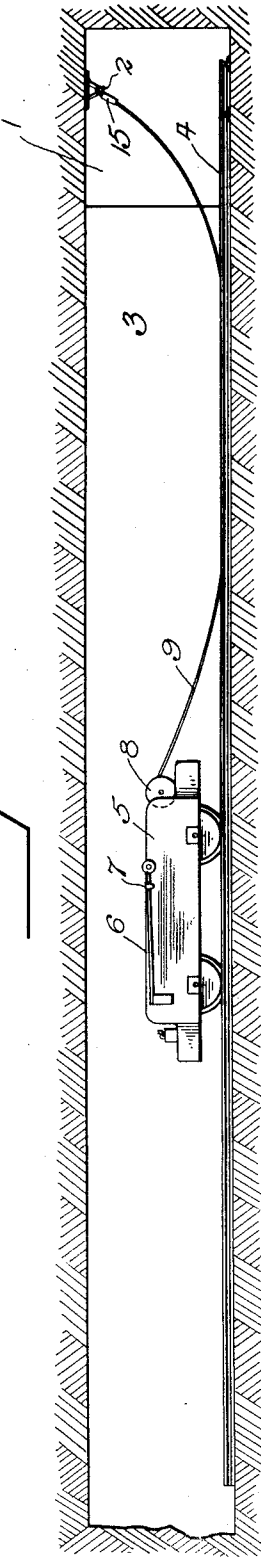


Fig. 2.

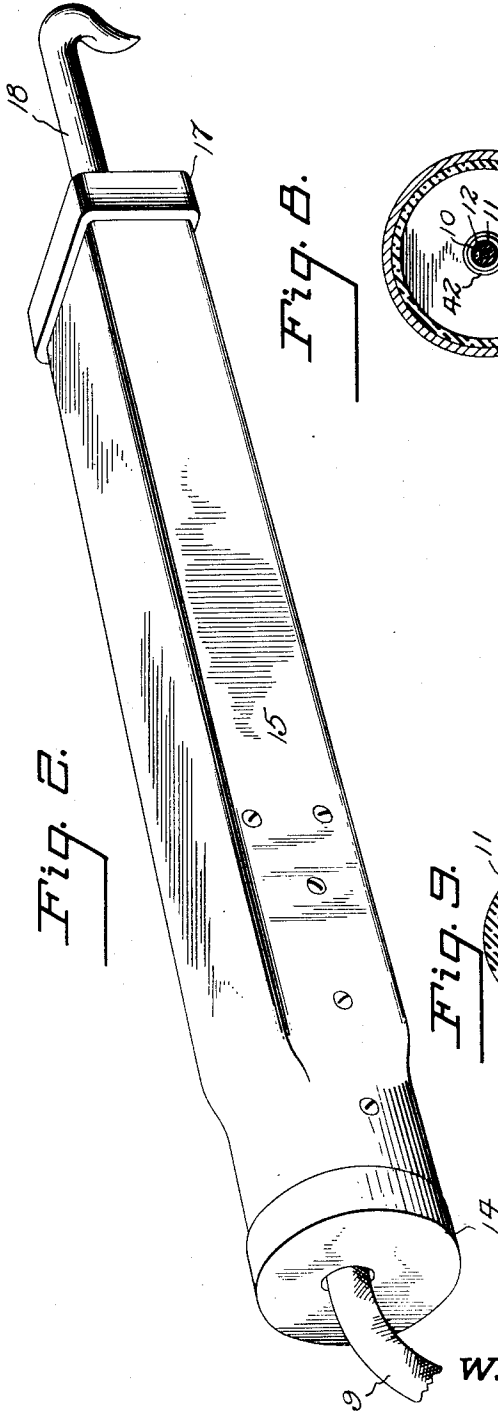


Fig. 3.

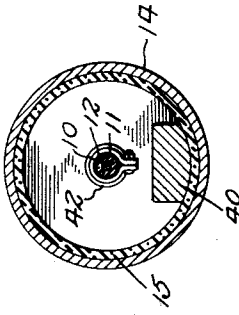
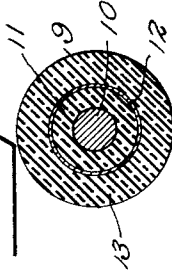


Fig. 4.



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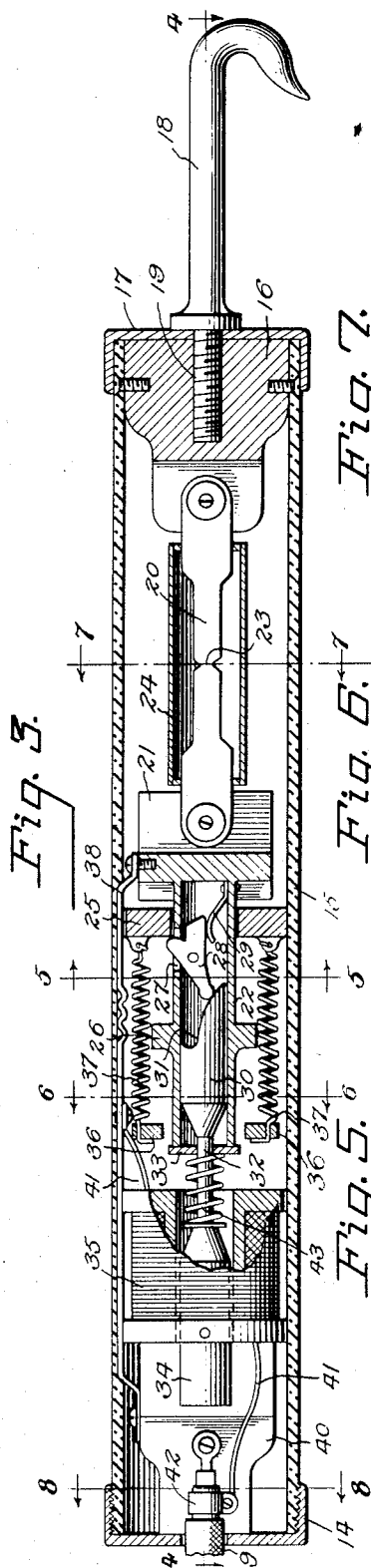
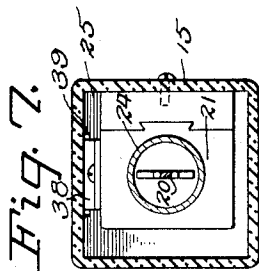
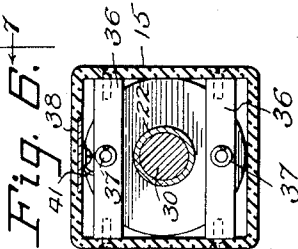
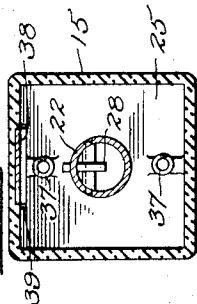
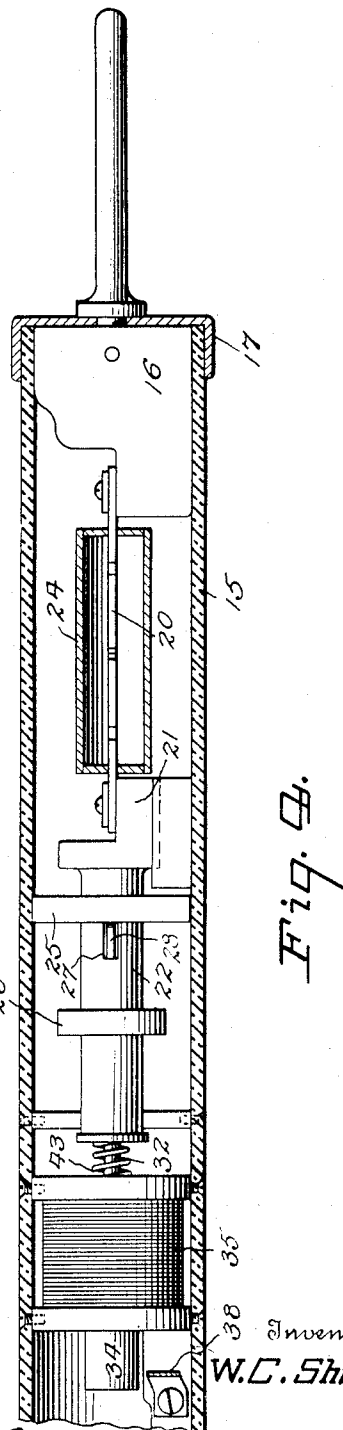
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Fig. 10.

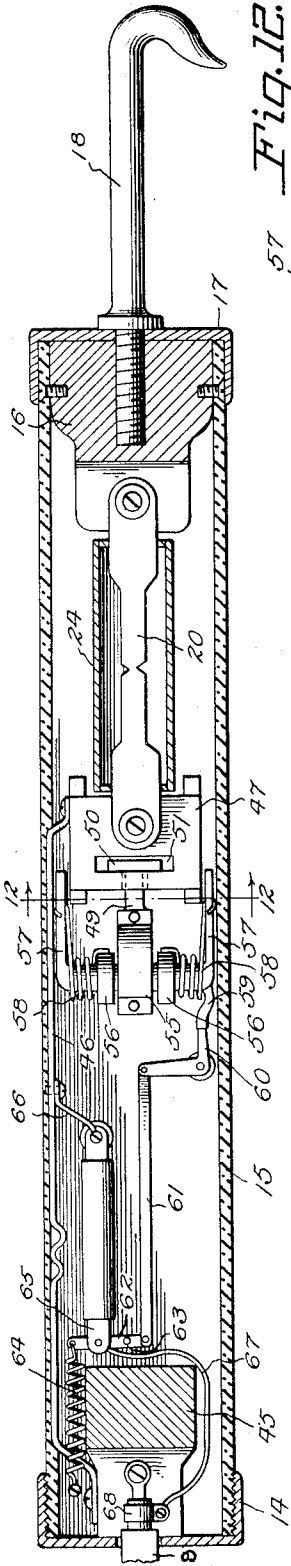


Fig. 11.

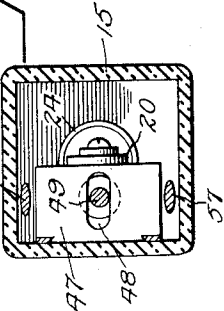


Fig. 12.

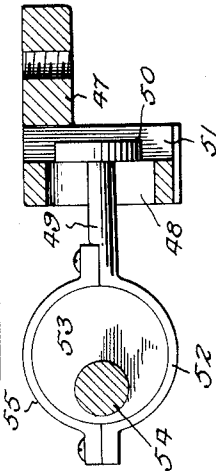
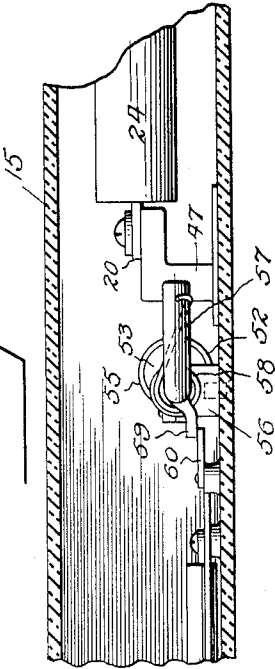


Fig. 13.



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UNITED STATES PATENT OFFICE

1,947,503

MEANS FOR PROTECTING TRAILING CABLES

Walter C. Shunk, Chicago, Ill.

Application January 20, 1932. Serial No. 587,807

12 Claims. (Cl. 175—294)

In mine operation, trains of cars drawn or propelled by electric locomotives are utilized to draw the mined material to the mouth of the mine, tracks upon which the trains run being laid through the main drift or passage of the mine and also into the lateral branch passages so that all portions of the mine may be reached and the cars carried to more distant points as the mining operations proceed to greater depths. Trolley wires are provided along the roof of the main passage but, for various reasons, principally safety of the workmen, are not carried into the side passages and when it is necessary for the locomotive and other electrically driven machines to operate in the side passages or drifts, the trolley is lowered and a trailing cable is connected to the end of the trolley wire and paid out along the ground as the locomotive proceeds into and through the side passages. This trailing cable is mounted upon a reel carried by the locomotive and is connected to the motor of the locomotive so that, when the trailing cable is in use, current will be conveyed by it from the trolley wire to the motor to drive the latter. The trailing cable is carried around corners into the side passages and past columns into connecting passages and is exposed to water and mud in the tracks and blows from falling objects and is sometimes cut through by extending over a track rail and being severed by a wheel passing over the same. As a result of the hard usage to which the trailing cable is subjected and the various contingencies to which it is exposed, rupturing of the same frequently occurred heretofore and when such rupture occurred, short circuits were formed involving high currents and, consequently, high temperature arcs and flashes were produced which often severed the cable so that operation was suspended while the cable was spliced. The flashes occurred on the track rails and metal parts of the equipment and caused serious injuries to workmen employed in the vicinity as well as mine fires and great damage to property. It is the object of the present invention to provide a trailing cable which will be protected in such a manner that it may be used for a long period without being worn to such an extent that the exposed parts will be conducive to short circuits. It is also an object to provide means whereby when a short circuit is formed the main circuit through the cable will be broken and arcing dangerous to life and property will be avoided. The invention is illustrated in the accompanying drawings and will be hereinafter fully described, the novel features being particularly pointed out in the appended claims.

In the drawings,

Figure 1 is a view showing a mine locomotive in a conventional manner and illustrating the use of the trailing cable,

Fig. 2 is an enlarged perspective view of the coupling which is connected to the trolley wire when the trailing cable is to be used,

Fig. 3 is a longitudinal section through the coupling,

Fig. 4 is a view of the coupling, partly in plan and partly in horizontal section, on the line 4—4 of Fig. 3,

Figs. 5, 6, 7 and 8 are transverse sections through the coupling on the lines 5—5, 6—6, 7—7 and 8—8 of Fig. 3, respectively,

Fig. 9 is an enlarged transverse section of the trailing cable,

Fig. 10 is a view similar to Fig. 3 showing another embodiment of the invention,

Fig. 11 is a view, partly in side elevation and partly in longitudinal section, of a part of the mechanism shown in Fig. 10,

Fig. 12 is a transverse section on the line 12—12 of Fig. 10,

Fig. 13 is a detail view of the eccentric connection shown in Figs. 10 and 11.

In the drawings, the reference numeral 1 indicates the main passage of a mine having a trolley wire, indicated at 2, mounted upon its roof, and 3 indicates a branch passage leading laterally from the main passage, with track rails 4 upon the floor of both passages. The numeral 5 designates a mine locomotive which is equipped with a conventional trolley 6 adapted to be held in its lowered inoperative position by a hook or other retainer 7 in the usual manner, and upon one end of the locomotive is mounted a reel 8 upon which the trailing cable 9 is normally wound. When the locomotive is traveling in the main passage of the mine, the trolley 6 is raised to engage the trolley wire 2 and the trailing cable is fully wound upon the reel 8. When the locomotive is to enter and travel in a side passage, the trolley is lowered and one end of the trailing cable is connected with the trolley wire while the opposite end of the cable is connected to the motor.

The cable, as shown in Fig. 9, comprises a central conductor 10 of a diameter suitable to carry sufficient current to operate the motor to which the cable is connected and about this central conductor is a jacket or sheath 11 of insulation. About the insulation 11 is fitted a tube 12 of conducting material, preferably loosely woven fine copper wires, and this copper tube or auxiliary conductor is covered by insulation 13 which is sufficiently heavy to withstand considerable wear. The cable is not attached directly to the trolley wire but its end is passed through an end cap 14 which closes one end of a casing 15 of insulating material which is closed, at its opposite end, by a plug 16 of conducting material, a cap 17 of insulation being fitted over the end of the casing and the end of said plug, as shown in Fig. 3.

A hook 18 has its shank provided with a threaded extremity 19 which is inserted through an opening provided therefor in the cap 17 and is engaged in the body of the plug 16, as shown clearly in Fig. 3. This hook 18 is engaged over the trolley wire 2, when the trailing cable is to be used, and is of conducting material so that it forms an electrical connection with the trolley wire and transfers current therefrom to the plug 16, as will be understood. Within the housing 15, one end of a fuse 20 is secured to the plug 16, as shown clearly in Figs. 3 and 4, the opposite end of the fuse being secured to the head 21 of a tubular slide 22. The fuse is preferably of the frangible type, being weakened between its ends, as indicated at 23, and around the fuse is provided a casing or sleeve 24 of insulation. The tubular slide 22, adjacent its head 21, is passed centrally through a block 25 which block may slide upon the tube, and to prevent rotation of the block relative to the tube the housing 15 and the block are both given a non-circular formation, as shown clearly in Fig. 5, so that the block will be held against rotation by the housing. The tubular slide 22 is provided, between its ends, with an external annular rib or stop 26 against which the block 25 may impinge in the operation of the device so as to impart longitudinal movement to the tubular slide, as will presently more fully appear, and in one side of the tubular slide is a longitudinal slot 27 through which projects one corner of a latch 28 which is pivotally mounted within the tube and is yieldably held in such position that its projecting corner will engage the block 25, as shown in Fig. 3, by a spring 29 bearing against the latch and secured within the tube. A plunger 30 is also slidably mounted within the tube 22 and has its inner or forward end beveled, as clearly shown at 31, said beveled end projecting under the rear end of the latch 28 so that, upon relative forward movement of the plunger, the latch will be rocked to be released from the block 25. The plunger has a reduced stem or extension 32 extending through a cap or other closure 33 for the rear end of the tube 22 and this stem 32 is, in turn, formed with or secured to a short bar 34 which forms the core or armature of an electromagnet or solenoid 35. Spaced from the block 25 and at opposite sides of the tube 22 and adjacent the rear end of the tube, when the tube is in its normal position, are cross bars or anchors 36 to which contractile springs 37 are attached, said springs extending to and being also attached to the block 25 so that they tend constantly to hold the block 25 against the latch 28 and to draw the block toward the rear end of the tube. It will be understood that the head 21 and the tubular slide 22 are of conducting material while the plunger 30 and the block 25 may be of insulation, the block 25 being preferably of insulation. The bar 34 forming the core of the solenoid 35 is, of course, of iron or other material which will respond promptly to the transmission of an electric impulse through the solenoid winding. Attached to the head 21 is a flexible conductor strip 38 which is seated in a recess or groove provided therefor in the adjacent side of the housing 15 and also passes through a recess or notch 39 provided therefor in the adjacent edge of the block 25, this conductor strip extending past the solenoid 35 and being then secured to a block 40 which may extend from the frame of the solenoid and provides a terminal and support for the end of the cable 9, as will be understood

upon reference to Fig. 3. The conducting core 10 of the cable is anchored upon this block 40 or connected with the end of the conducting strip 38 so that, when the trailing cable is connected to the trolley wire, current will flow through the hook 18, fuse 20, strip 38 and into and through the cable. A shunt or branch conducting strip 41 is connected mechanically and electrically with the conductor strip 33 and merges into the winding of the solenoid 35 and then passes to the rear of the solenoid and is connected to the auxiliary conductor 12 of the cable by a clamp 42, as indicated in Figs. 3 and 8. An expansion spring 43 is disposed around the shank 32, between the closure 33 and the end of the core 34, as shown clearly in Fig. 3, and yieldably holds the core and the plunger 30 in their normal positions.

Figs. 3 and 4 show the parts in their normal positions and, as long as the apparatus is operating properly, the current to drive the locomotive motor passes over the course which has been stated. A branch flow of the current will pass over the conductor strip 41 and through the winding of the solenoid to the auxiliary conductor 12 but this auxiliary conductor 12 is not connected to the motor of the locomotive and its end is enveloped in the sheath 13 of insulation so that until the auxiliary conductor is exposed, no electric energy will result from the presence of current in said conductor. The trailing cable rests upon the ground, as indicated in Fig. 1, at the rear of the locomotive, and the length of the same is played out and extended as the locomotive travels from the main passage. The cable is obviously subjected to wear by its contact with the ground and eventually the insulating sheath 13 will be worn through so that the conducting strip 12 will be exposed and will make contact with the ground, whereupon the latent current in the solenoid winding and the conducting strip 41 will become active and a circuit will be closed there-through so that the solenoid will be energized and the core 34 moved forwardly against the force of the spring 43. This forward movement will, of course, be transmitted directly to the plunger 30 which will move under the latch 28 and rock the same to release the block 25. The springs 37 then immediately contract and draw the block 25 forcibly against the rib 26 of the slidable tube 22 and effect an endwise movement of said tube which exerts a pull upon the fuse 20 and ruptures the latter, thereby breaking the inflowing current, so that damage is avoided.

The sheath 13 is heavy so that it will not be worn through under normal conditions for a considerable period and the cable will be useful for a considerably longer time than the cables now generally employed. The auxiliary conductor 12 carries sufficient current to energize the solenoid 35 but will not carry the full load from the trolley wire so that heavy sparking will not occur when a short circuit is formed by contact of the auxiliary conductor 12 with the ground or with a track rail or water which may be upon the floor of the mine passage. The structure is simple and compact and is certain in its operation. The flexibility of the cable is not impaired in the slightest degree and it may be wound upon the reel 8 when not in use in the usual manner and readily paid out when it is in use. The locomotive may pass around the sharp corners and bends present in the mine and the cable will follow it without being broken.

In the embodiment of the invention illustrated

in Figs. 10 to 13, there is provided the same housing 15 having a cap 14 at one end through which the trailing cable 9 passes and a cap 17 at the opposite end through which the trolley wire engaging hook 18 passes. The hook is secured to a plug 16 to which the fuse 20 is attached and the same sleeve 24 is provided around the fuse. The trailing cable is anchored to a block or head 45 at the end of the housing 15, remote from the plug 16, and a conducting strip 46, corresponding to the conducting strip 38 in the previously described form, is secured to the block or head 45 and also to the inner head 47 to which one end of the fuse is secured. The head 47 is provided with a slot 48 through which passes a stem 49 having a head 50 on one end which seats in a recess 51 formed in the head, as shown. The stem is formed on or secured to an eccentric strap member 52 which passes around an eccentric 53 formed upon a rock shaft 54, a mating eccentric strap 55 being disposed about the eccentric 53 and secured to the strap 52 and stem 49, as shown clearly in Fig. 13. The rock shaft 54 is mounted in bearings 56 provided therewith in the housing 15 and, at its ends, is provided with cranks or levers 57 which are disposed adjacent the sides of the housing and normally extend toward the head, as shown in Figs. 10 and 11. Torsion springs 58 are provided at opposite sides of the eccentric 53 and have their intermediate portions coiled around the shaft while their inner ends are engaged with the bearings 56 and their outer ends are engaged with the crank arms 57, as clearly shown. Normally, the greater width of the eccentric 53 is disposed between the rock shaft and the head 51 so that the parts are in the positions illustrated. When a short circuit is caused, the rock shaft will be released and the torsion springs will swing the arms 57 upwardly and rearwardly so that the shaft will be rocked and the eccentric shifted so that the greater length of its diameter will be at the rear of the rock shaft, this movement obviously exerting a pull upon the stem 49 which is transmitted through its head 50 to the block 47 so that a breaking pull will be applied to the fuse 20.

One crank arm 57 is provided with a rearward extension or stop 59 which normally rests upon one end of an angle lever 60 which is fulcrumed, at its angle, upon the side of the housing 15 and thereby holds the crank arm against movement under the influence of the spring 58. The opposite arm of the angle lever 60 extends toward the medial longitudinal line or axis of the housing 15 and is pivoted to a connecting rod 61 which extends rearwardly of the housing and is pivoted to one end of a lever 62 pivoted between its ends, as indicated at 63, and extending toward the opposite side of the housing, a retractile spring 64 being attached to the free end of the lever 62 and extending rearwardly therefrom and being anchored in any convenient manner upon the side of the housing. Between its pivot and the end to which the spring is attached, the lever 62 is pivoted to one end of a fuse 65, the opposite end of said fuse being connected through a branch conductor 66 with the conducting strip 46 and a conducting strip 67 extending from the fuse to a clip 68 whereby it is connected to the auxiliary conductor of the trailing cable. The fuse 65 is a low capacity fuse which will blow out under a weak current but is sufficiently strong to resist the action of the spring 64. Should a short circuit be formed through the auxiliary conductor of the trailing cable, the latent cur-

rent in the conductors 66 and 67 and the fuse 65 will blow out the fuse whereupon the spring 64 will contract and rock the lever 62 which will transmit the motion through the connecting rod 61 to the angle lever 60 which will be rocked from under the stop 59 whereupon the springs 58 will perform their previously described function and will cause the fuse 20 to be ruptured so that the further inflow of current through the cable connection will be arrested.

Having thus described the invention, I claim:

1. A trailing cable comprising a conducting core, a sheath of insulation about the core, an auxiliary conductor embedded in the sheath, a coupling for connecting the cable to a source of energy, a fuse within the coupling, a conducting strip conveying current from the fuse to the core of the cable, a branch conductor extending between the main conductor and the auxiliary conductor of the cable, and means whereby the fuse will be broken upon the completion of a circuit through the branch conductor.

2. A coupling for connecting a trailing cable to a source of energy comprising a fuse, an electric conducting member engageable with a source of energy and connected with the fuse, main and auxiliary conductors arranged to connect the fuse with the trailing cable, a movable element connecting the main conductor with the fuse, and means controlled by the passage of current through the branch conductor for exerting a pull through said element upon the fuse to rupture the latter.

3. A coupling for connecting a trailing cable to a source of energy comprising a housing of insulation, a hook secured in one end of the housing to engage over a main conductor, said hook being of conducting material, a fuse within the housing connected electrically with said hook, a head connected with the fuse, a conductor secured to said head and supported by the side of the housing within the housing, means for connecting said conductor with the trailing cable, a branch conductor extending from said conductor strip and connected with the trailing cable, means for imparting movement to said head for rupturing the fuse, and means for activating said last-mentioned means upon the closing of a circuit through the branch conductor.

4. Means for connecting a trailing cable with a main conductor comprising a fuse, a conductor-engaging element of conducting material connected with one end of the fuse, a slidable head secured to the opposite end of the fuse, a conducting strip secured to the head and connected with the trailing cable, a branch conductor leading from the conducting strip to the cable, means for holding the head normally stationary, and means whereby upon the formation of a circuit through the branch conductor said means will be released and a sliding movement will be imparted to the head to rupture the fuse.

5. Means for connecting a trailing cable to a main conductor comprising a fuse, a conductor-engaging element of conducting material connected with one end of the fuse, a slidable head secured to the opposite end of the fuse, a tube extending from the head, a latch carried by the tube, a detent normally engaged by the latch to hold the head and tube stationary, means for releasing the latch upon the formation of a circuit through the branch conductor, and means for causing the detent, when the latch is released, to engage the tube and impart endwise movement to the same and to the head.

6. Means for coupling a trailing cable to a source of energy comprising a fuse, a conductor-engaging element connected with one end of the fuse and formed of conducting material, a movable head secured to the opposite end of the fuse, a tube extending from the head and provided with an external projection and having a slot therein between the head and the projection, a latch normally extending through the slot, a plunger in engagement with the latch and normally retracted, a detent normally engaged by the latch and adapted when released by the latch to impinge upon the projection on the tube to impart endwise movement thereto and to the head to rupture the fuse, and means whereby upon the formation of a circuit through the branch conductor the plunger will be projected to release the latch.
7. Means for connecting a trailing cable to a source of energy comprising a fuse, a cable-engaging element of conducting material connected with one end of the fuse, a head secured to the opposite end of the fuse, a tube extending from the head, a conducting strip extending from the head to be attached to the cable, a branch conductor extending from said conductor to be attached to the cable, a projection on the tube, a detent disposed between said projection and the head and movable along the tube, a latch pivoted within the tube and projecting therefrom to engage the detent, a plunger within the tube having a beveled end engaging the latch whereby upon forward movement of the plunger the latch will release the detent, means for moving the detent along the tube to engage the projection thereon when the latch is released whereby to effect movement of the head and rupture the fuse, an electro-magnet in the winding of which the branch conductor is merged, an armature for said magnet connected with the plunger whereby upon energization of the magnet the plunger will be projected, and yieldable means for holding the plunger normally retracted.
8. Means for connecting a trailing cable with a source of energy comprising a fuse, a conductor-engaging element of conducting material connected with one end of the fuse, a movable head secured to the other end of the fuse, a tube extending from said head, a projection on the tube, a latch pivotally mounted within the tube and yieldably held in position projecting therefrom, a detent disposed about the tube between the latch and the head and normally held stationary by the latch, a plunger within the tube engaging the latch, a conducting strip secured to the head and adapted to be connected with the trailing cable, a branch conductor extending from the conducting strip to be attached to the cable, an electro-magnet the winding of which is connected to the branch conductor, an armature for said magnet connected with the plunger, an expansion spring disposed between the tube and the armature and normally holding the plunger in retracted position, and means for moving the detent to the projection on the tube whereby upon energization of the magnet the plunger will be projected to release the latch and the detent will be caused to impinge against the projection on the tube to move the head and rupture the fuse.
9. Means for connecting a trailing cable with a source of energy comprising a fuse, a conductor-engaging element of conducting material connected to one end of the fuse, a head secured to the opposite end of the fuse, a rock shaft dis-
- posed adjacent the head, a conducting strip secured to the head and arranged to be connected to the cable, a branch conductor leading from said conducting strip to be secured to the cable, a weak fuse interposed in the branch conductor, a connection between the rock shaft and the head, means for rocking the shaft whereby to impart movement of the head and exert a breaking pull upon the first-mentioned fuse, means for holding the rock shaft against movement, and means connected with the weak fuse for releasing said holding means whereby upon blowing of the weak fuse the rock shaft will be actuated to move the head and rupture the first-mentioned fuse.
10. Means for connecting a cable with a source of energy comprising a fuse, a conductor engageable element of conducting material connected with one end of the fuse, a head secured to the opposite end of the fuse, a rock shaft adjacent the head, an eccentric on said shaft, a stem connecting the eccentric with the head, a conductor strip extending from the head to be attached to the cable, a branch conductor leading from said conducting strip to be attached to the cable, a weak fuse interposed in said branch conductor, means for rocking the shaft, a stop member projecting rearwardly from the shaft, a lever supporting said stop member to normally prevent movement of the shaft, and means connected with the weak fuse whereby upon blowing of said fuse the lever will be released from the stop and the rock shaft will be turned to move the head and rupture the first-mentioned fuse.
11. Means for connecting a cable with a source of energy comprising a fuse, a conductor engageable element of conducting material connected with one end of the fuse, a head secured to the opposite end of the fuse, a conductor strip extending from the head to be connected with the cable, a branch conductor leading from said conducting strip to be connected to the cable, a weak fuse interposed in said branch conductor, means for moving the head, means whereby said head-moving means will be normally restrained, a lever secured to one end of the weak fuse, means for rocking said lever upon blowing of the fuse, a second lever engaging said restraining means, and connections between the two levers whereby upon blowing of the weak fuse the restraining means will be released and the head will be moved to rupture the first-mentioned fuse.
12. Means for connecting a cable with a source of energy comprising a fuse, a conductor-engaging element of conducting material connected with one end of the fuse, a head secured to the opposite end of the fuse, a conducting strip secured to the head and extending therefrom to be connected to the cable, a branch conductor extending from said strip to the cable, a weak fuse interposed in said conducting strip, a lever connected with said weak fuse, a rock shaft, an operative connection between the rock shaft and the head whereby when the shaft is turned the head will be moved toward or from the same, crank arms on the ends of the shaft, torsion springs tending to rock said arms and turn the shaft, a stop projecting away from one of said crank arms, a rocking element engaging said stop to hold the shaft against turning, and connections between said rocking element and the lever whereby upon blowing of the weak fuse the rocking element will be released from the stop and the shaft will be rocked to shift the head and rupture the first-mentioned fuse.

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