

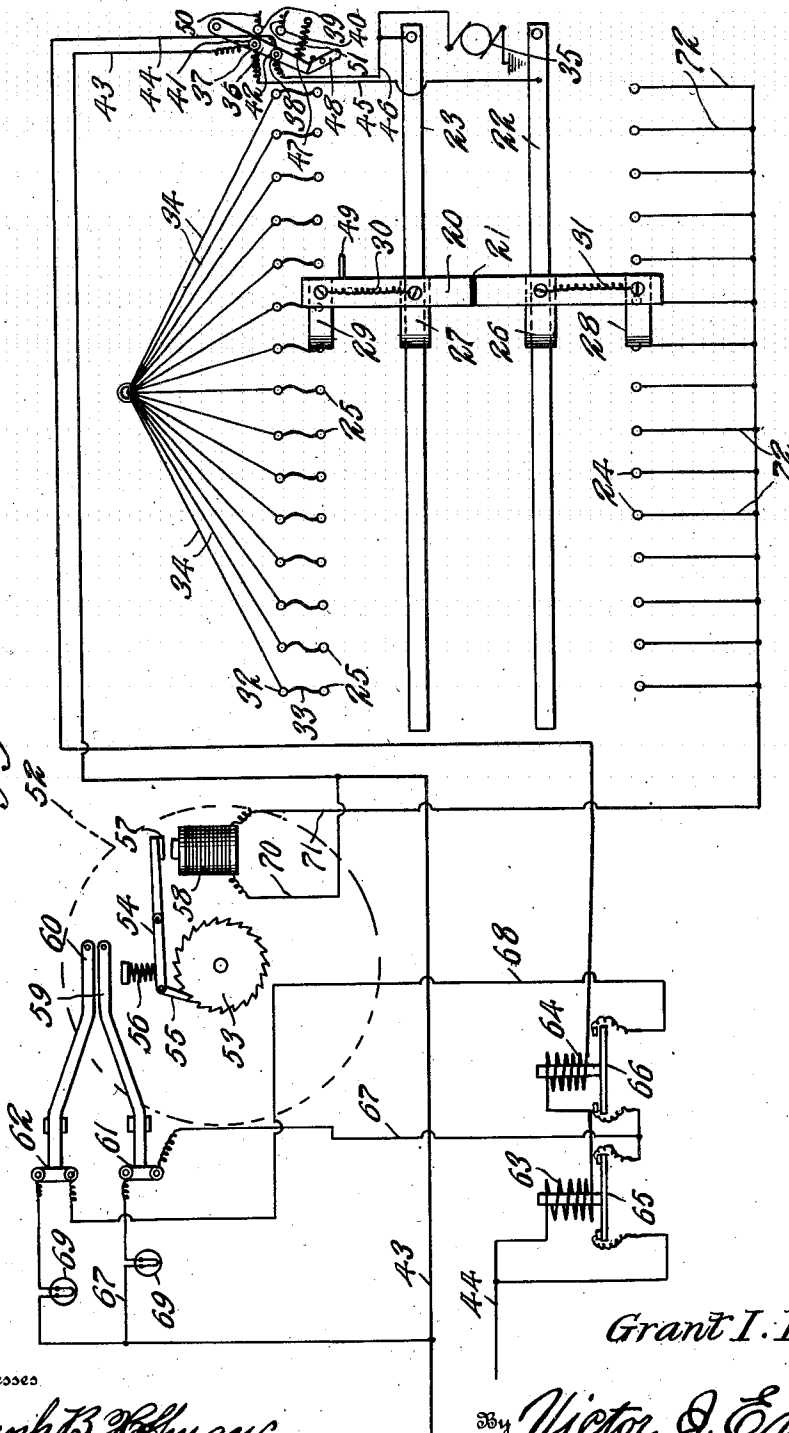
G. I. RAWSON.
MINE SHOT FIRING SYSTEM.
APPLICATION FILED MAY 4, 1909.

Patented Nov. 11, 1913.

3 SHEETS—SHEET 1.

1,078,463.

Fig. 1.



Witnesses

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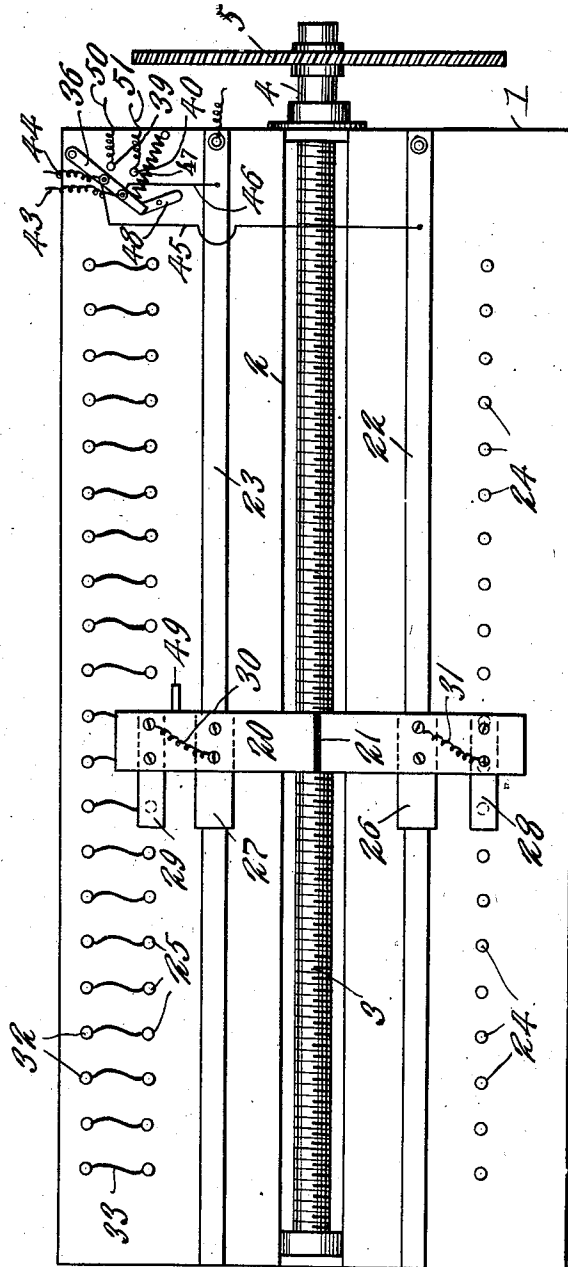
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3 SHEETS-SHEET 2.

Fig. 2.



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3 SHEETS--SHEET 3.

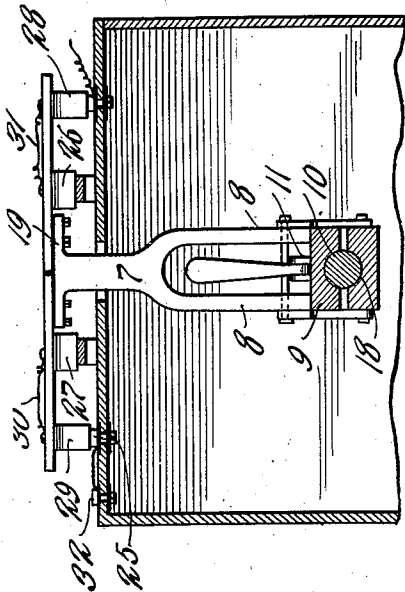


Fig. 3.

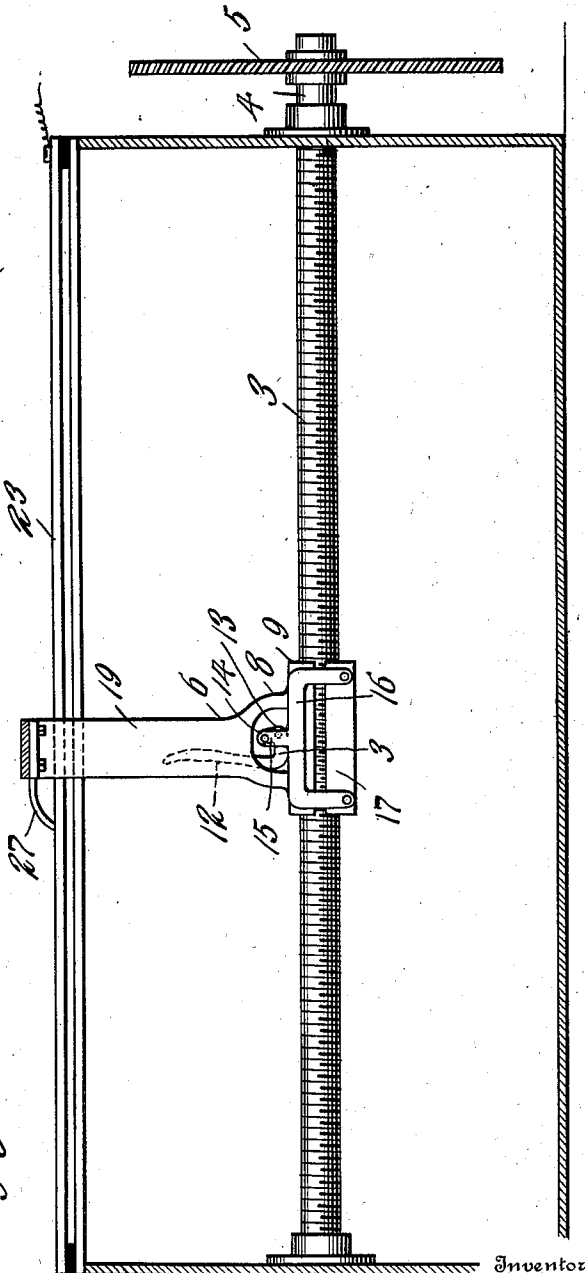


Fig. 4.

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UNITED STATES PATENT OFFICE.

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MINE-SHOT-FIRING SYSTEM.

1,078,463.

Specification of Letters Patent.

Patented Nov. 11, 1913.

Application filed May 4, 1909. Serial No. 493,792.

To all whom it may concern:

Be it known that I, GRANT I. RAWSON, a citizen of the United States, residing at St. Louis, State of Missouri, have invented new and useful Improvements in Mine-Shot-Firing Systems, of which the following is a specification.

The invention is directed to a mine shot firing system, being particularly directed to an apparatus which may be located in the mine adjacent the chambers in which the shots are to be fired and absolutely and accurately controlled from the surface of the mine.

The main object of the present invention is the provision of a machine of this character in which the shots are successively fired entirely at the will of the operator, the latter having such complete control of the machine as will permit starting or stopping of the machine at any point intermediate its initial or final stage.

A further object of the invention is the provision of means whereby the action of the machine will be effectively recorded at the surface of the mine, the construction insuring the recording of the operation of the machine as well as the fact as to the firing of the particular shot.

The invention will be described in the following specification, reference being had particularly to the accompanying drawings, in which:—

Figure 1 is a diagrammatic view illustrating the electrical connections with the machines and the recording apparatus. Fig. 2 is a plan of one of the machines. Fig. 3 is a broken transverse section of the same. Fig. 4 is a longitudinal section.

Referring particularly to Figs. 2 to 4 inclusive, wherein is shown the preferred type of the machine, 1 represents a casing, preferably of rectangular or other appropriate form, said casing being wholly inclosed except for a slot 2 extending longitudinally and centrally of the cover or upper wall thereof. In the end walls of the casing and extending centrally thereof is mounted a feed shaft 3, which is threaded in that portion arranged between the end walls. The shaft extends beyond what will be termed the rear end wall of the casing to provide a stub shaft 4 on which is mounted a worm gear 5.

Mounted on the feed shaft 3 is a carriage 6, including a standard 7 formed for the

greater portion of its length to provide spaced bars 8. Secured on the lower ends of the bars 8 is a block 9, formed in its relatively lower surface with a depression 10 interiorly threaded for cooperation with the feed shaft. The block 9 is formed on its upper surface with vertically arranged spaced ears 11, between which is pivoted an operating lever 12 having a cam nose 13. To the free end of the cam nose of the lever is secured a transversely arranged rod 14, which extends beyond the bars 8 of the standard and is connected at each end to an upright 15 projecting from an inverted U-shaped frame 16. The lower ends of the side bars of each frame 16 are pivotally connected to a block 17 similar in all respects to the block 9 and formed with a longitudinal centrally arranged depression 18 interiorly threaded to engage the feed shaft. The arrangement of the parts is such that when the lever 12 is in one position the cam nose thereof will bear upon the upper surface of the block 9 with the effect to draw said block and the block 17 toward each other and cause the threads in the block depressions to engage the threads of the feed shaft, whereby in the operation of said shaft the carriage will be moved longitudinally of the casing 1.

Beyond the upper wall of the casing 1 the carriage standard is provided with a head plate 19 designed to support a carrier strip 20, which thus extends transversely of the casing. The strip is preferably of non-conducting material, though if desired it may be made of two ordinary metallic sections separated by an insulating strip 21.

Secured in the top wall of the casing 1 and arranged in spaced parallel relation are contact bars 22 and 23, each of said bars extending the full length of the casing top and, of course, underlying the carrier strip 20. Beyond the bar 22, which will be hereinafter termed the recording contact bar, the casing 1 is provided with a series of longitudinally alined recording contacts 24, these contacts being arranged in spaced relation and in a line parallel with the recording bar contact 22. Beyond the bar contact 23, and in alinement longitudinally of the casing, are arranged a series of contact points 25 forming the shot contacts, these latter contacts extending in a line parallel to the contact bar 23, hereinafter termed the shot firing contact bar.

The carrier strip 20 is provided with four spaced contact fingers 26, 27, 28 and 29, these fingers being preferably of curved spring metal and secured to the contact strip for co-
 5 operation with a particular part of the electrical equipment of the machine, that is the fingers 26 and 27 are designed to at all times bear upon the respective contact bars 22 and 23, the contact finger 28 is designed for suc-
 10 cessive electrical engagement with the contact points 24, while the contact finger 29 is designed for successive coöperation with the shot firing contact points 25. Assuming the carrier strip to be of non-conducting mate-
 15 rial the fingers 27 and 29 are electrically connected by a conductor 30, while the fingers 26 and 28 are similarly connected by a conductor 31 and thereby establish electrical connection between the shot firing contact
 20 bar and the shot firing contact points, and also between the recording contact bar and the recording contact points.

Each shot firing contact point is in connection with a firing conductor terminal
 25 point 32, said points 32 being also secured in the top wall of the casing and respectively alined transverse the casing with the firing contact points. The connection between the respective pairs of points 25 and
 30 32 are by means of ordinary fuses 33, whereby to prevent passage of an excessive current beyond the points 32. The points 32 are connected by means of conductors 34 with the respective shots, said conductors 34
 35 preferably leading from the machine in the form of a cable and being divided as necessary to serve each shot with a single conductor, the returns from all shots being grounded. This particular feature is not
 40 important in the present invention and no further detailed description thereof is deemed necessary herein.

Each machine is provided with a motor
 35, on the armature shaft of which is arranged a worm to at all times engage and
 45 operate the worm gear 5 on the feed shaft. The machines are adapted to be used in series throughout the mines, and for this reason I provide means whereby when each
 50 machine has completed its shot firing operation it will automatically disconnect itself from the power service and connect the next succeeding machine to said service. To this end each machine is provided with a switch
 55 blade 36 pivotally mounted at an appropriate point in the machine and designed to play between two pairs of spaced contacts, the first pair 37 and 38 of which are the service contacts of the particular machine in
 60 which the switch is mounted, while the second pair 39 and 40 are the service contacts of the next succeeding machine. The switch blade, which is of insulating material carries
 65 contacts 41-42 adapted for engagement with the contacts of each respective pair in

accordance with the position of the blade, and the said contacts 41 and 42 are, in the initial or first machine of the series, connected with the service conductors 43-44.
 70 From the machine contacts 37-38 conductors 45-46 lead to the respective contact bars 22-23, the motor being included in the circuit. The switch blade is held under the tension of a spring 47 so that its normal tendency is to coöperate with the contacts
 75 39 and 40, but I provide a trip lever 48 mounted adjacent the free end of the switch so that when said lever is engaged with the switch the latter is held so as to direct the power of service conductors 43 and 44
 80 through the machine conductors 45-46. The carrier strip 20 is provided with a trip arm 49, which, when said carrier strip reaches the limit of its operative movement, will engage the trip lever 48 and release the
 85 switch 36 to the influence of the spring 47 whereby said switch will immediately cut out the machine in which it is mounted and cut in the next succeeding machine, it being understood that the contacts 39 and 40 are
 90 by conductors 50-51 connected to the next succeeding machine.

I will now proceed to describe the recording device, it being understood, however, that such specifically forms the subject matter of a copending application filed May 4, 1909, Serial No. 493,791, and is described herein simply to render clear the effective operation of the firing machine forming the subject matter of this invention.
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The recording apparatus comprises a machine mounted at the surface of the mine including a disk 52 bearing a series of lines dividing the same into squares each corresponding with one shot, the squares being
 105 preferably arranged in concentric series so that each machine corresponds to one series of squares. The machine is mounted for rotation being provided with a ratchet 53 designed to be operated by a lever 54 carrying a pawl 55 and spring pressed through the medium of a spring 56 in one direction, the opposite end of the lever having an armature strip 57 designed to be controlled
 110 by an electro-magnet 58, the parts being arranged so that upon energization of the electro-magnet the lever 54 will be operated so as to cause the pawl 55 to engage the next tooth in advance of the ratchet 53, and upon deenergization of the electro-magnet
 115 the spring 56 will force the lever in the opposite direction, causing the pawl to advance the ratchet and thereby the disk 52 one step. For coöperation with the disk I arrange independent perforating or punching elements 59-60, their operative ends being so
 120 relatively disposed that they will if both are operated provide spaced punches or openings in the particular square underlying the implements. Each of the perforating im-
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plements are in the form of levers pivotally mounted in an appropriate manner and operated by electro-magnets 61 and 62 respectively. The service conductors 43 and 44 lead from any suitable source of current supply at the surface of the mine, the former leading direct to the contact 37 of the first machine while the latter leads through ordinary electro-magnets 63 and 64, the service conductor forming the windings of the electro-magnets. These respective magnets are wound for different current strengths, that is the armature 65 of the electro-magnet 63 will be attracted when a current of a certain strength is passing through the service conductor, while the armature 66 of the electro-magnet 64 will only be attracted by a current of greater strength. Hence it is possible for a current of predetermined strength to pass through the service conductors and only energize one of the electro-magnets, as 63, while if the greater current passes through the wire of course both of the electro-magnets 63 and 64 will be operated. The armatures 65 and 66 form in effect switches or closures for secondary circuits, that controlled by the armature 65 including conductors 67 which energize the electro-magnet 61 of the perforating implement 59 while the armature 66 is included in a circuit comprising conductors 68 which control the electro-magnet 62 of the perforating implement 60, both the secondary circuits terminally including the service conductors 43 and 44, and if desired suitable resistance as incandescent lights 69. The electro-magnet 58 for feeding the disk 52 is energized by conductors 70 and 71, the former of which is connected to the service conductor 43, while the latter leads to the firing machine and is connected to each of the recording contacts 24 by conductors 72.

In the normal operation of the machine the closing of the service circuit at the surface of the mine after the shots have been properly fired will, through the motor, cause a rotation of the feed shaft 3, and hence the travel of the carriage longitudinally of the casing. As the carriage travels throughout the length of the casing it will successively engage the shot contacts and record contacts, firing the shots in succession and also energizing the electro-magnet 58 to advance the record disk 52 step by step, it being noted, however, that the actual movement of the disk being under the influence of the spring 56 occurs only while the contact finger 28 is passing between the respective contacts, or when no current is flowing through the machine other than through the motor. If the machine is in normal operation the current strength will operate electro-

magnet 63 closing the secondary circuit including conductor 67 and causing the perforating implement 59 to perforate the disk in the square corresponding to the particular shot. If a short circuit should occur on the service conductor the current will be in sufficient strength to affect the electro-magnet 64, also operate the electro-magnet 63, thereby energizing both the electro-magnets 61—62 and operating both the perforating implements. If for any reason by the breaking of a conductor or the like no current is passing, then neither perforating implement will be operated, so that the disk will indicate at each shot whether or not the shot was fired, and the reason for the non-firing in the event such is the result.

The shot firing machine is of simple construction, requiring practically no adjustment on the part of the operator in its initial setting beyond the arrangement of the switch 36 and the positioning of the carriage at the forward end of the feed screw, which latter is readily accomplished by releasing the blocks 9 and 17 by the movement of the lever 12 and moving the carriage longitudinally of the machine by hand.

Having thus described the invention what is claimed as new, is:—

In a machine of the class described, a casing, a series of contacts arranged on the casing and disposed longitudinally thereof and spaced apart, a contact bar mounted on the casing longitudinally thereof adjacent to said contacts, a second series of contacts arranged on the casing and disposed longitudinally thereof and spaced, a second contact bar on the casing arranged longitudinally thereof adjacent to said last contacts, a carriage adapted to travel longitudinally of said casing and including a carrier strip disposed transversely of the casing, contact fingers arranged on said strip and depending therefrom and spaced apart, connections between said fingers, said connections serving to establish electrical connection between said first-mentioned bar and contacts and said second bar and contacts, to lug on said strip, an electric circuit including said contact bars, a switch controlling said circuit and disposed in the path of movement of said lug whereby the circuit may be broken when the carriage has reached the end of its path of movement, and means for moving said carriage longitudinally of said casing.

In testimony whereof I affix my signature in presence of two witnesses.

GRANT I. RAWSON.

Witnesses:

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