J. H. REINEKE.

DEVICE FOR IGNITING FUSES.

APPLICATION FILED DEC. 8, 1914.

1,133,183.

Patented Mar. 23, 1915.

Fig. 1.

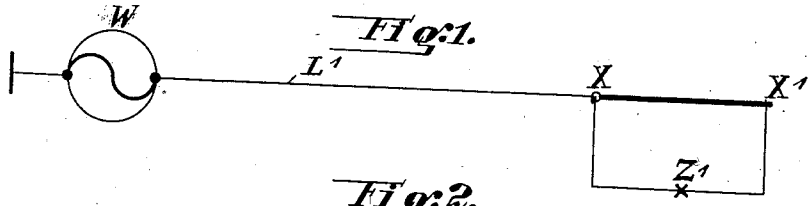


Fig. 2.

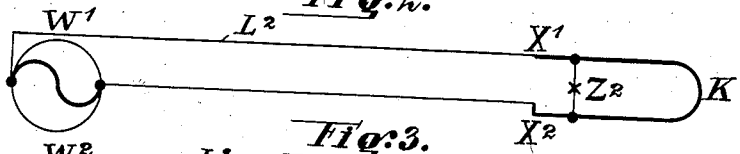


Fig. 3.

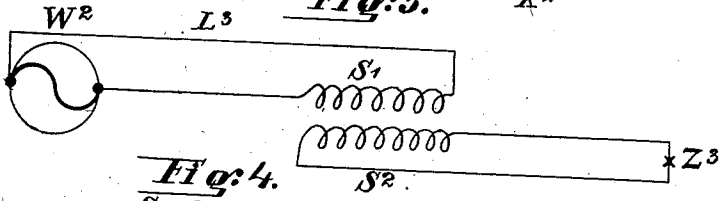


Fig. 4.

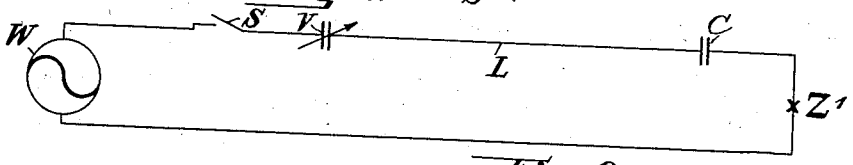


Fig. 6.

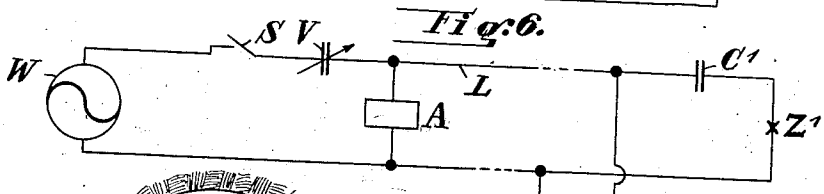
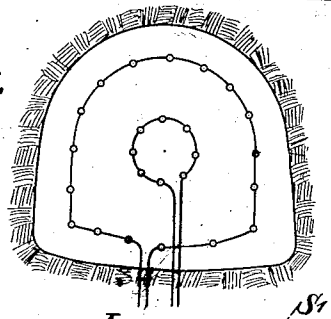


Fig. 5.



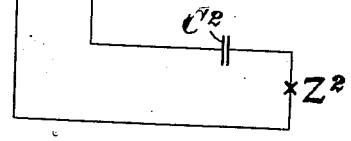


Fig. 7.

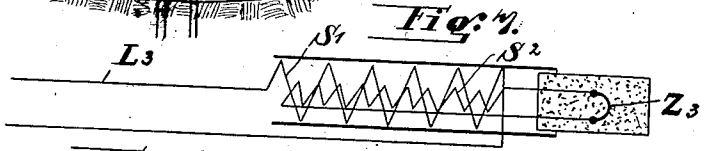
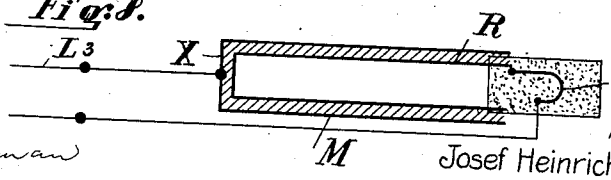


Fig. 8.



WITNESSES:

Chas. K. Leibman

P. J. Kolhaus

INVENTOR

Josef Heinrich Reineke

BY Munn & Co.

ATTORNEYS

UNITED STATES PATENT OFFICE.

JOSEF HEINRICH REINEKE, OF WEITMAR, NEAR BOCHUM, GERMANY.

DEVICE FOR IGNITING FUSES.

1,133,183. Specification of Letters Patent. Patented Mar. 23, 1915.

Application filed December 8, 1914. Serial No. 876,171.

To all whom it may concern:

Be it known that I, JOSEF HEINRICH REINEKE, a subject of the King of Prussia, residing at Weitmar, near Bochum, in the Kingdom of Prussia and German Empire, have invented a new and useful Improved Device for Igniting Fuses, of which the following is a specification.

In mining and other similar works explosive charges are at the present time almost exclusively fired by electric means, because it was considered that, compared with other fuses, the electric ignition affords much greater security against unintentional firing. In the course of time however it has been found that, even in the case of electric ignition, the charges are sometimes fired unintentionally and with more or less serious results. These accidents are due to the fact that in the pipes, rails, etc., provided in mines stray currents acquire such an intensity that they cause fuses on which they act to become incandescent. This is a consequence of the peculiar electric conditions existing in mines which are quite different from those on the surface of the earth, as, for example, is explained in the journal "*Der Bergbau*" 1903, page 565, etc. The danger is all the greater because the conductor leading from the source of electricity to the fuse has, as a rule, a length of 100–200 m., and this conductor, in accordance with its temporary use, is laid with but little care. By the present invention this unintentional response of the fuses is avoided by using alternating currents of high frequency for igniting the fuses and by connecting the fuses to the conductor in such a manner that continuous electric currents or alternating currents of ordinary frequency, which may enter the conductor, are not able to ignite the fuse, as this can only be effected with the assistance of a particular kind of current. It is advisable although not imperative, to increase the frequency to such an extent that electric waves are produced.

As shown in the drawing the invention can be carried out in various ways.

Figure 1 shows the connection of the fuse with the source of electricity by a single conductor. Fig. 2 the connection of the fuse to the source of electricity by two conductors, Fig. 3 the arrangement of the fuse in a special circuit which is excited by induction. Fig. 4 the arrangement of a condenser in the circuit containing the fuse. Figs. 5 and 6 illustrate the way in which two different fuse-circuits are arranged and connected in regard to each other. Fig. 7 represents a fuse in combination with two induction coils, and Fig. 8 a fuse combined with a condenser.

In Fig. 1 W is the source of the alternating currents of the desired high frequency, to which is connected the single conductor L_1, which operates as a linear oscillator. The points X, X_1 for connecting the fuse Z_1 are so chosen that between the same there is a sufficient potential, for which purpose one point is preferably at the top of a convex curve and the other point is at the bottom of a concave curve of a diagram representing the vibrations. This manner of connecting electric receivers to a single conductor is known of itself. With such an arrangement the fuse can be ignited by the source W, while, owing to the use of a single conductor, other electric currents can have no effect on the fuse Z_1, so that there is no danger of this fuse being unintentionally ignited.

In the arrangement shown in Fig. 2 the points of connection X, X_2 of the fuse Z_2 are bridged over by a conductor K of such small resistance that a continuous current and alternating currents of ordinary frequence can have no effect on the fuse, while an igniting current of sufficiently high frequence, when the bridging piece is properly adjusted to produce as high a potential as possible, will at once ignite said fuse.

According to the arrangement shown in Fig. 3 the fuse is not connected by tangible means with the conductor L_3, but said fuse is ignited by induction between the two coils S_1, S_2 having but few windings, these coils being so dimensioned that ordinary electric currents cannot produce any effective induction. It is indifferent whether the induction coils S_1, S_2 are flat or cylindrical.

In the devices above described it is necessary to adjust the connection of the fuse to the conductor leading to the source of electricity. This can be easily effected, but in practice difficulties occur, because the conductor necessarily varies in length. By providing induction coils or condensers or corresponding devices an adjustment can indeed be effected, but this adjustment can not be left to an ordinary workman, because some skill is needed. These difficulties can

be overcome by using an adjustable induction coil, condenser, or the like, so that the ignition is not immediately effected by closing the circuit, but by the adjustment of said device. In other words, after the circuit has been closed, the device (for example condenser) is adjusted until the ignition takes place.

In Fig. 4 a suitable arrangement of this kind is shown by way of example.

The fuse Z_1 is connected with the assistance of a condenser C to the conductor L, which leads to the source of electricity W. In the conductor L the switch S and adjustable condenser V is provided. As soon as the conductor is properly laid the circuit is closed by moving the switch S, whereupon the condenser V is adjusted until a position is reached in which the ignition can take place. With the assistance of this device a further advantage is obtained in connection with the firing of several groups of fuses in series. For example, in carrying out a cross cut, it is often necessary to ignite two groups of fuses one after the other. In such a case a number of holes are first bored in the middle of the cross section to be treated, in order that a core may be blown out, so that the second group of fuses near to the edge of the cross section can be more efficient toward the center. Heretofore it was usual to ignite the first group of fuses and then, after a certain interval which is necessary owing to the dangerous after-damp, to allow the second group of fuses to follow. This interval causes an undesirable delay. It has not been found of advantage to use two special igniting conductors, because they occasion considerably more work.

According to the invention two or more groups of fuses can be ignited one after the other the other by differently adjusting the separate groups and connecting them to the same conductor. If now the condenser V is adjusted the group will be first ignited which first accords with the position taken by the condenser, while on further adjusting the condenser, which can be done at any interval desired, the second group will follow. The connections suitable for this purpose are shown in Fig. 6. The group of fuses Z_1 and condenser C_1 are connected to the conductor L, while the group Z_2 and condenser C_2 are connected to the same conductor. If now, as explained above, after closing the switch S, the condenser V is adjusted, the condensers C_1, C_2 will come into concordance with V one after the other, so that the fuses will be ignited in the desired order. The different kinds of fuses can, for example, be colored in such a way that they can be easily distinguished from each other. In this connection it is of special advantage to provide means showing when concordance is obtained and for this purpose a suitable device A may be arranged in the conductor L, said device consisting, for example, of wires which become incandescent when the particular concordance is obtained.

It will be clear that the induction coil, condenser or other device used must be arranged as near to the fuse as possible, so that the phenomena to be avoided can not occur between said device and the fuse. For this purpose the tube of the fuse can contain the condenser, induction coil or other corresponding part, so that no conductor is required between these parts. This combination is shown in Fig. 7 by way of example, two coils S_1 and S_2 being arranged one in the other, the one S_1 being connected to the conductor L_3, while the other S_2 is connected to the fuse Z_3. The said coils are contained in the tube of the fuse. A fuse of this kind is manipulated in the manner explained above for other constructions, as the projecting ends of the coil S_1 have only to be connected with the conductor L_3.

The construction shown in Fig. 8 shows the combination of a fuse with a condenser, an outer metal layer, for example, a brass tube M, and an inner metal layer in the form of a tube R being provided. The fuse embedded in the igniting material Z_3 is connected direct with the inner metal layer R, while, on the other side it is connected with one pole of the conductor L_3, the other pole of said conductor being connected with the outer layer M or vice versa. Ordinary technical currents are not able to bridge the insulating layer H between M and R, but as soon as a current of suitable frequency is caused to act the fuse is ignited. By thus combining the fuse with a coil, condenser or other suitable device a further advantage is obtained. With ordinary fuses it is necessary to first connect the fuse with the induction coil, condenser, or the like, which later then has to be fastened to the conductor leading to the source of electricity. As now the firing of the fuses is done by unskilled labor, there is danger of the adjusting device not being suitably connected, in which case the fuse will not be properly ignited. In the present case in which the adjusting device is combined with the fuse it is quite impossible for mistakes to occur. The workman has only to connect the fuse to the conductor in exactly the same manner as any other fuse. Uninsulated wires can be used as conductors in some cases.

The following circumstance also renders the invention of great importance: It is mostly necessary to fire several fuses simultaneously, and, as is well known, failures to ignite the fuses often occur. In making the fuses it is practically impossible to give them all exactly the same degree of resistance, and, although the fuses are sorted as

far as possible according to their resistance, it sometimes occurs that, when the fuses are connected in series, one or the other responds too early, so that the circuit is interrupted and the remaining fuses cannot ignite. This drawback is overcome according to the present invention. If, for example, the induction coils belonging to the various fuses are connected in the manner shown in Fig. 3, this circuit is firstly entirely independent of the different resistances of the fuses and remains uninfluenced on firing. Even when one or the other of the fuses responds before the others the ignition of the entire fuses will still take place. The invention has also another advantage, inasmuch as the workmen are compelled to properly lay the conductor in its full length. According to the rules the fuses must be ignited a certain distance away. The miners are however often too negligent to unwind the conductor to the full extent, but fire the fuse from a much nearer and therefore more dangerous point. If this were attempted when working according to the present invention the unwound part of the coil would occasion such a strong self induction that the current would be too weak to ignite the fuse. The conductor must therefore be unwound to the full extent in accordance with the rules.

What I claim and desire to secure by Letters Patent of the United States is:

1. The described device for igniting electric fuses which comprises in combination, a source of electricity of high frequency, a conductor connecting said source with the fuses, and means to prevent continuous currents or alternating currents of ordinary frequency from acting on said fuses, substantially as, and for the purpose, set forth.

2. The described device for igniting electric fuses comprising in combination, a source of electricity of high frequency, a conductor connecting said source with the fuses, means to prevent continuous currents or alternating currents of ordinary frequency from acting on said fuses, and a device to regulate the intensity of the current passing through said conductor, substantially as, and for the purpose, set forth.

3. The described device for igniting electric fuses comprising in combination, fuses adapted to be ignited by electric currents of different strengths, a source of electricity of high frequency, a conductor connecting said source with the fuses, means to prevent continuous currents or alternating currents of ordinary frequency from acting on said fuses, a second conductor connecting each of said means with the source of electricity and said fuses, and an adjustable condenser in said second conductor, substantially as, and for the purpose, set forth.

4. The described device for igniting electric fuses comprising in combination, fuses adapted to be ignited by electric currents of different strengths, a source of electricity of high frequency, a conductor connecting said source with the fuses, means to prevent continuous currents or alternating currents of ordinary frequency from acting on said fuses, a second conductor connecting each of said means with the source of electricity and said fuses, a device to regulate the intensity of the current passing through said conductors, and an indicator in the electric circuit formed by said conductors, substantially as, and for the purpose, set forth.

5. The described device comprising in combination, a tube, a fuse within said tube, an induction device comprising a pair of coils disposed within said tube, one of said coils being connected with said fuse, substantially as, and for the purpose, set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSEF HEINRICH REINEKE. [L. S.]

Witnesses:
HELEN NUFER,
CLARICE EAGER.