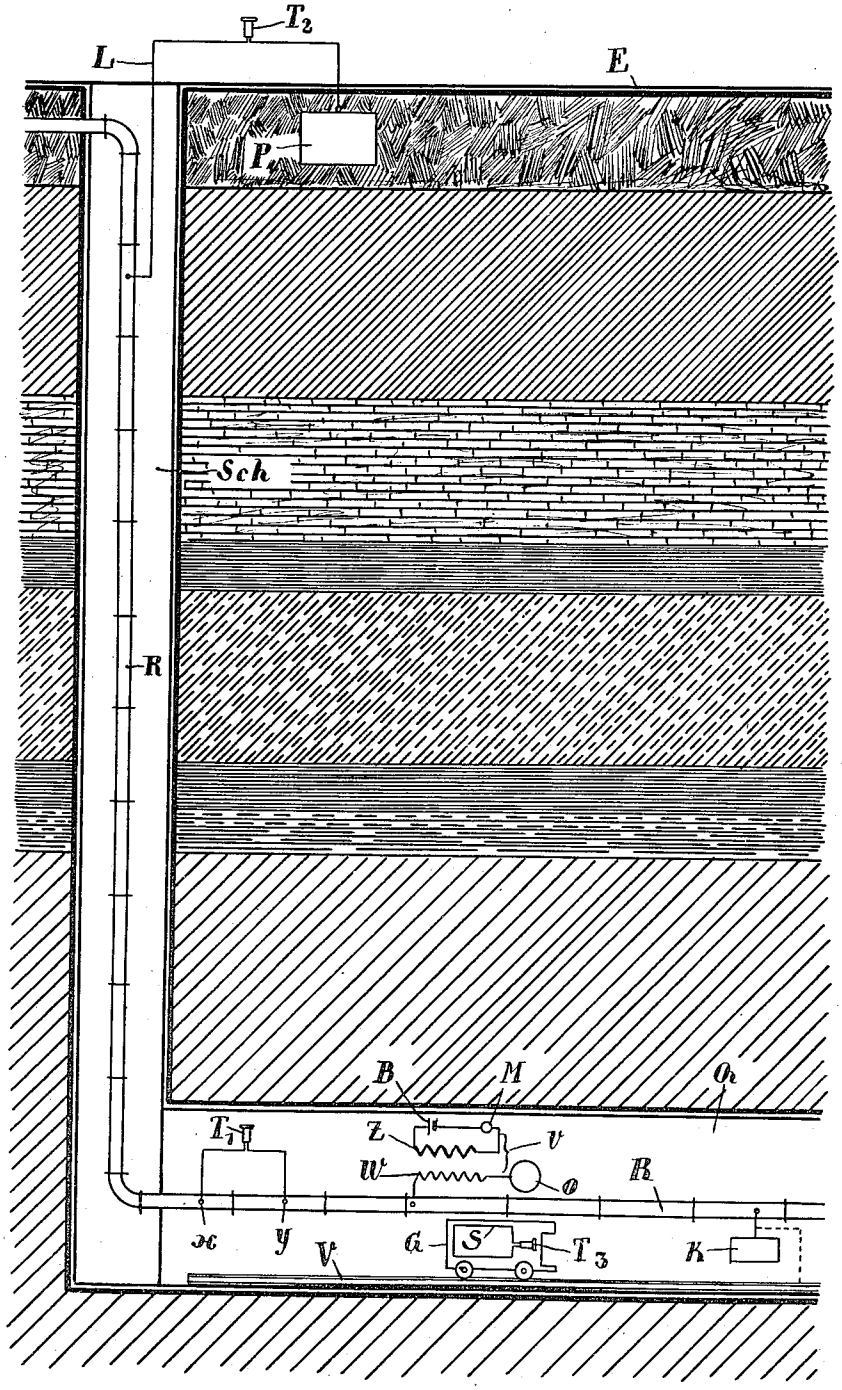
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APPARATUS FOR THE ELECTRIC TRANSMISSION OF SIGNS OR SPEECH IN MINES.

APPLICATION FILED JULY 16, 1912.

**1,175,082.** Patented Mar. 14, 1916.




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# UNITED STATES PATENT OFFICE.

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## APPARATUS FOR THE ELECTRIC TRANSMISSION OF SIGNS OR SPEECH IN MINES.

1,175,082. Specification of Letters Patent. Patented Mar. 14, 1916.

Application filed July 16, 1912. Serial No. 709,660.

*To all whom it may concern:*

Be it known that I, JOSEF HEINRICH REINEKE, engineer, residing at Graf-Engelbert strasse 33, Bochum, in Westphalia, Germany, have invented certain new and useful Improvements in Apparatus for the Electric Transmission of Signs or Speech in Mines, of which the following is a specification.

The object of this invention is to provide improved means for the electric transmission of graphic acoustic signals or speech in mines, whereby telephonic and telegraphic communications between under-ground localities and between such localities and the surface are facilitated.

The invention essentially consists in utilizing, as electric conductors between the receiving and the transmitting stations, the existing metallic connecting systems such as rails, pipes, haulage cables, and the like, with the aid of electrostatically chargeable conductors connected to the terminals of such systems.

The tendency of electric charges of adequate potential to flow into conductors of large superficial area, selecting the paths of least resistance, renders it practicable to utilize for this purpose uninsulated or poorly insulated conductors, even if gaps occur therein, as in the case of rails, pipes and the like. The static charge is produced at the transmitting station, and is instantly perceptible at the receiving station. To prevent rapid saturation of the "line", large conductors are used. The connection between the transmitting station and the conductors, though possibly imperfect, directs the flow of electricity so that signals can be received in a regular manner at different parts of the system. The special electrical conditions obtaining in mines are in this connection important, in that the bed-rock is, as a conductor, much inferior to the surface soil. This not only affords a kind of natural insulation, but establishes a difference of conditions between the surface and the interior of the mine. The surface soil, the normal electrical state of which is disturbed by the working of the system, is not required to furnish a connection between the transmitting and receiving stations, but is used as a condenser of practically infinite capacity. The charge imparted to the surface soil is taken up so rapidly, that a continuous current can be obtained. In the mine, an artificial condenser of wire fabric may be used, or part of the pipe system or the like not used as line conductor may furnish the condenser. The method of working, as indicated, allows of using a very simple form of transmitter. Irrespective whether continuous circuit or alternating current is employed, the transmitter may be an instrument having a primary circuit containing the microphone and battery, the secondary coil being connected at one end only to line. The rapid variations occurring in speech acting on the transmitter, produce oscillations in the secondary coil, which, in conjunction with the high potential of the charge, produce oscillations of the ether. The line and the secondary coil thus form a linear oscillator, which may have a gap or gaps without detriment to the transmission. The form and amount of energy required for the transmission of graphic or acoustic signals are in general practically the same as in ordinary telegraphic and telephonic practice.

By reason of the fact that the current in the imperfect, and possibly interrupted, conductor has a definite value and direction, whereas the potential varies at different points, messages can be taken from the conductor by electrically bridging two points in series, between which there is an adequate potential difference and connecting a telephonic or telegraphic instrument to the connecting wire.

The fact that the oscillations produced by the current fluctuations generate fluctuating induction, lines may be utilized by using a receiver which comprises antennæ or an electric resonator whereby the oscillations are transmitted to a telephonic or other instrument. This is more particularly of advantage if the line is formed by a moving conductor, for example a haulage rope, or if the receiving station is moving, as for example on a tram; it is also convenient if the receiving station requires to be shifted with facility, as for example at the working face of the mine.

One form of apparatus for carrying the improved method into effect is diagrammatically illustrated in the accompanying

drawing, which is an ideal vertical section of the mine.

In this example the pipe R leading from the gallery Q through the shaft Sch to the surface soil E is used as the line conductor, and is connected to one end of the secondary coil W of the transmitting station Y. The other end of this coil may be connected to a suitable electrical counterpoise, as for example the conductor O having a large surface capacity. The primary coil Z of the transmitter is connected to the microphone M and the battery B. The lower end of the pipe R is connected to a conductor K having a large surface capacity, for example a wire fabric, or, as indicated by dotted lines, to the rails V. The telephone $T_1$ is connected to the pipe R at $x$, $y$, so as to bridge a portion thereof. Another telephone $T_3$ is connected by a wire loop or antennæ S located a certain distance from the pipe R, and capable of being moved along the line, as for example by the car G.

Sound waves acting on the microphone of the telephone used as transmitter produce oscillations of high pressure and frequency in the coil W, and these are communicated by the pipe. The induction lines due to the oscillating currents act on the resonator S, to which the telephone $T_3$ is connected. It does not matter if there is relative movement between the line and the resonator S, because the velocity of such movement is of course so small, compared with the velocity of the electric oscillations, that it can produce no perceptible interference. Accordingly the haulage cable of the cage may be used instead of a stationary pipe, the telephone $T_2$ at the surface being in that case also served by means of antennæ or a resonator.

Another method of serving the telephone $T_2$ at the surface consists in joining a good conductor L to the pipe R, below the upper end of the latter, that is to say in the shaft, and connecting this conductor L in series to the telephone $T_2$ and to a plate P embedded in the soil. In this case an adequate branch current goes through the circuit L to earth, and operates the telephone.

Many other modifications can of course be made, without departing from the principle of the invention.

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

1. In the electric transmission of signs in subterranean mines, the combination of the conventional conductive metal construction in mine service with electrostatically chargeable conductors having large surface capacities and with sign transmitting and sign receiving means.

2. In the electric transmission of signs in subterranean mines, the combination of the conventional conductive metal construction in mine service with means for connecting such construction near one terminal thereof with the surface soil which constitutes an electrostatically chargeable conductor having a large surface capacity.

3. In the electric transmission of signs in subterranean mines, the combination of the conventional conductive metal construction in mine service with means for connecting such construction near one terminal thereof with the surface soil which constitutes an electrostatically chargeable conductor having a large surface capacity and with an electrostatically chargeable conductor having a large surface capacity and located within the mine.

4. In the electric transmission of signs in subterranean mines, the combination of the conventional conductive metal construction in mine service with electrostatically chargeable conductors having large surface capacities, and with a transmitting station comprising a primary coil, a microphone and a current generator in circuit with said primary coil, and a secondary coil connected to the conductive metal construction.

5. In the electric transmission of signs in subterranean mines, the combination of the conventional conductive metal construction in mine service with electrostatically chargeable conductors having large surface capacities, and with a transmitting station comprising a primary coil, a mircophone and a current generator in circuit with said primary coil, a secondary coil, an additional electrostatically chargeable conductor having a large surface capacity, and means for respectively connecting the ends of said secondary coil to the conductive metal construction and to said additional electrostatically chargeable conductor.

6. In the electric transmission of signs in subterranean mines, the combination of the conventional conductive metal construction in mine service with electrostatically chargeable conductors having large surface capacities, and with a receiving station comprising a telephone, and means for connecting said telephone to said conductive metal construction.

7. In the electric transmission of signs in subterranean mines, the combination of the conventional conductive metal construction in mine service with electrostatically chargeable conductors having large surface capacities, and with a receiving station comprising a telephone, and means for connecting said telephone in parallel to a section of said conductive metal construction.

8. In the electric transmission of signs in subterranean mines, the combination of the conventional conductive metal construction in mine service with electrostatically chargeable conductors having large surface capaci-

ties, a transmitting station composed of a primary coil, a microphone and a current generator in circuit with said primary coil, and of a secondary coil connected to the conductive metal construction, and a receiving station composed of a telephone and means for connecting said telephone in parallel to a section of said conductive metal construction.

9. In the electric transmission of signs in subterranean mines, the combination of the conventional conductive metal construction in mine service with an electrostatically chargeable first conductor embedded within the surface soil, an electrostatically chargeable second conductor located within the mine and having a large surface capacity, means for respectively connecting the ends of said conductive metal construction to said first and second conductors, a transmitting station comprising a primary coil, a microphone and a current generator in circuit with said primary coil, and a secondary coil connected to the conductive metal construction, and a receiving station comprising a telephone, and means for connecting said telephone in parallel to a section of said conductive metal construction.

10. In the electric transmission of signs in subterranean mines, the combination of the conventional metal structures in mine service that extend along the mine-excavations, with means for electrostatically charging said structures, and with means for rendering said charging perceptible at a point distant from the charging point.

11. In the electric transmission of signs in subterranean mines, the combination of the conventional metal structures in mine service that extend along the mine-excavations, whereby the rock-formations lining said excavations constitute an insulator for said structure, with means for electrostatically charging said structures, and with means for rendering said charging perceptible at a point distant from the charging point.

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