Aug. 25, 1925.

1,551,220

F. E. SCHEFFLER

SIGNALING ARRANGEMENT

Filed March 6, 1923

2 Sheets-Sheet 1

Fig. 1.

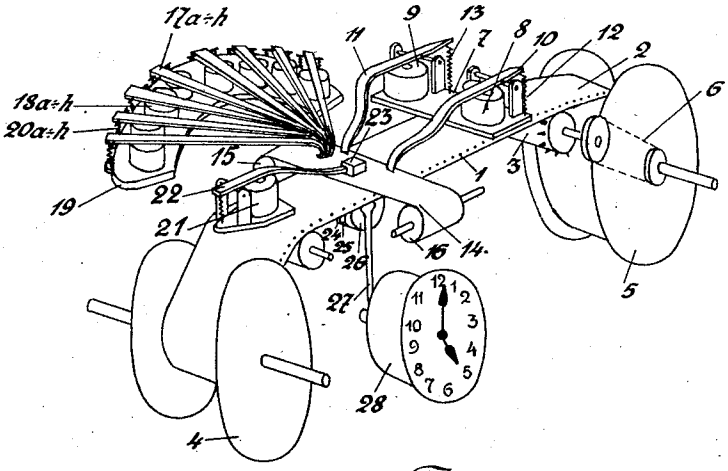
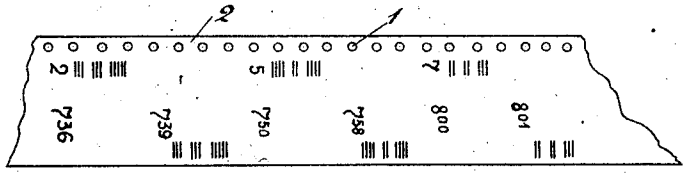


Fig. 2.



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2 Sheets-Sheet 2

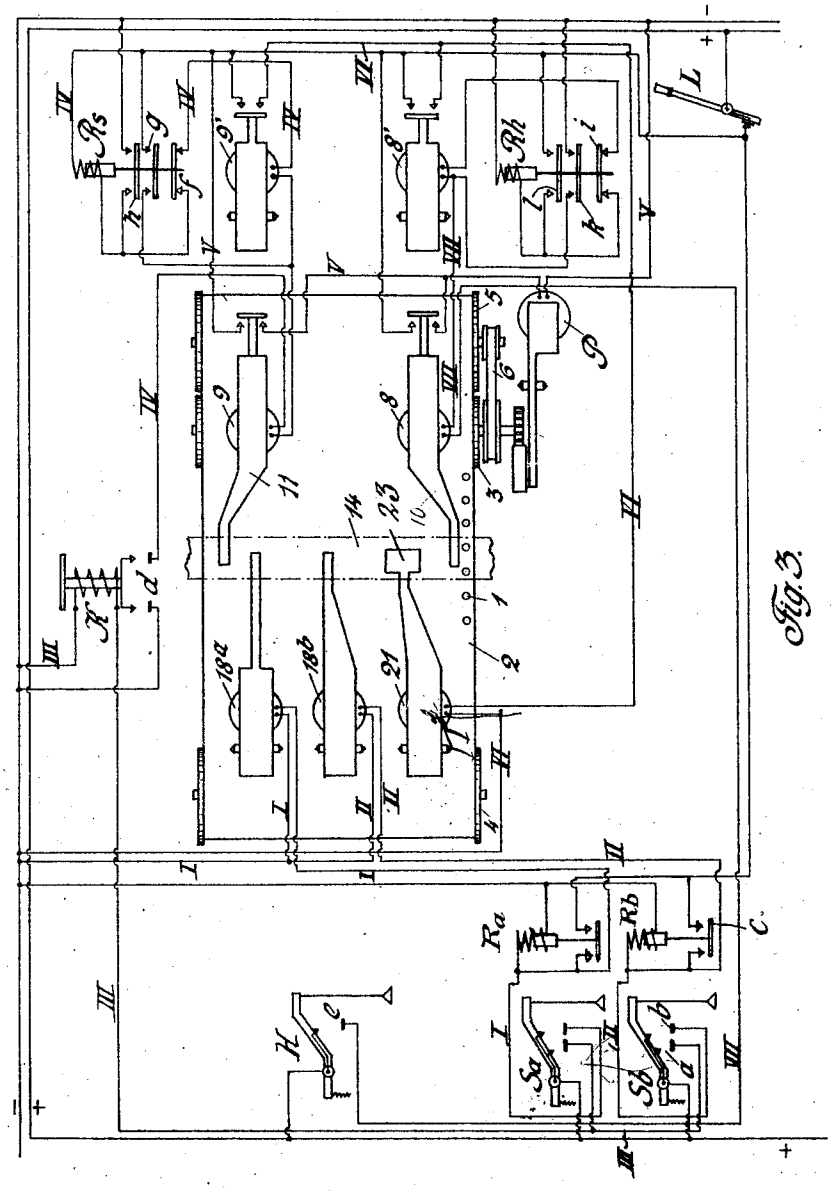


Fig 3.

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UNITED STATES PATENT OFFICE.

FRITZ EDUARD SCHEFFLER, OF KIEL, GERMANY.

SIGNALING ARRANGEMENT.

Application filed March 6, 1923. Serial No. 623,250.

To all whom it may concern:

Be it known that I, FRITZ EDUARD SCHEFFLER, engineer, citizen of the German Republic, and residing at Kiel, county of Schleswig-Holstein, and State of Prussia, Germany, have invented certain new and useful Improvements in Signaling Arrangements, of which the following is a specification.

This invention relates to an arrangement for recording and checking electrical signals and more particularly mine signals at a distance from the point at which they are ordinarily received.

In mining operations usually a vertical shaft is driven down from which then horizontal passages are driven at different levels, which are commonly called "levels". For the mining operations then the shaft is utilized as a passageway for the miners and the material, and for this purpose a so-called "bank" is built above the shaft which carries the sheaves over which the hoisting rope passes. As is further customary the hoisting engine stands laterally of the bank so that, owing to this necessary arrangement, it is impossible for the hoisting engineer to observe the hoisting operations themselves. In operating the hoisting engine he must thus rely solely upon signals which are given to him from the different levels. In the course of develepment of the mining art, it has become customary to give mining signals in such a way that the hoisting engineer receives his orders only from the man on the bank who surveys the hoisting operations and is called the "banks man", whereas the signals from the different levels are only sent to the "banks man", who then transmits the signal to the hoisting engineer. The signals usually consist of one or several electrically transmitted bell signals forming a code which then is transmitted through the banks man to the engineer.

It has recently been found in mines that it is desirable to record not only the signals sent from the levels or the banks man to the hoisting engine driver and relating to the speed curve of the hoisting rope, but also to provide for an accurate registration of the various other signals. This is important for investigations of accidents that occur during hoisting operations. It is a matter of course that these recording and checking operations should be made as independent as possible of all other ordinary operations and that the checking apparatus should be such as to be immune from unauthorized acts.

The object of the invention is to provide apparatus of this kind and this is accomplished by arranging each signal sent from a level and the corresponding signal sent from the bank to be recorded opposite to each other on a recording tape located at some remote point. In addition to the level and bank signals the time at which each signal is given is also automatically printed on the tape.

I am aware that signaling apparatus with a recording tape are already known. But these apparatus are only arranged to make the signal from the level to the engine house visible, while the object of the present invention is to provide a checking apparatus adapted to be used as an auxiliary to the ordinary apparatus for audible and visible signals. If desired a plurality of such checking apparatus could be employed. My apparatus also differs in that the known recording tapes do not have the level from which the signal is given marked upon them, nor does any marking of the time at which the signal is given take place, and above all it is to be noted that with the known recording devices it is exceedingly difficult to distinguish between the various signals. Another point of distinction is that the known recording tapes are arranged to have the signals recorded in the form of perforations in accordance with the special purposes that these apparatus are designed to fulfill.

In distinction herefrom in the apparatus according to the invention the signals are printed on the tape. The electrical signaling impulses operate electromagnets whose armatures are arranged to act as printing levers which, with the aid of an inking ribbon, produce strokes or dashes on the tape in groups that correspond to the various signals. The feed motion of the recording tape may be produced automatically through the signaling impulses. Special electromagnets are provided for printing on the tape the number of the level from which the signal is given. Finally a system of type-wheels associated with a clockwork is

provided and an electromagnet strikes the inking ribbon against a typewheel at the moment any signal is given so as to impress upon the tape the time of the day and, if desired, also the date.

The invention is shown in the drawing in which—

Fig. 1 is a perspective view of the novel device.

Fig. 2 is a strip or tape showing records which result from the operation of the device and

Fig. 3 is a diagram of circuits that illustrate the switching operations of the device.

Referring to Figs. 1 and 2 of the drawing, 2 is a recording tape with perforations near its edge 1 with which a feed roll 3 engages for the purpose of unwinding the tape from a reel 4 and onto a reel 5. In order to keep the tape taut the reel 5 is rotated by the shaft of the roll 3 by means of an elastic cord 6 which is adapted to slip on the driving pulley of the reel 5. Rotary motion is imparted to the roll 3 in the manner described hereinafter in detail in connection with Fig. 3. After each signaling impulse the tape 2 is stepped forward by means of an electromagnet P, (Fig. 3) and the extent to which it is fed forward reaches a certain maximum when the duration between two signaling impulses exceeds a certain limit. The purpose of this arrangement is to enable corresponding code signs to be obtained independently of the differences of time in the giving of the signals.

Arranged above the tape 2 on a common base plate 7 are two electromagnets 8 and 9 whose armatures are shaped in the form of two printing levers 10 and 11 each having a short arm acted upon by springs 12 and 13 respectively, and whose long arms carry types at their free ends which are adapted to print a stroke at their respective edges of the tape 2 whenever they are attracted by the magnets 8 and 9 respectively. The strokes thus printed extend transversely to the length of the tape.

The printing levers 10 and 11 cooperate with a coloring or inking ribbon 14 which travels across the tape 2 over two rollers 15, 16, this motion being imparted to the ribbon 14 in any suitable manner.

Arranged in front of the lever 11 above the inking ribbon 14 are the free ends of eight further two-armed armature levers 17^{a-h} whose corresponding electromagnets 18^{a-h} are arranged upon a curved base plate 19. The levers 17 are normally raised from the inking ribbon 14 by means of springs attached to the base plate 19. The electromagnets 18^{a-h} correspond to the various levels in the shaft of the mine and the ends of the levers above the ribbon 14 carry types which print the Figures 1–8 which identify the various levels.

Also arranged above the recording tape 2 is an electromagnet 21 whose armature 22 is combined with a two-armed lever that carries a striker or printing block 23 at its free end. When the electromagnet is energized the block 23 is caused to strike the inking ribbon 14 and to thus press it down sharply against the recording tape 2 and a typewheel system 24, 25, 26 that is kept moving by means of a transmission shaft 27 driven by clockwork 28. This type-wheel system 24, 25, 26 impresses the day, hour and minute on the recording tape 2 when the electromagnet 21 is energized.

The section of tape shown in Fig. 2 has a train of signals recorded upon it. On the upper half of the tape there is a numeral next to each signal, these numbered signals being such as are given from the levels, while the unnumbered signals on the lower half of the tape are the ones that are given by the banksman. All of the recorded signals shown were given on a Tuesday between 7^{36} and 8^{01} and corresponding marks are printed at the middle of the tape.

In Figure 3 the invention is shown in connection with a commonly used signaling method for mine hoists. In order to simplify the drawing only two levels are assumed from which signals are sent and received. The recording device may be located at any suitable place, for instance in the office of the mine superintendent. The bank is denoted with H, and the bank key by which signals are transmitted to the hoisting engineer is denoted with *e*. The keys at the different levels are indicated with *Sa* and *Sb* respectively. By the latter two signal devices the signals are transmitted to the bank. According to the present invention it is intended to record on the tape the following three occurrences:

(1) The origin of the signals.
(2) The character of the signal itself.
(3) The time of the signal reception.

As a fourth operation it is necessary to advance the recording tape after each signal impulse.

The hoisting operation occurs in the manner that for instance for hoisting from a level to the bank the signal is given from the level to the bank, thence it is forwarded to the engine room. For clearness sake the aural alarm signal apparatus which is provided for the transmittion of the signals has been omitted in the drawings.

For explaining the operation of the arrangement shown in the drawings a signaling operation is assumed and functions are described which occur in the circuit arrangement if a signal is given which consists for instance of two current impulses.

First of all the signal, which for instance may be given from the lower level, is given by twice pulling the level key *Sb*. Thereby

the contact *a* which is located near the pivotal point of the key closes a circuit which runs over the supply line designated with + by way of contact *a* and relay K to the minus side of the supply system. Thus relay K closes the switch *d* whereby the relays 9, 9′ and R*s* are connected in series to the supply line by way of a lever L which bears a suitable contact as shown. Thus by means of the energized relay 9 a single character, for instance a dot or dash, is imprinted on the recording paper strip 2 by means of the colored ribbon 14. When this occurs the relay 9 simultaneously closes a contact provided on its armature and thereby a current impulse is sent over the relay coil P. This latter relay attracts an armature which engages, by means of a pawl, a ratchet wheel connected with the feeding device for the paper strip, the pawl being arranged in such manner that when the armature of relay P moves, the pawl is withdrawn the distance of one tooth of the ratchet wheel and the ratchet wheel is operated only after the armature has been released by relay P.

By means of relay 9′ a contact, provided at its armature, is closed and thereby relay 21 is thrown into circuit. The end of the armature of this latter relay carries a hammer which throws the paper strip on which a colored ribbon is provided against a time stamp which is permanently operated by means of a clockwork. Thus this relay imprints the time of the signal receipt. However, relay 9′ is energized only for a moment, because its circuit is closed over contact *f*. This contact *f* is interrupted by the slightly retarded relay R*s* immediately after relay 9′ has responded. Simultaneously relay R*s* closes the two contacts *h* and *g*. Now a circuit is established for the exciter current for relay R*s* from the minus side of the supply line over contact *h*, relay R*s* contact at lever L to the plus side. By means of contact *g* relay 9 is connected to the plus side of the system by way of the contact at lever L.

The above described operations occur within only a fraction of a second. Thus shortly after contact *a* at the level key S*b* is closed the condition of the entire system would be as follows:

Relay K maintains contact *d* closed. By this contact relay coil 9 is connected to the supply line and this coil maintains the contact connected with its armature closed. By way of this contact relay coil P is connected with the supply line. Relay R*s* is connected to the supply line by way of the contact on lever L. Relay 9′ is disconnected. For a moment the printer of relay 9 rests on the paper strip. The armature of relay 21 has already returned into its rest position after it has imprinted the time of the signal.

The occurrences which are brought about by closing contact *b* at the level key S*b*, are independent of the just described occurrences and will, therefore, be discussed later.

If the signal man at the level releases the level key S*b*, after he has given it a short pull, it is returned into the open position shown by means of the spring, and contact *a* is opened. This causes the deenergization of relay K. This in turn causes opening of contact *d* so that thereby the energizing circuit for relay 9 is interrupted. Thus the armature of relay 9 returns into its normal open position and thereby opens the contact connected with its armature, this in turn causes deenergization of relay P whose armature then also returns into its open position. This motion of the armature of relay P causes the feeding wheel for the paper strip to make one feeding stroke by means of the pawl connected with the armature and thus the paper strip is fed forward. Only relay R*s* does not return into its resting position. Thus so far records have been made on the paper strip in the form of a signal dash and the time of receipt of the signal. Now if the signal man by pulling the level key S*b* with a short pull the second time, contact *a* again closes the energizing circuit for relay K. This again closes contact *d*, relay 9 is thus again energized and its armature imprints a second signal dash on the paper strip. Simultaneously the contact on relay 9 is again closed and thus relay P is energized. This latter relay attracts its armature, the feeding pawl connected with that armature passes the distance of one tooth over the ratchet wheel (i. e. it makes its idle stroke) so that when the armature of relay P returns into the off position the ratchet wheel is fed forward another tooth and the paper strip is fed forward accordingly. Upon release of the level key S*b* its contact *a* is again opened and thereby relay K deenergized. Thereby its contact is opened which in turn causes deenergization of relay 9 which opens the contact controlled by it and thereby causes the deenergization of relay P. Thus the armature of the latter in returning into its off position as just described performs the feeding stroke for the paper feed. For each subsequent signal of the same character repeated the same functions just described are repeated. It will be noted that relay 21 thus comes into action only at the first of a number of similar signal impulses, so that the time of the receipt of the signal is imprinted only once for a signal of the same character. On the other hand relays 9 and P operate for each repeated signal impulse of the same character, so that each individual signal impulse is recorded and every time the paper strip fed forward one step.

The simultaneous closing of contact *b* of level key S*b* when the latter is operated as

described before, produces effects entirely independent from the occurrences just described. When level key S*b* is pulled the first time, a circuit is closed by way of contact *b* which leads from the plus pole of the supply line by way of relay 18^b to the minus pole. The armature of relay 18^b then imprints the designation of the level, for instance in this case S*b*, on the paper strip. The armature of relay 18^b has a yielding end, and ordinarily with relay 18^b energzied it will not touch the paper strip with its end which carries the type. The imprint by this type is only made by the sudden energization of relay 18^b which impels the armature towards the paper strip so that the momentum gained by its yielding end carries the type to the paper strip and produces the imprint, whereupon the type immediately recedes from the paper and remains a slight distance away from it though the relay may remain energized. The closing of contact *b* further energizes the relay R*b*. This relay is slightly retarded in its action and, right after relay 18^b has produced the level imprint, on the paper, it closes contact *c*. When this happens relays R*b* and 18^b are directly connected to the supply line by way of contact *c*. In their energizing circuit now only the contact at lever L is located. Therefore when contact *b* is opened the energization of relays R*b* and 18^b is not effected. Likewise they remain unaffected in this energized condition if at every repeated signal from the same level contact *b* is repeatedly closed and opened.

By the operations thus far described relay 9 has imprinted the signals given, relay 18^b has imprinted on the strip the level designation and relay 21 has imprinted the time of the first signal.

Now the signal given from the level to the bank is forwarded by the banks-man to the hoisting engineer by means of the bank key H. When this key is operated contact *e* is closed. The closing of this contact the first time when the first signal from the level arrives, has the effect that simultaneously relays 8, 8′ and R*h* are connected to the supply line. Relay R*h* the same as relay R*s* operates with slightly retarded action. Consequently relay 8 responds first and thereby imprints a signal character for instance a dash on the paper strip. In addition to this it also closes the contact connected to its armature and thereby causes energization of relay P. The latter attracts this armature and thus sets the next feeding stroke for the paper strip 2 in the manner described hereinbefore. Relay 8′ is not retarded and responds immediately, closing the contact connected with its armature so that over this contact a current impulse flows from the plus side of the supply line by way of the contact of lever L and relay 21. Thus relay 21 is enabled to print the time of arrival of the first signal from the bank upon the paper strip. Now the retarded relay R*h* responds and opens contact *i* and thus deenergizes relay 8′. This causes the opening of the contact controlled by the armature of relay 8′ so that the energizing circuit for relay 21 is interrupted. When relay R*h* responds contacts K and *l* are closed. By way of contact *l* relay R*h* is now connected directly to the supply line so that in its circuit only the contact controlled by lever L is located. By way of contact *k* one terminal of relay 8 is directly connected to the minus side of the supply line whereas the other terminal of this relay is connected to the plus side of the line by way of contact *e* of the bank key H. As soon as the contact *e* is opened by releasing the key, relay 8 becomes deenergized. Its armature moves away from the paper strip and opens at the same time the contact controlled by the relay armature. By this contact, as was stated before, relay P was connected to the supply line. Thus by opening this contact this relay becomes deenergized so that now its released armature performs the paper feeding step in a manner described hereinbefore. Relay R*h* remains energized irrespective of any repetition of signals through repeated depression of bank key H. If the key H is operated the second time for giving the second signal of the same character and if thereby contact *e* is closed the second time, relay 8 is energized and by means of this relay in the manner described before the second signal of the same character is imprinted on the paper. At the same time the energized relay by means of its armature closes its armature contact and thereby again energizes the feeding relay P which, as was also described hereinbefore, sets the feeding mechanism for the next feeding step. When bank key H is now released relays 8 and P are again deenergized so that the paper is again fed forward another step. This occurrence is repeated as often as the signal from the bank is repeated.

When the transmission of signals is over the whole arrangement is in the following condition: Relay R*b* is energized and contact *c* is closed. Likewise relays 18^b R*s* and R*h* are energized.

Now the signal given from the bank to the engineer must be executed by correspondingly operating the hoisting machine. Let us assume for the present example that lever L is the brake lever of the hoisting machine. Thus in order to set the hoisting machinery in motion the engineer must release lever L and he thereby opens the contact at the lower end of the lever. As previously described this contact controls all relays still energized in this condition of the system. When lever L is released first

relay R*b* is de-energized, and returns into its normal position in which contact *c* is open. At the same time relay 18[b] is deenergized and returns to its normal position, and also the energizing circuit for relays R*s* and R*h* is opened so that also these relays return to their normal position. This returns the whole system into the condition in which it is ready to receive an entirely new signal when the engineer has again set the brake lever into the position shown after the hoisting operation is complete.

I claim:

1. In a mine signaling system between the levels, the bank and the engine room, the combination with a signal transmitter at each level, a signal receiver at the bank electrically connected with each of said level transmitters, a signal transmitter at the bank and a receiver at the hoisting engine electrically connected therewith, of a single device including a recording tape for recording thereon in a single column the signals received from all of the different levels, means for recording in said column the identity of the signaling level, means for recording on said tape the signal transmitted from the bank to the hoisting engine and means for recording on the tape the time of said signals transmitted.

2. In a mine signaling system between the levels, the bank and the engine room, the combination with a signal transmitter at each level, a signal receiver at the bank electrically connected with each of said level transmitters, a signal transmitter at the bank and a receiver at the hoisting engine electrically connected therewith, of a single device including a recording tape for recording thereon in a single column the signals received from all of the different levels, means for recording in said column the identity of the signaling level, means for recording on said tape the signal transmitted from the bank to the hoisting engine, means for recording on the tape the time of said signals transmitted, and means for causing the identification means and the time recording means to respond only once for each signal irrespective of the number of impulses of which such signal may be composed.

3. In a mine signaling system between the levels, the bank and the engine room, the combination with a signal transmitter at each level, a signal receiver at the bank electrically connected with each of said level transmitters, a signal transmitter at the bank and a receiver at the hoisting engine electrically connected therewith, of a single device including a recording tape for recording thereon in a single column the signals received from all of the different levels, means for recording in said column the identity of the signaling level, means for recording on said tape the signal transmitted from the bank to the hoisting engine, means for recording on the tape the time of said signals transmitted, and a control relay suitably connected in circuit to be energized when a signal impulse is received and adapted to immediately thereby render the level identification means unresponsive to further impulses of which a level signal identified may be composed, said control relay having suitable contact devices to also close a circuit, including its own circuit and the hoisting engine control, to permit deenergization of the control relay only when the engine control has been operated in response to the signals originally given from the level.

In testimony whereof I affix my signature.

FRITZ EDUARD SCHEFFLER.