No. 775,416. PATENTED NOV. 22, 1904.

C. G. & E. J. BURKE.

# ELECTRIC SYSTEM OF TRANSMISSION.

APPLICATION FILED DEC. 17, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1,

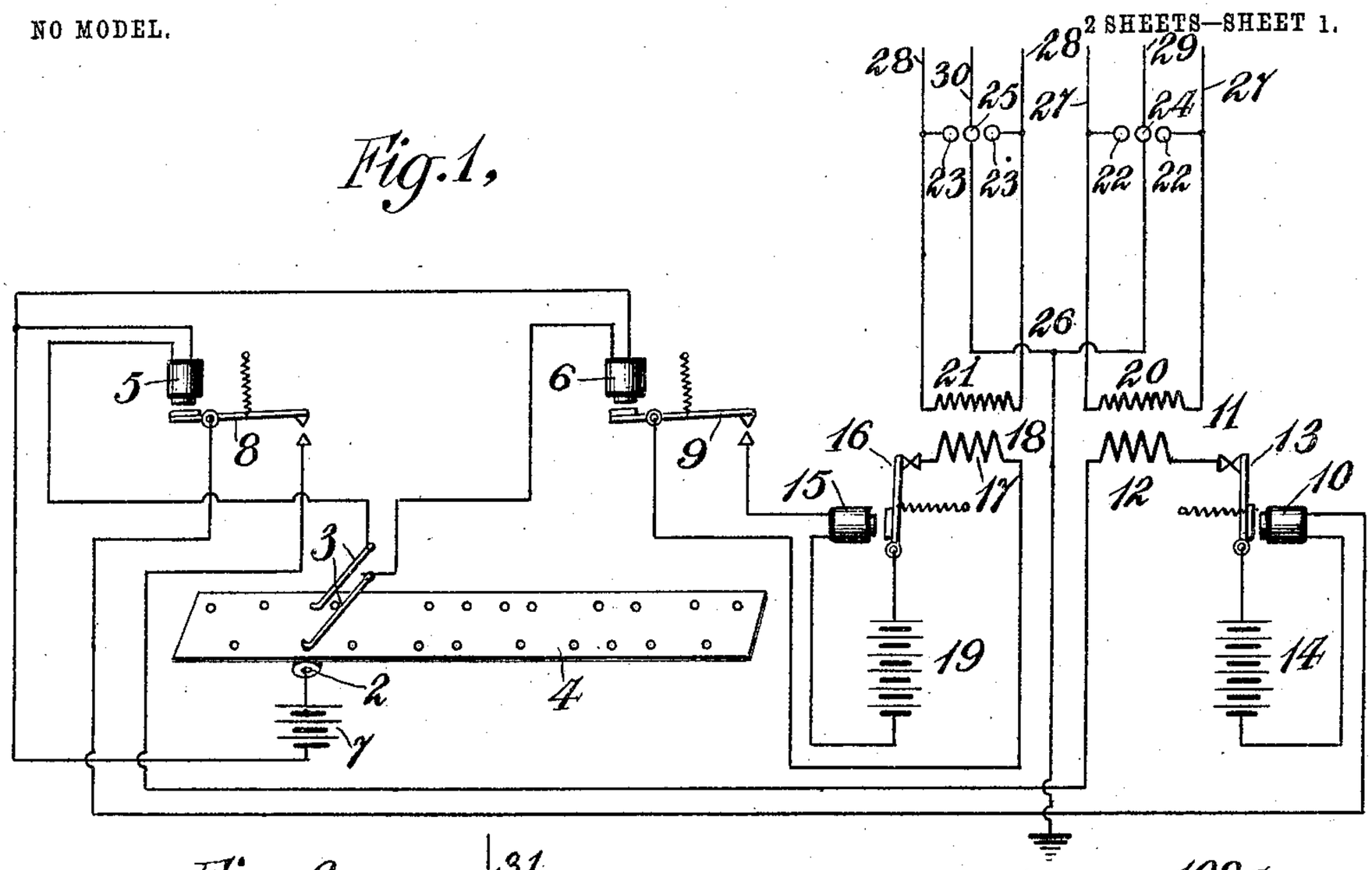


Fig. 2,

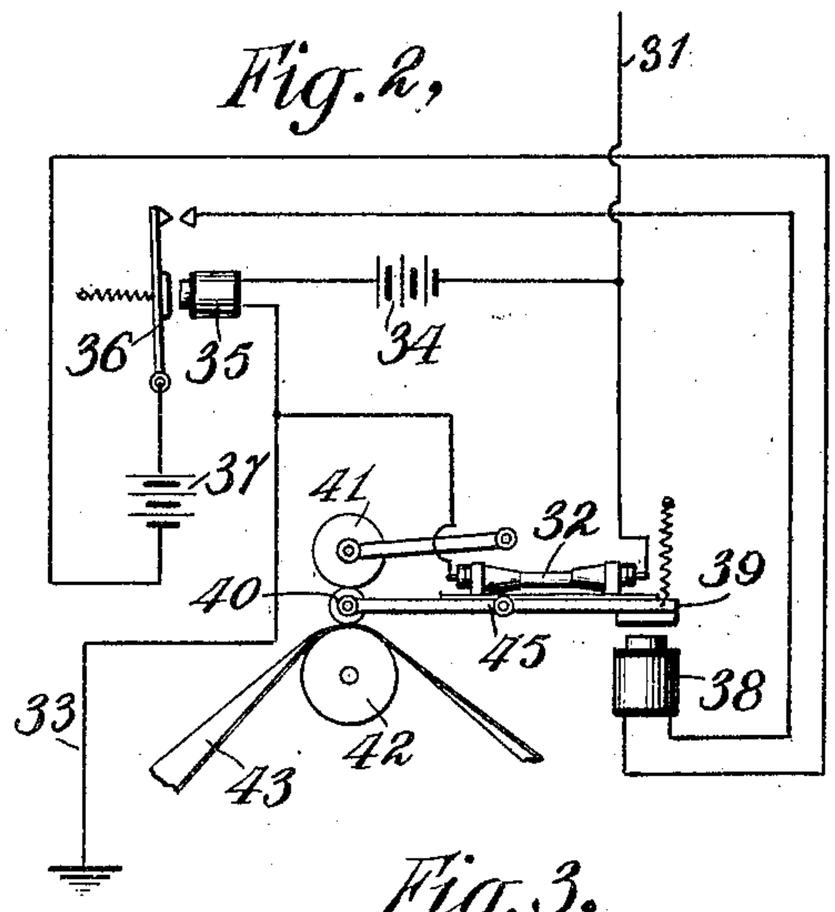


Fig. 9,

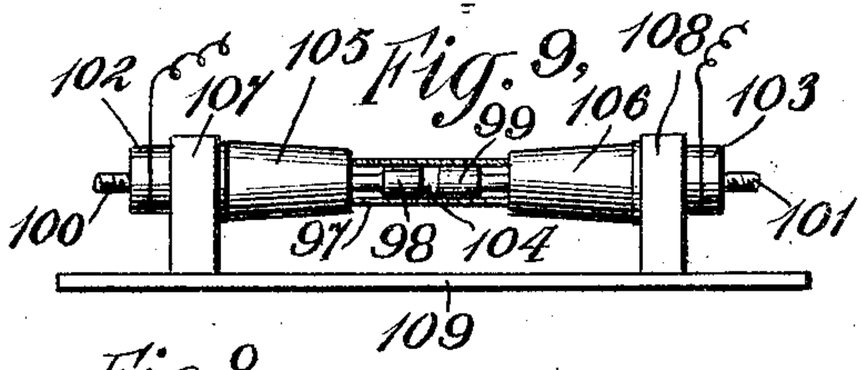


Fig. 8,

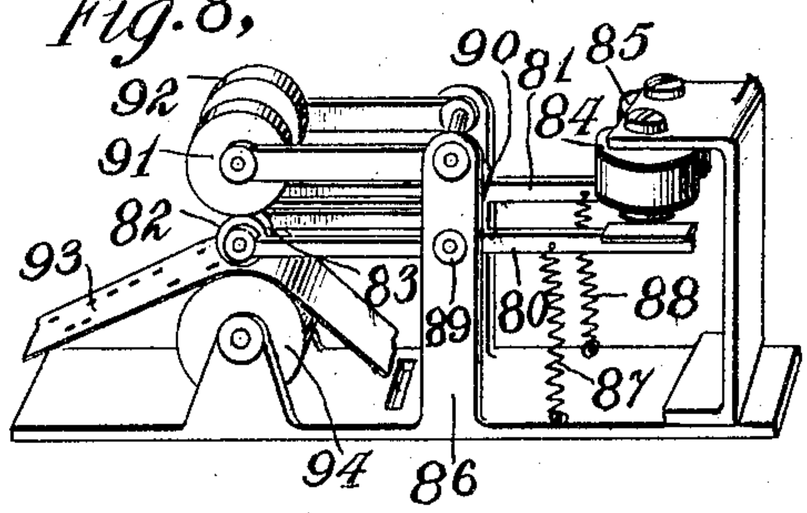


Fig. 3,

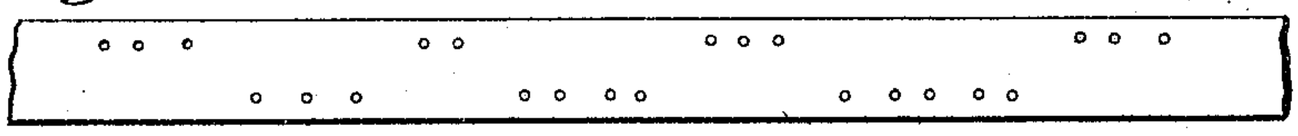


Fig. 4,

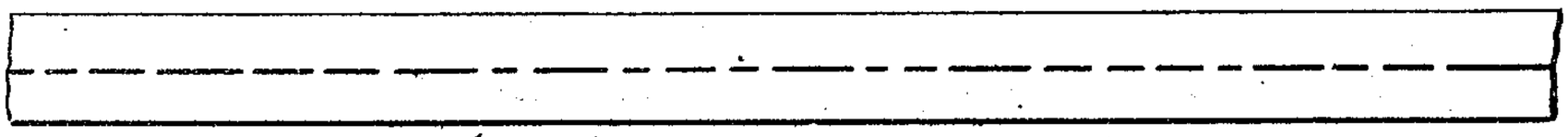

Fig. 7

WITNESSES:

Edwin Seger

Geo. M. Harris.

INVENTORS

Charles G. Burke.

Edward J. Burke.

BY

F. F. Compton.

ATTORNEY

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# ELECTRIC SYSTEM OF TRANSMISSION.

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 6,

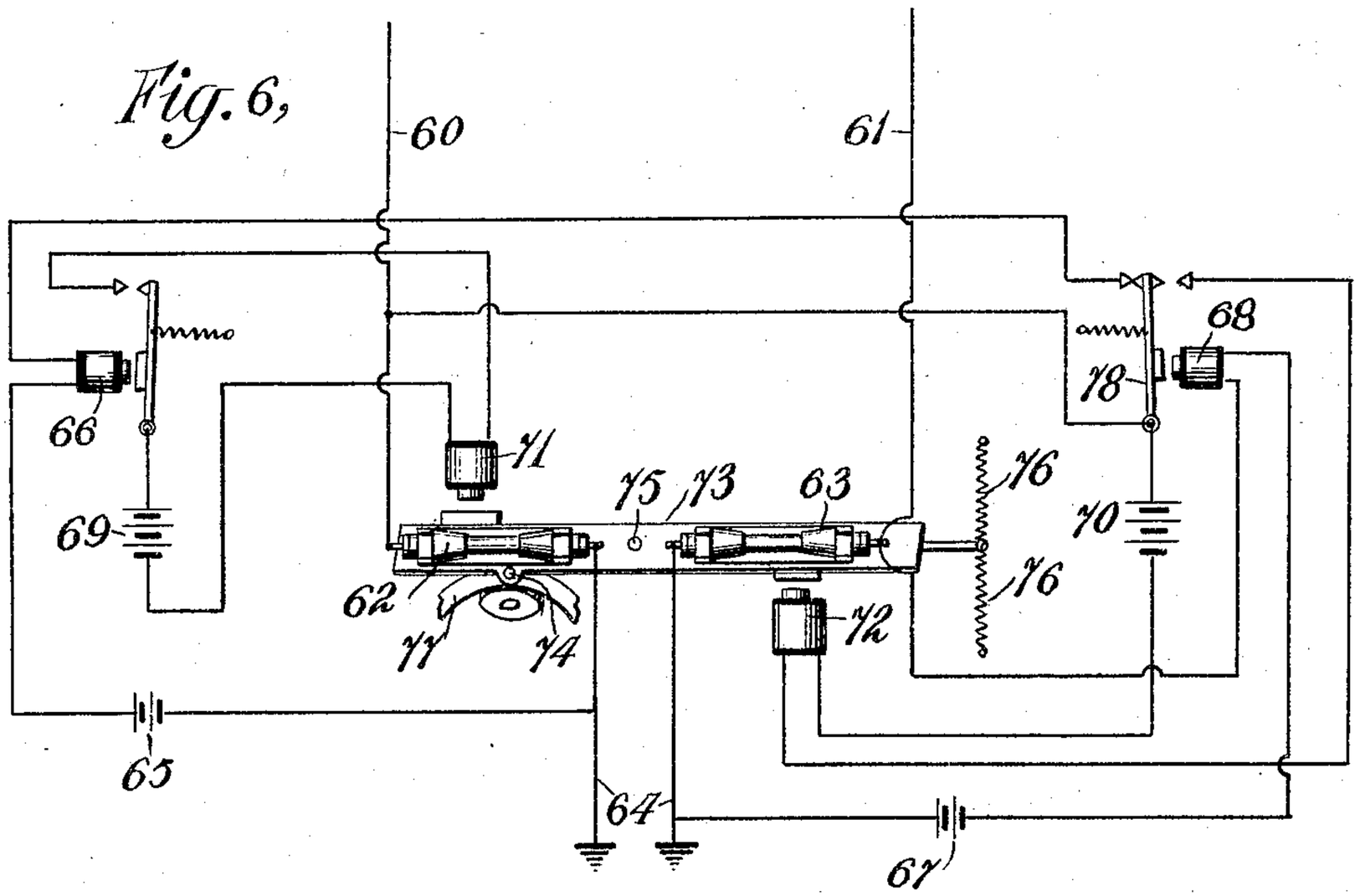



Fig. 5,

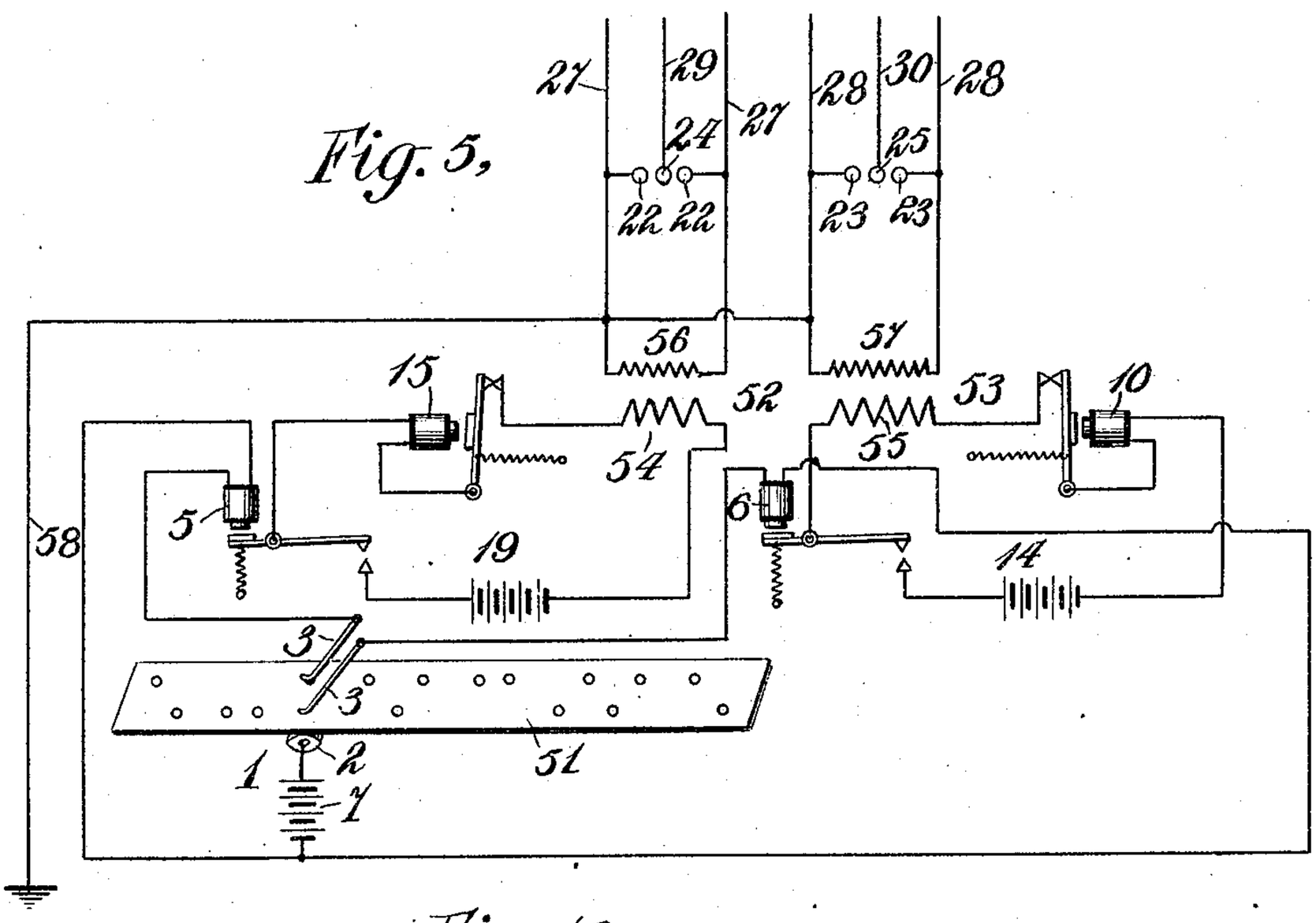
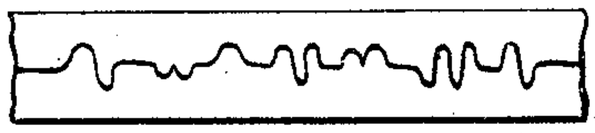



Fig. 10,




WITNESSES:

Edwin Segal

Geo. M. Harris.

INVENTORS

Charles G. Burke

Edward J. Burke

BY

F. F. Crampton.

ATTORNEY

No. 775,416. Patented November 22, 1904.

# UNITED STATES PATENT OFFICE.

CHARLES G. BURKE AND EDWARD J. BURKE, OF BROOKLYN, NEW YORK, ASSIGNORS OF TWENTY-ONE THIRTIETHS TO JOHN Q. A. WHITTEMORE, OF BOSTON, MASSACHUSETTS.

## ELECTRIC SYSTEM OF TRANSMISSION.

SPECIFICATION forming part of Letters Patent No. 775,416, dated November 22, 1904.

Application filed December 17, 1903. Serial No. 185,545. (No model.)

*To all whom it may concern:*

Be it known that we, CHARLES G. BURKE and EDWARD J. BURKE, citizens of the United States, and residents of the borough of Brooklyn, in the county of Kings, State of New York, have invented a certain new and useful Improvement in Electric Systems of Transmission, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

Our invention relates to electric transmission, and it particularly relates to systems of wireless telegraphy.

It has for its object to provide an efficient means for communication between two distant points and to record the messages sent.

The invention also consists in providing a plurality of means for sending impulses, whereby each means is permitted to be restored after its operation.

The invention also consists in providing a system whereby the disruptive effect of the induction-coil of the system takes place in the aerial, and, further, in providing a third terminal in operative relation with the terminals of the induction-coil for increasing the efficiency of the system.

The invention also consists in other features set forth in this specification and illustrated in the accompanying drawings.

Heretofore in systems of electric transmission known as "wireless telegraphy" it has been usual to employ a single emitting apparatus to produce electrical oscillations or disturbances at a sending-station and a detector of such waves or disturbances at a receiving-station. These emitters generally consist of a means for producing disruptive discharges of very high potential. These disruptive discharges are attended by sparks of enormous intensity and are very destructive in their action at the points of interruption and other points of the system. The receiver systems known in the art at present generally have coherers containing metallic grains or filings loosely confined to form an imperfect conductor of electricity.

In sending the signals the Morse code of dots and dashes may be used or the Burke code, described in Patent No. 737,072, may be used. If the Morse code is used, the contact-key is closed substantially three times as long to form the dash as it is in producing the dot. In practice it is found that the prolonged contact of the transmitting-key which is necessary to produce disruptive discharges capable of forming a dash soon exhausts the source of power, if such source be a battery, and that the points of interruption and the sparking points become quickly impaired and inoperative. This is also true of a repetition of a number of disruptions in succession, whether the number of disruptions are produced by sending a number of dots in succession or however they may be produced. This intermitting impairment of the parts of the transmitting apparatus and exhaustion of the batteries occurring as they often do at critical periods become a serious impediment to practical commercial transmisson and are obstacles to the general use of this form of telegraphy.

One of the purposes of our invention is to keep the battery normal and to prevent impairment of the points of interruption of the transmitter.

Referring to the drawings, Figure 1 illustrates a transmitting system, and Fig. 2 illustrates a receiving system, as used in one form of the invention. Fig. 3 illustrates a ribbon that may be used for sending messages by the system illustrated in Fig. 1. Fig. 4 illustrates a ribbon showing a record of the message received by the same system. Fig. 5 illustrates another form of the invention wherein signals of different characters may be sent, and Fig. 6 illustrates the receiving system to be used with the system illustrated in Fig. 5. Figs. 7 and 10 illustrate ribbons having records of messages sent. Fig. 8 illustrates a recorder that may be used in connection with the receiving system. Fig. 9 illustrates the coherer that may be used in connection with the receiving systems.

Referring to Fig. 1, 1 is a transmitter of a form well known in the art, which consists of a stationary contact 2, located below two movable contacts 3 3. A strip of ribbon is passed above the contact 2 and below the two movable contacts 3 3. The ribbon is usually made of paper and is punched at different points, according to the nature of the message to be sent. As the ribbon is passed over the stationary contact, the movable contacts being spring-pressed, they pass through the holes and make contact with the stationary contact and close the circuit. The holes in the ribbon may be so arranged as to send impulses to form dots through one contact and impulses to form dashes through the other contact or to send impulses which form dots or dashes through the contacts in succession. In this form of the invention, however, the holes of the ribbon are so arranged as to send impulses which form either dots or dashes through each of the two contacts 3 3, the holes being as illustrated in the ribbon of Fig. 1. The distance of the holes located on both sides of the ribbon from each other measured along the ribbon correspond to the dot or dash. By this arrangement of holes an impulse is sent first through one contact and then through the other, and so on alternately. In this form of the ribbon (illustrated in Fig. 3) the holes are so arranged that the complete signal indicating any letter or character will be sent first through one of the contacts 3 and then through the other, and so on alternately. Two transmitting systems are associated with the contacts, one contact controlling one system and the other contact controlling the other system. By using a plurality of transmitting systems one system is permitted to recover while the other is in use. This allows the batteries to become depolarized and to recover their normal condition, and it also keeps the contacts and the points of disruptive discharges normal. The signals are transmitted in such a way that successive elemental units will not be sent out from a single emitter. In this way there will be an appreciable time between the successive sparks of the same transmitter. In the transmitting system of Fig. 1 one of the contacts 3 is connected to a magnet 5 and the other to a magnet 6. The two magnets 5 and 6 are connected to one pole of the battery 7. The stationary contact 2 is connected to the other pole of the battery. The circuits are closed by the contacts 3 3 making contact with the contact 2 through the holes of the ribbon and are then opened by the material of the ribbon passing between 2 and 3 3. The magnets 5 6 are energized and deënergized by the opening and closing of the contacts 3 3. The magnets 5 6 operate armatures 8 9, respectively. The armature 8 controls the circuit of a vibrator 10 and an induction-coil 11, which produces impulses in the circuit which are transformed into currents of high potential into another circuit. A Ruhmkorff coil, however, may be used in place of the vibrator and the transformer, the vibrator being actuated by the current passing through the primary coil. The vibrator 13, the primary coil 12 of the induction-coil 11, and the armature 8 of the magnet 5 are connected serially with the battery 14.

In the systems now known in the art the resistance of the vibrator or primary circuit to secure the best results is very low, and when the system is used for any length of time the battery becomes polarized and runs down. By using a plurality of transmitting systems the systems have an opportunity to recover. The armature 9 of the magnet 6 also controls a similar system to that controlled by the armature 8 of the magnet 5. The vibrator-magnet 15, its armature 16, the primary coil of the induction-coil 18, and the armature 9 are also connected serially with the battery 19. The secondaries 20 and 21 of the induction-coils 11 and 18 have connecting-lines which run to a point of considerable altitude to form aerials for the transmission of signals. The aerials comprise terminal points 22 22 23 23 where disruptive discharges occur. The potential of the current produced in the secondary circuit being sufficiently great to break across from one terminal to the other a disturbance is produced and waves or pulsations are sent into space. To the terminal points may be attached the antennæ 27 27 28 28, which will greatly increase the effect of the disturbance caused by the disruptions produced between the terminals. Other terminals or conductors 24 25 may be used to increase the effect produced by the terminals. The said terminals 24 25 are located between the terminals 22 22 and 23 23. The number of the terminals thus located between the terminals connected to the secondaries of the induction-coils may be increased to any number which will cause a corresponding increased effect to be produced by the disruptions of the electric current. Antennæ may be also connected to the said other terminals or conductors, which will further increase the action produced by the disruption of the pulsating current. The antennæ 29 30 are connected to the terminals or conductors 24 25, as shown in the figure. A ground connection 26 may or may not be connected to the aerials. It may be connected to the extra terminals or conductors 24 25 or it may be connected to one side of the secondary coil, as illustrated in Fig. 5. It has, however, been found that in some cases the systems work better when the earth connection is omitted.

In the present art it is found that where a single transmitting system is used the terminals become useless when they are used for too long a period, and thus for the time being prevent the transmission of signals. By using a plurality of transmitting systems and

sending signals or parts of signals of the systems in succession the terminals are kept in their normal condition.

A receiving system is provided which is actuated by both emitters and may be connected to the earth by the connecting-line 33. The coherer may be of any form known in the art; but we preferably use a special form of a coherer, described hereinafter. A battery 34 and a magnet 35 are connected serially with the terminals of the coherer. The resistance of the coherer is normally so high that practically no current passes along the circuit of the battery 34. When an electric pulsation or disturbance is received by an antenna or aerial 31, the impulse passes through the coherer 32 and causes an adherence of particles and produces a comparative perfect contact. This greatly reduces the resistance of the coherer, so that a current passes from the battery 34 through the magnet 35. The magnet 35 then becomes energized and operates its armature 36. The armature 36 controls a circuit of the battery 37. A recorder is connected in the circuit and is operated by the current of the battery 37. The recorder consists of the magnet 38 and its armature 39. The armature 39 operates a marking-roller 40 in a manner well known in the art. The marking-roller is connected by an arm to the armature 39 and is raised and lowered as the armature is operated by the magnet 38. An inking-roller rests on the marking-roller and is adapted to feed a marking fluid to the marking-roller. A platen-roller 42 is also provided, which is located below the marking-roller 40. A ribbon 43 is drawn between the marking-roller and the platen-roller. The arrangement of the recorder may be such as to normally make a continuous line—that is, it may be such that the marking-roller will rest normally on the ribbon. When a signal is received by the aerial 31 and coherer 32 operates, the magnet 38 is energized and the marking-roller will be raised from the ribbon. The line formed by the marking-roller may thus be broken into parts by the pulsations received by the aerial. The parts of the line thus formed will vary in length according to the period of time between the successive periods of pulsations. Pulsations sent and received by the system may thus be of uniform duration, and the instruments may be set to receive but the one set of impulses—namely, that to form the dot. The parts of the line thus formed may be used as signals. The recorder may also be arranged so as to mark only when the magnet 38 is energized; but this would necessitate that the instruments be set so as to receive pulsations of two or more periods differing in length, and the number of elemental signals would be greatly increased in order to send a message. The coherer 32 is connected in such a way that as soon as its function is performed on the receipt of the impulses it is decohered. This is accomplished by mounting the coherer on the means for reproducing the signals—that is, on the recorder or the sounder, if a sounder is used. The coherer which is particularly adapted to this arrangement is described hereinafter. When the decoherer is actuated by an impulse coming from the aerial 31, it actuates the magnet 35. When this is done, its function is performed. The magnet 35 actuates its armature 36. The armature 36 in turn closes the circuit of the battery 37, and this actuates magnet 38, which operates the recorder and jars the coherer 32, mounted on the armature 39.

The system may be so arranged that signals of a different character may be sent and so that the different signals will affect corresponding receiving devices differently, and the signals will be reproduced according to the character of the signals sent. The receiving systems or devices may be attuned to the corresponding sending systems or devices or the receiving devices may be constructed so as to have different susceptibilities, the one of greater susceptibility being cut out when the one of less susceptibility is in operation and the one of greater susceptibility being capable of operation by impulses which are insufficient to operate the one of less susceptibility. In Figs. 5 and 6 is illustrated this modified form of the invention. An automatic transmitter may be used in this form of the invention in the manner described above. The strip 51 is punched according to the message to be sent. When it is desirable to record the messages as they are received by means of an oscillating recorder, holes corresponding to dots are punched along one edge of the ribbon and another set of holes are punched along the opposite edge to correspond to dashes. When the pulsations are received by the recorder, the recorder moves to the right or left to indicate the dots and dashes. If a double recorder is used, two messages may be sent and recorded at the same time. The recorder may be made on the same ribbon. Also, if impulses for short periods only are sent, the dots and dashes may be indicated by the position of the marks on the ribbon—that is, those near one edge will correspond to the dots and those near the other edge to the dashes.

In the system illustrated in Fig. 5 the ribbon 51 opens and closes the contacts 3 3 in the same way that they are operated in the system illustrated in Fig. 1, and the contacts 3 3 control the transformers as described above. The transformers or induction-coils 52 53 operate to transform the current of the circuit of the vibrators to the circuit of the aerials. The primary coil 54 of the induction-coil 52 is connected in the circuit of the vibrator 15, and the primary coil 55 is connected into the circuit of the vibrator 10. The primary coils operate on the secondary induction-coils 56

57. One of the secondary coils 57 has a greater number of turns than that of the secondary coil 56, while the primary coils have about the same number of turns. The coil 57 will produce a current of greater potential in its circuit than the coil 56. Aerials formed of terminals or points of disruption of the coils are connected to the coils 56 and 57, and the discharges which occur between the terminals in the two sets of instruments differ. Antennæ 27, 28, 29, and 30 may be connected to the terminals as in the system illustrated in Fig. 1. Other terminals or conductors may also be provided, which operate in the same way as described above. The usual form of ground connection 58 may be used or may be omitted, as stated above.

The receiving system illustrated in Fig. 6 is arranged so as to receive the signals of different characters and to reproduce the same. In the figure, 60 and 61 represent receiving-antennæ connected to the coherers 62 and 63, respectively. The opposite terminals of the coherers 62 and 63 are connected to the earth by the connections 64. The terminals of coherer 62 are connected serially with the battery 65 and the magnet 66. The terminals of the coherer 63 are connected serially with the battery 67 and the magnet 68. The magnets 66 and 68 have armatures in each case which close circuit through a reproducing means, such as a sounder or a recorder. In the system illustrated a recorder is shown. The magnets 66 and 68 close the circuits of the batteries 69 70, respectively, through the magnets 71 72, respectively. The magnets 71 and 72 operate on a common armature 73, which carries a recording pen or siphon 74. The armature is pivoted at 75, a point between the magnets. Two springs 76 76 are connected to one end of the armature. The springs 76 76 act against each other and tend to keep the armature at a short distance from each of the magnets 71 and 72, so that when one of the magnets—as, for example, magnet 72—is energized the armature is drawn in one direction and when magnet 71 is energized the armature is drawn in the opposite direction. When both magnets are deënergized, the armature takes an intermediate position. A strip 77 may be fed under the siphon 74, and as the armature is oscillated by the operation of the magnets 71 and 72 a wave will be produced, thus recording the impulses affecting the magnets 71 and 72. The armature 78 of the magnet 68 performs the double function of closing the circuit of the battery 70 and opening the circuit of the battery 65, so that when the magnet 68 is actuated the circuit of the magnet 66 will be opened and it cannot operate on its armature to energize the magnet 71. Magnet 72 will then alone move the recording-pen. The coherer 62 is set so as to be operated on by impulses of a low intensity, while coherer 63 is set so as to be operated by an impulse of a higher intensity and will not be operated by the impulse that will operate the coherer 62. The tension of the springs of the armature may be also set so that the system may may be differently affected. The impulses that operate coherer 63 will, moreover, operate the coherer 62; but when the coherer 63 is operated the magnet 68 is energized and the circuit of the coherer 62 and the battery 65 is broken and the magnets 66 and 71 will remain normal. The recording-pen will then move in response to the action of the coherer 63 and the magnet 72. When impulses of a lower intensity are received, the coherer 63 will not be affected; but the coherer 62 will be affected, and as the magnet remains normal the magnets 66 and 71 will be energized, and the armature will swing in the opposite direction in response thereto. A record of impulses thus received is illustrated in Fig. 10. A movement of the pen to the right may be used to indicate a dot, and a movement to the left may be used to indicate a dash.

Tappers or other means may be provided for decohering the coherer in the manner well known in the art; but we prefer to mount the coherers on the armature of the means for reproducing the signals—that is, in the system illustrated on the armature 73 of the recorder. As soon as the armature is moved in response to the action of the magnets 71 or 72 the coherer is decohered and is ready to receive the next impulse.

Another form of a recorder is illustrated in Fig. 8. This form of a recorder is adapted to record the impulses as they are received by the receiving systems, as in the form of the invention illustrated in Figs. 5 and 6.

In the recorder illustrated in Fig. 8 the armatures 80 and 81, which carry the marking-rollers 82 and 83, support the rollers away from the ribbon 93. When the magnets 84 and 85 are energized, the rollers are brought down so as to make contact with the ribbon, and a mark is made thereon. The marks which are produced along one edge of the ribbon may be used to correspond to dots, and the marks made along on the opposite edge of the ribbon may be used to correspond to the dashes. In this case the marks used to record the dashes may be of the same length as the marks used to record the dots. The armatures 80 and 81 are mounted on a standard 86 and are drawn a short distance away from the magnets 84 and 85 by the operation of the springs 87 and 88. The armatures move on the common pivot-pin 89 and are limited in their motion by the cross-piece 90. Inking-rollers 91 and 92 are used to feed the ink to the marking-rollers well known in the art. The ribbon 93 is fed over the platen-roller 94 and beneath the marking-rollers 82 and 83.

Fig. 7 illustrates a record as made by the

device illustrated in Fig. 8. The dots on one side correspond to the dots of the Morse code, and the dots on the other correspond to the dashes. The receiving system illustrated in Fig. 6 when operated in connection with the recorder illustrated in Fig. 8 may be used to receive and record two messages at the same time. The signals of the message formed of dots and dashes may be recorded along one edge of the ribbon by one of the magnets of the recorder—as, for example, magnet 84—and the signals of the other message may be recorded along the other edge of the ribbon by the magnet 85. In such cases one of the messages will be sent by using impulses of certain periodicity or intensity, and the other message will be sent by using impulses of another periodicity or of a higher intensity.

The coherers used to operate the recorder illustrated in Fig. 8 may be mounted on the armature carrying the marking-rollers and may be decohered upon recording each impulse.

The form of the coherer that we prefer to use and which gives greatly-improved results is a coherer having carbon particles to form an imperfect contact. A mixture of carbon particles or carbon pieces with other material, such as filings, may be used; but it is preferable to use nothing but carbon particles to form the imperfect contact of the coherer.

The coherer is illustrated in Fig. 9, wherein 97 represents an insulating-tube consisting of glass or other insulating material. In the tube there are mounted two terminals 98 and 99, having threaded stems 100 and 101, to which may be attached wires by means of nuts for connecting the coherer in an electric circuit. The terminals may be composed of any conductive material, such as carbon or metal. Between the terminals 98 and 99 there is loosely placed a small quantity of carbon 104. Carbon in any form may be used; but we preferably use carbon particles. The amount may be varied according to the conditions of the systems with which this coherer is used. The tube 97 is mounted in two vulcanite cones 105 106. The coherer is supported by the spring-clips 107 108, located on the base 109. The current of high potential upon passing through the coherer causes the particles to cohere and greatly reduces the resistance of the coherer. If then the coherer is slightly jarred, the particles separate, and the coherer is again in condition to receive another impulse. It is found that the coherer illustrated in Fig. 9 decoheres with a much lighter jar than the coherers now known in the art, and, furthermore, the life of the coherer illustrated in the figure is greater than that of the coherers known in the art.

My invention may be modified by those skilled in the art without departing from the spirit thereof. The number of emitters and receivers may be varied, and the manner of reproducing the signals may be varied without altering the invention.

What I claim, and desire to secure by Letters Patent, is as follows:

1. In a system for purposes of communication the combination of an automatic transmitter, means associated with the said transmitter for sending impulses of different intensities, sending and receiving aerials, and a recorder adapted to move according to the character of the messages sent by the said transmitter.

2. In a system for purposes of communication the combination of an automatic transmitter, means associated with the said transmitter for sending signals of different intensities, sending and receiving aerials, a recorder, and means responsive to the different intensities for causing the said recorder to record the different indications sent.

3. In a system for purposes of communication the combination of an automatic transmitter, means associated with the said transmitter for sending impulses of two different intensities, sending and receiving aerials, a recorder, a means responsive to one of said intensities for causing the said recorder to move in one direction and a means responsive to the other of the said intensities for causing the recorder to move in the other direction.

4. In a system for purposes of communication the combination of a strip having holes located along different lines according to the nature of the impulse to be sent, contacts adapted to make contact through the said holes, sending and receiving aerials, means associated with each of the said sending-aerials and with certain of the said contacts for sending signals according as the associated contacts are closed, coherers associated with the said receiving-aerials and a marker operated by the said coherers.

5. In a system for the purposes of communication the combination of a strip having holes located at different points according to the nature of the signal to be sent, contacts controlled by the said strip, sending and receiving aerials, means associated with each of the said sending-aerials and with each of the said contacts for sending signals according as the associated contacts are closed, coherers, a recorder, and means operated by the said coherers for causing the recorder to move according to the coherer affected.

6. In a system for purposes of communication, the combination of an induction-coil, an aerial comprising terminals, two of the said terminals connected to the said induction-coil, and a third terminal or conductor in operative relation to the first-named terminals, and an antenna connected to the said terminal or conductor.

7. In a system for purposes of communica-

tion the combination of an induction-coil, an aerial comprising terminals, the said terminals connected to the said induction-coil, another terminal located between the first-mentioned terminals and antennæ connected to each of the said terminals.

8. In a system for purposes of communication the combination of a circuit-closer, an induction-coil operated by the said circuit-closer, an aerial comprising a pair of terminals and antennæ connected to the said terminals, another terminal in operative connection with the said pair of terminals and an antenna connected to said other terminal.

9. In an electric system the combination of an automatic transmitter consisting of a plurality of movable contacts, a plurality of batteries, one battery corresponding to each of the said movable contacts, a magnet located in the circuit of each of the said contacts and adapted to close the circuit of each of the said batteries, an induction-coil located in the circuit of each of the said batteries, and a sending-aerial associated with each of the said induction-coils and batteries and contacts and operated thereby, a strip having holes corresponding in their relative positions to the different parts of the signal and adapted to permit the different contacts to close, a receiving-aerial operated by each of the said sending-aerials, and a means for recording the said parts of the said signals as one continuous signal.

10. In an electric system the combination of an automatic transmitter consisting of a plurality of movable contacts, a plurality of batteries, one battery corresponding to each of the said movable contacts, a magnet located in the circuit of each of the said contacts and adapted to close the circuit of each of the said batteries, an induction-coil located in the circuit of each of the said batteries, and a sending-aerial associated with each of the said induction-coils and batteries and contacts and operated thereby, a strip having holes corresponding in their relative positions to the alternate parts of the signal and adapted to permit the different contacts to close alternately, a receiving-aerial operated by each of the said sending-aerials, and a means for recording the said parts of the said signals as one continuous signal.

In testimony whereof we have signed our names, in the presence of two subscribing witnesses, on this 14th day of December, 1903.

CHARLES G. BURKE.
EDWARD J. BURKE.

Witnesses:
EDWIN SEGER,
FAUST F. CRAMPTON.