E. G. GODFREE.

AUTOMATIC TOLL RECORDER FOR TELEPHONE SYSTEMS.

APPLICATION FILED MAR. 18, 1912.

1,111,742.

Patented Sept. 29, 1914.

2 SHEETS—SHEET 1.

Fig. 1.

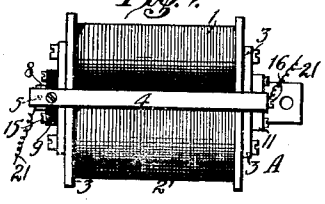


Fig. 3.

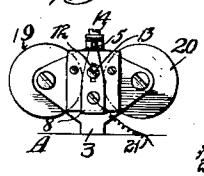
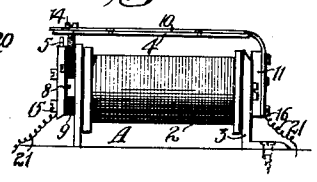


Fig. 2.



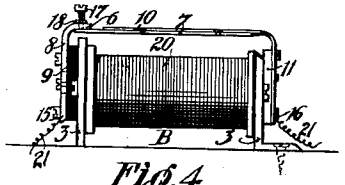


Fig. 4.

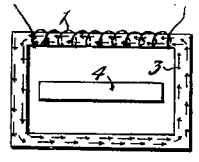


Fig. 5.

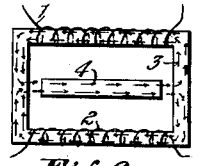


Fig. 6.

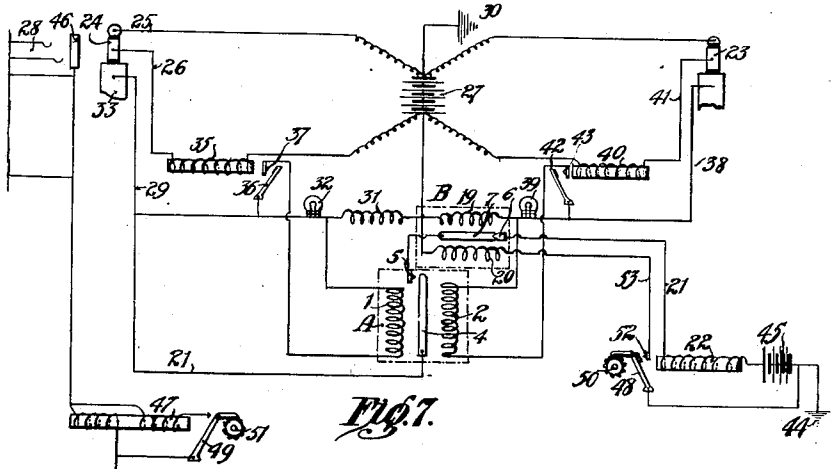
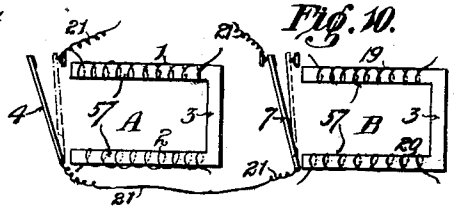


Fig. 7.

Fig. 10.



Witnesses:

F. C. Schroder

M. J. Whittaker

Inventor:

Ernest Graham Godfree.

per

L. W. Waghorn

Attorneu

E. G. GODFREE.

AUTOMATIC TOLL RECORDER FOR TELEPHONE SYSTEMS.

APPLICATION FILED MAR. 18, 1912.

1,111,742.

Patented Sept. 29, 1914.

2 SHEETS—SHEET 2.

Fig. 8.

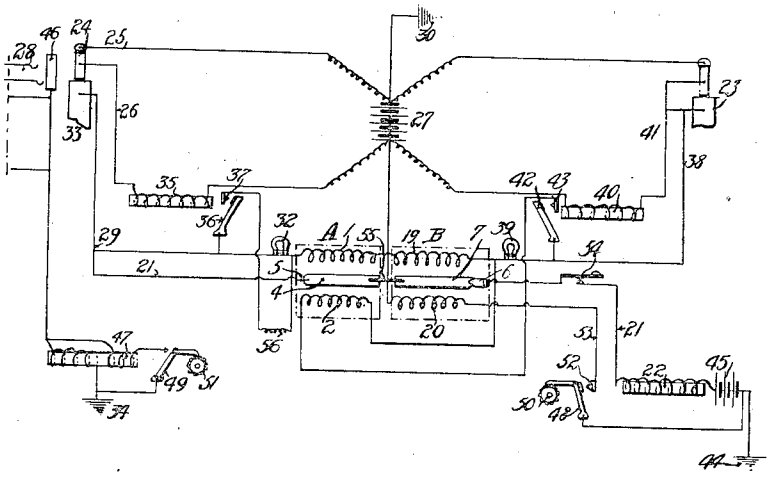
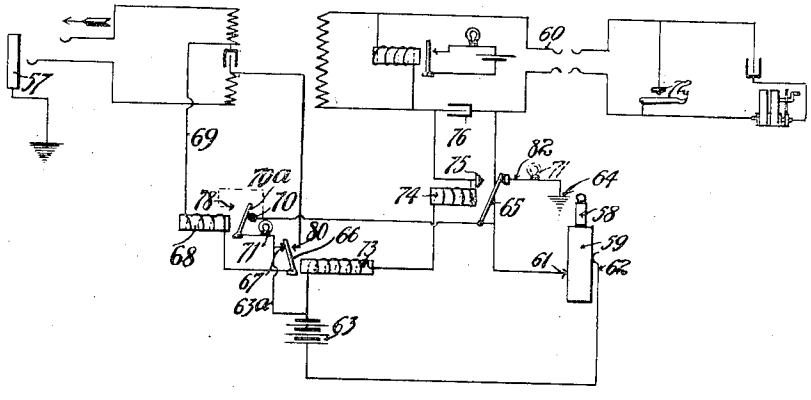


Fig. 9.



Witnesses:

H. C. Schroder

M. J. Whittaker

Inventor:

Ernest Graham Godfree

per

H. W. Waghorn

Attorney.

UNITED STATES PATENT OFFICE.

ERNEST GRAHAM GODFREE, OF SANDRINGHAM, NEAR MELBOURNE, VICTORIA, AUSTRALIA.

AUTOMATIC TOLL-RECORDER FOR TELEPHONE SYSTEMS.

1,111,742. Specification of Letters Patent. Patented Sept. 29, 1914.

Application filed March 18, 1912. Serial No. 684,604.

To all whom it may concern:

Be it known that I, ERNEST GRAHAM GODFREE, a citizen of the Commonwealth of Australia, and resident of "Keighley," Sandringham Road, Sandringham, near Melbourne, in the State of Victoria, Commonwealth of Australia, have invented a new and useful Improved Automatic Toll-Recorder for Telephone Systems, of which the following is a specification.

This invention has been devised in order to provide a simple and inexpensive yet thoroughly reliable contrivance which will automatically record the total number of effective and individual calls made by the various subscribers or users of a telephone exchange.

The invention possesses several novel features and as it is not positioned in the speaking circuit the effectiveness of that circuit is not impaired.

The basic principle underlying this invention consists in placing a consequent pole electromagnet in the circuits of telephone exchange systems. This consequent pole electromagnet is adapted to automatically close the circuit in which the registering devices are operated only when the calling and answering subscribers are in communication. A second consequent pole electromagnet is also inserted in the circuit and operates after each toll has been recorded and automatically opens the meter circuit. An open circuit is maintained during the use of the line but when the calling plug is withdrawn at the close of conversation the armature of the second consequent pole electromagnet automatically returns to its normal position.

The installation of the invention does not necessitate additional wiring and the recorder can be placed on a common battery exchange without altering the system or upsetting the operative arrangements thereof and in most cases it takes the place of existing gear.

The improved toll recorder may be used for automatically registering the total number of effective calls controlled by or made by any one operator and as the effective meter circuit corresponding to set of plugs in use is immediately opened after registration of the call, such meter is immediately in readiness to register other calls made by subscribers or other users. A reliable check is made of all effective calls as it only records those calls to which an answer from the subscriber with whom it is desired to communicate has been received and thereby frees the operator at the exchange from a considerable amount of work, and furthermore, when the meter controlled by the recorder is checked and it is found that the load carried by one attendant is abnormally heavy the load may readily be distributed according to the present practice at the exchanges.

The improved toll recorder comprises what is known as a consequent pole electromagnet. This electromagnet is so placed that when a current traverses the circuit due to a person calling up or otherwise intimating his desire to be put in communication with a particular number or by the completion of the electric circuit through his instrument, and connections at exchange, one coil of the magnet is energized and the lines of force or magnetic flux thus produced traverse the complete magnetic circuit through the iron core of the consequent pole electromagnet without attracting an armature which is connected in circuit with any suitable registering device. Immediately the subscriber required answers his call, for instance, by taking his receiver off the hook, a current is caused to traverse the other coil of the consequent pole electromagnet. This coil is so wound that when energized the magnetic flux produced in the core becomes opposed to that produced by the other coil and the lines of force or magnetic flux pass through the armature, which then becomes attracted to the poles of electromagnet and closes the circuit in which is operated the registering devices. Once the armature is attracted to the consequent pole electromagnet, a magnetic bridge is formed in the case of the second consequent pole electromagnet and the armature is held against the pole of the consequent pole electromagnet until the circuit through its coil is broken by the calling plug being withdrawn.

The device may be placed in a circuit in which the operator at the exchange has the control of the recording operations by causing the automatic toll recorder to perform its function by means of a press button or its equivalent.

It will be understood that when once the

magnetic lines are produced in a definite direction through the armature their course cannot be altered until circuit through both coils of the consequent pole electromagnet are opened, that is to say, the molecules of iron being set in a definite direction a change of that direction cannot be attained except by first opening the circuits through both coils. For instance, if the armature is attracted and the circuit through one coil opened, the path of less retardation to the lines of force produced by the one energized coil would probably be through the core but according to this invention the lines of force are sent through the armature and remain so until the circuits through both coils are opened.

In order that the invention may be more readily understood it will now be described with reference to the accompanying drawings in which—

Figure 1 is a view in plan of my improved automatic toll recorder for telephone systems. Fig. 2 is a view in side elevation, and Fig. 3 is a view in end elevation. Fig. 4 is a view in side elevation of the automatic toll recorder with a slight constructional modification of the armature contacts to suit its position, and operative action in the telephone circuit hereinafter described. Figs. 5 and 6 illustrate diagrammatic views of the magnetic field at various stages in the operation of the automatic toll recorder. Fig. 7 is a diagrammatic view of the circuit illustrating the method of installing the invention in a common battery exchange telephone circuit whereby the total effective and subscribers' calls are recorded independently of any action or control of the exchange operator. Fig. 8 is a diagrammatic view of a circuit wherein this automatic recorder is employed but where the exchange attendant controls the automatic action. Fig. 9 illustrates a diagrammatic view of a magneto junction circuit whereby the automatic toll recorder is adapted to be operated on a system where a common battery exchange and a magneto exchange are working in conjunction. Fig. 10 is a diagrammatic view illustrating modification of the invention wherein differentially wound electromagnets are adapted to be inserted in the circuit and operate in lieu of the consequent pole electromagnets.

The same reference numerals indicate the same or corresponding parts throughout the drawings.

The toll recorder consists essentially of two coils of wire, 1, 2, wound in the same direction and placed on a core 3 having a continuous magnetic circuit, and so constructed that magnetic influence is not brought to bear on the armature 4 placed parallel with the coils as illustrated diagrammatically in Figs. 5 and 6 until both the coils are energized which causes the lines of force produced by each coil to oppose that of the other and to traverse the armature 4 as indicated in Fig. 6. The armature therefore becomes attracted to the consequent pole electromagnet A and closed contact is made at 5 in the said consequent pole electromagnet A and the circuit opened at 6 in the consequent pole electromagnet B when the current traverses the respective circuits. The circuit in which the register motors operate is therefore closed by operation of the consequent pole electromagnet A and reopened by operation of consequent pole electromagnet B.

In Figs. 1, 2 and 3 part of the invention is illustrated showing the consequent pole electromagnet A with its armature 4 in its normal position (out of contact) and Fig. 4 illustrates consequent pole electromagnet B constructed in the same way except that the armature 7 is normally in contact as hereinafter described.

The preferred construction of the consequent pole electromagnet A is as follows:— The coils 1, 2 are mounted on a core 3, affixed in any suitable manner. A contact plate 8 is insulated from the core or pole piece 3 by suitable material 9 such as ebonite or the like and this plate carries the contact point 5 with which the armature 4 is adapted to contact and close the circuit. The armature 4 is carried by a spring 10 insulated from the core or pole piece 3 by a packing piece 11. The contact plate 8 is preferably provided with a slot 12 and is adapted to be adjusted by the screw 13. An adjustable keeper or screw 14 is mounted in the insulation 9 in such a manner that the armature 4 can readily maintain its operative action. Terminals 15 and 16 are provided to complete the circuit.

The consequent pole electromagnet B is constructed in approximately the same manner as the magnet A except that the contact plate 8 is provided with an extension or contact point 6 adapted to receive the adjusting screw 17 which may also carry a lock-nut 18 (Fig. 4). If desired, the contact plate 8 may be adjusted as illustrated in Fig. 3. The armature 7 of this magnet B is normally in contact (Fig. 4). The coils 19 and 20 (Fig. 3) are mounted to the core 3 as above described.

When applied or inserted in a common battery exchange circuit two automatic devices as illustrated diagrammatically in Fig. 7 are used for each pair of switching plugs. The device indicated at A makes contact and completes the meter circuit 21 and causes the meter 22 to register while the second magnet indicated at B is brought into action after the meter 22 has registered opening the meter circuit 21 and maintaining an open circuit owing to the armature 7 being drawn

down and held in that position until the respective circuits are opened due to the calling plug 23 being withdrawn. When the circuit is made by the automatic operation of the magnet A the meter circuit is closed and if the receiver at the subscriber's end is placed on the hook a current in the opposite direction is sent through the circuit which shunts lamp and only a device or magnet such as B—that immediately breaks the circuit after toll has been recorded—can be an effective one except when special provision is made when wiring to obviate this.

On existing telephone systems when the subscriber takes the transmitter off the telephone hook in order to call the exchange, a lamp or other indicating device is brought into operation at exchange and notifies the operator. On the answering plug 24 being inserted in its socket or jack the lamp or indicator is switched out of circuit and the circuits 25 and 26 are completed from the battery 27 through switch socket or jack 28 to subscriber and circuit 29 is completed from earth 30 battery 27 coil 31 lamp 32 sleeve 33 of plug 24 to earth 34 and causes supervisory lamp 32 to glow. The circuits 25 and 26 being completed the relay 35 becomes energized and armature 36 is brought to contact point 37. This causes supervisory lamp 32 to become short circuited or cut out and extinguished due to the current passing through coil 1 of the magnet A which is suitably wound for the purpose. When the calling plug 23 is inserted in the jack corresponding to the number of subscriber required the current from the central battery 27 flows through the circuit 38 and causes supervisory lamp 39 to glow. When the called subscriber answers, relay 40 on circuit 41 is energized, armature 42 engages contact point 43 and supervisory lamp 39 is short circuited or cut out and coil 2 of consequent pole electromagnet A is then energized. The two coils 1, 2 of consequent pole electromagnet A now being energized, and the two subscribers in communication the armature 4 is attracted and makes contact at 5. The battery current then traverses earth 44 to battery 45 through meter 22, circuit 21, contact 6, armature 7, contact 5, armature 4, sleeve 33, contact socket 46, through service meter 47 to earth 34, completing the circuit and causing meters 22 and 47 to attract armatures 48, 49, the call being thereby registered on both recording devices 50 and 51. The armature 48 of call meter 22 when attracted makes electrical contact between 48 and 52 and a current then flows through the circuit 53 from earth 30, battery 27, through coil 20 over contacts 48 and 52 to earth at 44. Both coils 19 and 20 of magnet B are then energized and armature 7 is attracted. The coil 19 being energized the whole time while calling plug 23 is in socket the armature 7 is held in a position to open the meter circuit 21 and prevent waste of electrical energy as well as to allow the total effective call meter 22 to be operated again only when other subscribers are put in communication. The magnet B does not allow its armature 7 to return to normal position (armature in contact) until the circuits are opened due to the calling plug 23 being withdrawn.

Fig. 8 illustrates a relay circuit similar to Fig. 7, but in this case the automatic operation is under the control of the operator or exchange attendant. An extra press button 54 is placed in the meter circuit 21 and when connection is made between the subscribers the press button 54 under the operator's control is depressed or operated and the magnets A. B. then operate automatically as described with reference to Fig. 7. As illustrated, the armatures 4 and 7 of the consequent pole electromagnets A and B are connected as indicated at 55. The supervisory lamp 32 is short circuited and extinguished due to the current passing through the coil 56.

In some common battery exchange systems resistance coils are included in the positions indicated by the coils 1, 2 and 19 in Figs. 7 and 8. By winding the coils 1, 2, in the consequent pole electromagnet A and the coil 19 of the magnet B to the same resistance as the resistance coils at present in use only the addition of the coil 20 is required. By this arrangement, the cost of installation of my system of toll recording is considerably reduced and simplified.

According to a modification of this invention a differentially wound relay 57 (one form of which is illustrated in Fig. 10) may be inserted in the above circuits in lieu of the above described consequent pole electromagnets A and B. The cores 3 of the differentially wound electromagnets 57 are not continuous as in the other figures. The coils 1 and 19 are so wound that when energized, the magnetic effect in the cores is not sufficient to attract armatures 4 or 7, but when the coils 2 and 20 are energized the magnetism in the cores is augmented and the armatures 4 and 7 become attracted and close or open the meter circuits as the case may be. When coil 1 is energized the magnetic effect is not sufficient to cause armature 4 to be attracted but when coil 2 is energized in conjunction with coil 1 the magnetic effect is augmented or made greater and the armature 4 becomes attracted. The relay B similarly operates when coils 19 and 20 are energized and the same recording operation is effected as described with reference to the consequent pole electromagnets and as illustrated in Figs. 7 and 8.

When it is desired to automatically operate the toll recorder on telephone systems

that are worked in conjunction with each other such as common battery and magneto systems, an electromagnet 74 is wound and connected up as shown in Fig. 9 and placed in the circuit at a magneto exchange. The electromagnet 74 is placed in the circuit to operate in conjunction with the electromagnets A and B illustrated in the other figures and the earth connections are cut off when both the subscribers are in communication, the line being free from earth sounds and the like interruptions that are usually encountered. By the insertion of the magnet 74 in the circuit the toll recorder may be operated while at the same time exactly the same indications may be given that take place in the present system. The operator, at the central battery exchange end, places the plug in socket 57 and speaks to operator at the magneto exchange. The operator at the magneto exchange takes plug 58 from its seat 59 and inserts it in the socket 60. The contacts 61, and 62, come together and current from battery 63 flows from earth 64, over armature 65 through contacts 61 and 62 to battery 63 line 63^a, contact 67, armature 66 through coil 68, energizing same along line 69 to earth 30 (Fig. 8) at common battery exchange as indicated by the arrow. A parallel circuit from battery 63 to lamp 71, armature 70^a to contacts 61 and 62 back to battery 63 is also formed which causes the lamp to glow. When the electromagnet 68 becomes energized the circuit is broken at 70 and the lamp 71 is extinguished, which intimates to the operator that the plug 58 has been inserted in the right jack. When the called subscriber answers, contacts are closed at 72 and current flows from battery 63 through coil 73 to coil or electromagnet 74 to line, over contacts 72 back to return line over contacts 61 and 62 to battery 63. This causes electromagnet 73 to attract armature 66 and close the contacts at 66 and 80. At the common battery exchange various apparatus then perform their functions and circuit is given for transmission of speech in the usual manner and toll is automatically recorded on the meters 50 and 51 as hereinbefore described. Electromagnet 74 attracts armature 65 and makes contact at 75 thus bridging the condenser 76 and freeing the line from the effect of the condenser. At the close of the conversation the plug 58 is withdrawn and returned to its seat or socket 59, the circuit being opened at the contacts 61 and 62 and the circuits then assume their normal position.

Another form of magneto wiring may be included which gives an indication that the plug has been inserted in the wrong or right jack and also intimates whether the subscriber to magneto exchange has replied to the call from the common battery exchange. This may be done by positioning the lamp 71 in circuit 82, and adapting armature 70^a to contact at 78 as shown by dotted line and thus the better supervision of the operator is secured. The contact 70 under these conditions is not in circuit.

When an earth return circuit is used earth 64 is not required, the earth wire for the general system being brought into requisition to serve the same purpose.

The circuit above described will enable the electromagnets A and B to automatically record the number of effective calls only when both subscribers are in communication on a line that is connected up to mixed systems such as common battery and magneto exchange systems.

Having now fully described and ascertained my said invention and the manner in which it is to be performed, I declare that what I claim is:—

1. In a telephone toll recording system, a circuit, a consequent pole electro-magnet one coil of which is energized by the calling telephone, and the other coil energized by the answering telephone, an armature operated by said electro-magnet, a circuit closed by said armature, a toll recording device adapted to be operated by the closing of said armature circuit, and a second electro-magnet arranged in the circuit to operate and open the circuit after the meter has registered.

2. In a telephone recording system, a circuit, registering means located in said circuit, consequent pole electro-magnets adapted first to close and then open said circuit, and manually operated means for controlling the registration, substantially as specified.

3. In a telephone recording system a circuit, a registering device located in said circuit, a consequent pole electro-magnet adapted automatically to close said circuit when the desired parties are in communication, and a second consequent pole electro-magnet adapted after a toll has been recorded to open the meter circuit.

4. In a telephone recording system a circuit, a registering device in said circuit, and a consequent pole electro-magnet having its coils so wound that when energized the magnetic flux produced in the one opposes the magnetic flux produced in the other, and an armature adapted to become attracted by the electro-magnet and to close said circuit.

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

ERNEST GRAHAM GODFREE

Witnesses:
SIDNEY HENDLEY,
ANNIE EDWARDS.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."