June 24, 1930. O. E. MARVEL 1,766,505

ELECTRICAL APPARATUS

Filed March 2, 1925

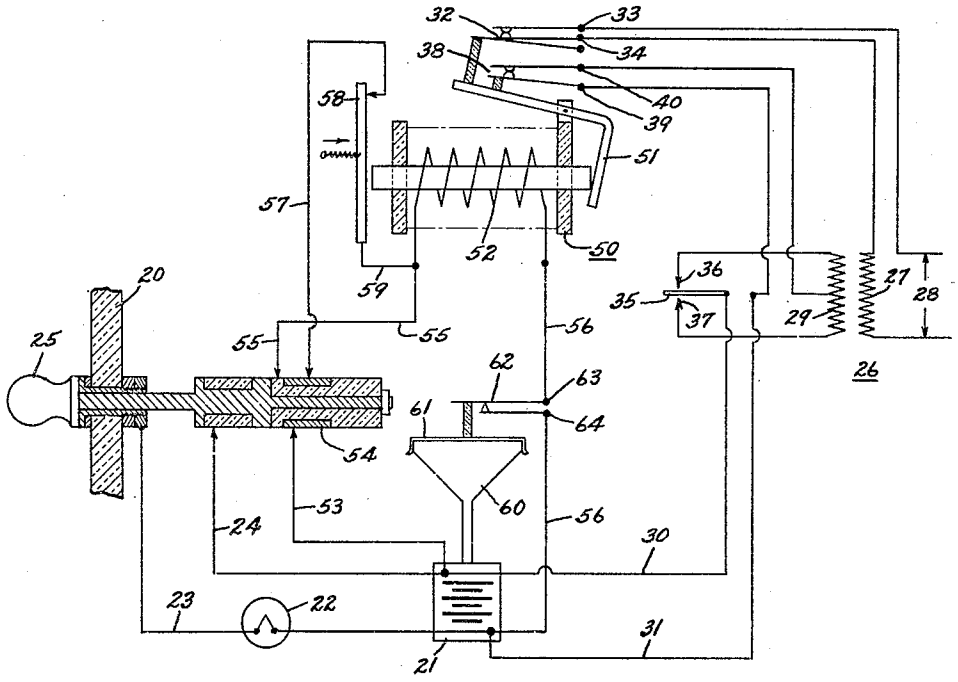


Fig. 1

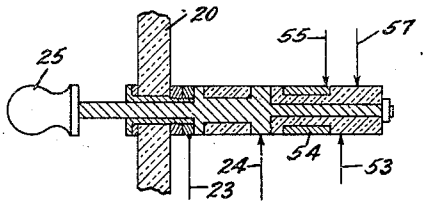


Fig. 2

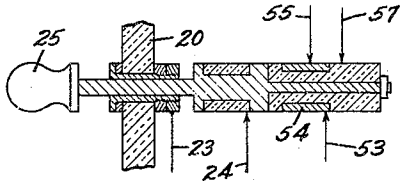


Fig. 3

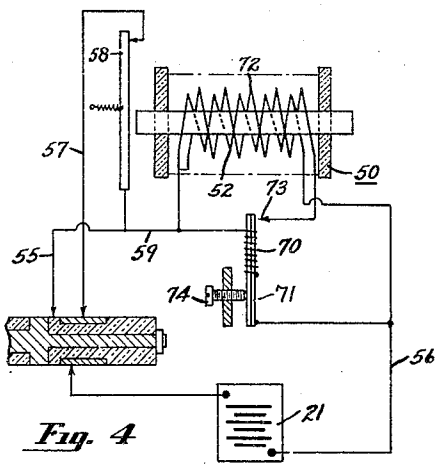


Fig. 4

Inventor

Orin E. Marvel

By Maréchal & Tehr

Attorney

Patented June 24, 1930 1,766,505

UNITED STATES PATENT OFFICE

ORIN E. MARVEL, OF DAYTON, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO GENERAL MOTORS RADIO CORPORATION, OF DAYTON, OHIO, A CORPORATION OF OHIO

ELECTRICAL APPARATUS

Application filed March 2, 1925. Serial No. 12,780.

This invention relates to apparatus for receiving radio signals and particularly to circuit arrangements for providing a satisfactory local source of energy therefor.

One of the principal objects of the invention is to provide an apparatus for receiving radio signals in which the switch for the filament circuit is arranged to also control related circuits.

Another object of the invention is to provide an apparatus for receiving radio signals having means for automatically connecting the storage battery with a battery charger upon the opening of the filament circuit.

Further objects and advantages of the present invention will be apparent from the following description taken in connection with the accompanying drawings, in which—

Fig. 1 is a schematic diagram of the present invention;

Figs. 2 and 3 show several operating positions of the filament control switch of Fig. 1; and

Fig. 4 is a modified form of the invention.

Apparatus for receiving radio signals, as now known, requires for its successful operation a local source of current which may be a storage battery. Owing to the frequent and extensive operation of such apparatus it often happens that the battery reaches a condition approaching full discharge without the operator being aware of this condition, and as a consequence of such a condition of the battery the operation of the receiving apparatus is likely to be affected unfavorably. For the best operation of radio receiving apparatus as well as to secure the longest life and greatest reliability from the storage batteries, it is highly desirable that the batteries be continually maintained at full charge. The present invention provides means for accomplishing this result by automatically connecting the storage battery with a battery charger or source of current immediately upon discontinuing the use of the receiving apparatus for the reception of signals.

Referring to the drawings, 20 denotes the panel of a radio receiving apparatus or set and 21 the storage battery or local source of electrical energy for the radio receiving apparatus. The receiving apparatus includes local work circuits such for example as the filament circuit herein illustrated in which the filament of an electron discharge device 22 is connected to the battery 21 by means of the wires 23 and 24. For controlling the filament or work circuit 23, 24 the receiving apparatus is provided with a switch 25 which may be of push-pull or other usual type, the construction of the switch herein illustrated being such that when the switch 25 is pulled outwardly from the panel the work circuit 23, 24 is closed and the switch is then in what may be termed its closed position, as illustrated in Fig. 2. When the switch is pushed inwardly to its open position the work circuit 23, 24 is open as illustrated in Fig. 1.

Associated with the radio receiving apparatus is a second source of electrical energy adapted to charge the storage battery 21, this second source of electrical energy being herein illustrated as a battery charger 26 having a primary winding 27 connected with line circuit or wires 28 and a secondary winding 29 having its secondary or output circuit connected with the terminals of battery 21 by means of wires 30 and 31. The primary or input circuit of the battery charger is provided with a switch 32 having spring switch blades 33 and 34 by which the primary circuit may be opened or closed to control the operation of the battery charger. The battery charger herein illustrated is one of the vibrating-armature type having an armature 35 which is adapted to vibrate between cooperating contacts 36 and 37. In this type of battery charger the vibrating armature 35 may come to rest against one of the contacts 36, 37 when the battery charger is not in use thereby maintaining the secondary circuit closed across the terminals of the battery and causing a discharge of the battery through the secondary

circuit. To guard against this contingency the secondary circuit is also provided with a switch 38 having cooperating spring switch blades 39 and 40 to open or close the secondary circuit simultaneously with the opening or closing of the primary circuit. It will be understood that the present invention is not limited to the use of the particular type of battery charger herein illustrated but that any other type of battery charger may be employed and that in such other type of battery charger as well as in the type herein shown the secondary switch 38 may be omitted if desired.

The work circuit 23, 24 including the filament 22 has been taken as illustrative of one or all of the work circuits of the radio receiving apparatus which are normally closed during the operation of the radio receiving apparatus, and which circuits are open or in a non-flow condition when the radio receiving apparatus is not in use. The present invention contemplates the connection of the battery charger 26 or second source of electrical energy to the battery 21 as soon as the use of the radio receiving apparatus is discontinued, and it provides suitable means for automatically accomplishing this connection, which means will now be described.

The means for automatically connecting the battery charger 26 in charging relation with the battery 21 when the filament or work circuit is opened consists of an electromagnet 50 having a pivoted armature 51 which is adapted to be controlled thereby to open or close the switches 32 and 38 of the battery charger circuits. The electromagnet has a suitable winding 52 which may be connected in an energizing circuit which extends from one side of the battery through wire 53, contact 54 carried by the filament control switch, wire 55, winding 52 and wire 56 to the other side of the battery. The winding 52 may also form part of a holding circuit which extends from one side of the battery through wire 53, contact 54 carried by the filament control switch 25, wire 57, armature 58, wire 59, winding 52, and wire 56 to the other side of the battery.

The construction and arrangement of the filament control switch 25 and the contacts cooperating therewith is such that while the filament or work circuit 23, 24 is closed the energizing and the holding circuits of the electromagnet 50 are open as illustrated in Fig. 2. This is the normal condition for operation of the radio receiving set and it will be observed, the electromagnet 50 being deenergized, that the switches 32 and 38 of the battery charger are open, and the battery charger 26 is therefore disconnected from the battery 20.

When it is desired to discontinue operation of the radio receiving set the filament control switch 25 is moved from its closed position, illustrated in Fig. 2, to its open position illustrated in Fig. 1. This movement is normally fairly rapid, but in moving from the closed position shown in Fig. 2 to the open position shown in Fig. 1, the filament control switch passes through the intermediate position illustrated in Fig. 3. In this position it will be observed that the filament circuit is already open but the contact ring 54 has connected the wires 53 and 55 to close the energizing circuit thereby causing the electromagnet 50 to attract the armatures 51 and 58. Attraction of the armature 51 closes the switches 32 and 38 to connect the battery charger 26 in operative charging relation with the battery 21. Attraction of the armature 58 closes the holding circuit, which, as heretofore stated, includes the wire 57 and armature 58. On further movement of the filament control switch from the position shown in Fig. 3 towards that shown in Fig. 1 the contact ring 54 closes the holding circuit from wire 53 to wire 57 so that now current is flowing through both the energizing circuit and the holding circuit. The final movement of the filament control switch 25 to the position shown in Fig. 1 serves to open the energizing circuit between wires 53 and 55 so that the electromagnet is energized solely by virtue of the current flowing through the holding circuit which includes the switch 58.

The battery charger 26 being thus connected to the battery 21, the latter is charged and such charging continues until the battery has attained a condition of full charge. It is well known that after a battery is fully charged, any further charging thereof will cause liberation of gas therefrom, a condition which is commonly termed "gassing" of the battery. In the present invention advantage is taken of this phenomenon to disconnect the battery charger from the battery when the latter has attained its full charge. A funnel or other suitable conduit 60 is connected with the interior of one or more of the battery cells, and the upper end of the funnel is closed by means of a suitable flexible wall 61 to form a gas chamber, the flexible wall 61 being herein illustrated as a rubber diaphragm. A switch 62 having spring switch blades 63 and 64 is connected in the wire 56 of the electromagnet control circuits. The switch 62 is normally closed but when the battery gases as a result of the battery having attained its full charge the switch 62 is opened thereby breaking the holding circuit to deenergize the winding 52 of the electromagnet. Such deenergization of the electromagnet releases the armature 58 to open the holding circuit, and also releases the armature 51 to open the switches 32 and 38 of the battery charger 26, thereby ren-

dering the latter inoperative to further charge the battery.

Should it be desired to resume operation of the radio receiving apparatus before the battery is fully charged and before the switch 62 has operated, it will be seen that the mere usual movement of the filament control switch to the normal position for closing the filament circuit, as illustrated in Fig. 2, will open the circuits of the electromagnet to deenergize the latter and automatically discontinue operation of the battery charger 26.

While the arrangement illustrated in Fig. 1 shows one means responsive to the state of charge of the battery for discontinuing the charging operation when the battery attains full charge, it is to be understood that any other suitable means may be employed for accomplishing this result. One such alternative means is illustrated in Fig. 4. Advantage is taken of the fact that the voltage across the terminals of the battery being charged increases as the charging progresses so that when the battery attains full charge the voltage has attained a certain value which depends somewhat upon the rate of charge but which may nevertheless be taken as corresponding to and indicating a full charge of the battery. The general arrangement of circuits and parts in Fig. 4 is the same as shown in Fig. 1 except that instead of the chamber 60 for receiving the battery gases, there is connected between the wires 56 and 59 a thermostat heating circuit 69 including the thermostat heating coil 70 which latter surrounds or is in heating relation with a bi-metallic thermostat blade 71.

A second or reverse winding 72 is placed upon the electromagnet 50 this winding also being connected between the wires 56 and 59. The circuit of this reverse winding 72 is adapted to be controlled by the thermostat blade 71 which, when it is heated sufficiently, moves into engagement with the contact 73 to close the circuit through the reverse winding 72. At other times, when the thermostat blade 71 is not heated sufficiently, then the circuit through the reverse winding is open and the reverse winding is therefore ineffective.

In the operation of this form of the invention it will be seen that when the switch 25 is moved to position to open the filament circuit and to close the charging circuit, the thermostat heating circuit 69 is immediately connected across the terminals of the battery. Current thus flows through the thermostat heating coil 70 to heat the thermostat blade 71, but the heat generated by the heating coil 70 is not sufficient to cause the thermostat blade 71 to engage the contact 73 because of the low voltage of the battery. As the battery becomes charged the voltage thereof rises and this results in an increased current flow in the thermostat heating circuit until finally at a predetermined voltage corresponding to full charge of the battery, the thermostat blade 71 is caused to engage contact 73 thereby closing the circuit of the reverse winding 72. The reverse winding 72 is so arranged that upon the flow of current therethrough its effect opposes that of the main winding 52 to deenergize the electromagnet 50 thereby permitting the holding circuit to open at 58, and to discontinue the charging operation. The thermostat blade may be adjusted to operate at any desired voltage by means of the adjusting screw 74. While it has been stated that the reverse winding 72 operates to deenergize the electromagnet 50, it should be understood that it is not essential to the successful operation of this form of control that the electromagnet be entirely deenergized, but only that the effective ampere turns thereof be reduced to such a point as to permit the armature 58 to drop out. It will be understood that the change in the number of ampere turns in the electromagnet 50 may be readily effected by causing the thermostat 71 to close a circuit of suitable resistance which is in shunt with the winding 52, whether this shunt circuit is exterior to the electromagnet 50 or whether it includes a reverse winding for the electromagnet as herein illustrated.

From the foregoing it will be apparent that the present invention provides a radio receiving apparatus having means for at all times and automatically maintaining the battery in a fully charged condition. Further, it provides such an organization and arrangement of parts that the battery charging may be effected automatically merely by the normal and usual movement of the control switch with which the radio receiving apparatus is already provided for starting or stopping operation of the radio receiving apparatus.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. An apparatus for receiving radio signals comprising, in combination, a radio receiving set having a filament circuit, a control panel for said set, a manually operable switch carried by said control panel for opening and closing said circuit, a source of electrical energy connected with said circuit, a second source of electrical energy adapted to charge said first source of energy, and means operable upon the opening of said filament circuit by the opening

movement of said switch to automatically connect the second source of energy in charging relation with said first source, and means responsive to the state of charge of said first source to disconnect the second source therefrom.

2. An apparatus for receiving radio signals comprising, in combination, a radio receiving set having a work circuit, a switch carried by said receiving set and included in said work circuit for opening and closing said work circuit, a source of electrical energy connected with said circuit, a second source of electrical energy adapted to charge said first source of energy, and means operable upon the opening of said switch to automatically connect the second source of energy in charging relation with said first source.

3. An apparatus for receiving radio signals comprising, in combination, a radio receiving set having a filament circuit, a control panel for said set, a manually-operable control switch associated with said panel for opening and closing said filament circuit, a source of electrical energy connected with said circuit, a second source of electrical energy adapted to charge said first source of energy, and relay means operable upon the opening of said switch to automatically connect the second source of energy in charging relation with said first source.

4. In an apparatus for receiving radio signals having a work circuit and a switch therein for opening and closing said circuit, a source of electrical energy connected with said circuit, a second source of electrical energy comprising primary and secondary circuits, adapted to charge said first source of energy, and means operable upon the opening of said work circuit by said switch to connect the second source of energy in charging relation with said first source, said means comprising an electromagnet connected with one of said sources and adapted to be energized thereby, an armature controlled by the electromagnet, and switch means conected in the primary and secondary circuits of said second source to control the operation thereof.

5. In an apparatus for receiving radio signals having a work circuit and a switch therein for opening and closing said circuit, a source of electrical energy connected with said circuit, a second source of electrical energy adapted to charge said first source of energy, and means operable upon the opening of said work circuit by said switch to connect the second source of energy in charging relation with said first source, said means comprising an electromagnet, armature and switch means controlled by said electromagnet, an energizing circuit for the electromagnet, and a holding circuit for the electromagnet.

6. In an apparatus for receiving radio signals having a work circuit and a switch therein adapted to be moved between opening and closing positions to open or close said work circuit, a source of electrical energy connected with said circuit, a second source of electrial energy adapted to charge said first source of energy, and means operable upon the movement of said switch towards open position for opening said work circuit to connect the second source of energy in charging relation with said first source, said means comprising an electromagnet having energizing and holding circuits, said switch being constructed and arranged to close the energizing and holding circuits upon movement towards opening position, and then to open the energizing circuit upon further movement towards opening position.

7. In an apparatus for receiving radio signals having a work circuit and a switch therein adapted to be moved between opening and closing position to open or close said work circuit, a source of electrical energy connected with said circuit, a second source of electrical energy adapted to charge said first source of energy, and means operable upon the movement of said switch towards open position for opening said work circuit to connect the second source of energy in charging relation with said first source, said means comprising an electromagnet having energizing and holding circuits, said switch being constructed and arranged to close the energizing circuit upon movement towards opening position, to also close the holding circuit upon further movement towards opening position, and then to open the energizing circuit upon still further movement towards opening position.

8. An apparatus for receiving radio signals comprising, in combination, a radio receiving set and a work circuit, a switch carried by said receiving set and included in said work circuit for opening and closing said circuit, a source of electrical energy connected with said circuit, a second source of electrical energy adapted to charge said first source of energy, and means operable upon the opening of said work circuit by said switch to connect the second source of energy in charging relation with said first source, said means comprising an electromagnet connected with one of said sources, switch means controlled by the electromagnet for controlling said connection of said second source with said first source, and means responsive to the state of charge of said first source of energy to change the magnetic effect of said electromagnet whereby to cause operation of said switch means to interrupt the charging operation.

9. In an apparatus for receiving radio signals having a work circuit and a switch

therein for opening and closing said circuit, a source of electrical energy connected with said circuit, a second source of electrical energy adapted to charge said first source of energy, and means operable upon the opening of said work circuit by said switch to connect the second source of energy in charging relation with said first source, said means comprising an electromagnet having a winding connected with one of said sources, switch means controlled by the electromagnet for controlling said connection of said second source with said first source, and means including a second winding on the electromagnet responsive to the state of charge of said first source of energy to change the effective ampere turns of said first winding whereby to cause operation of the switch means to interrupt the charging operation.

In testimony whereof I hereto affix my signature.

ORIN E. MARVEL.