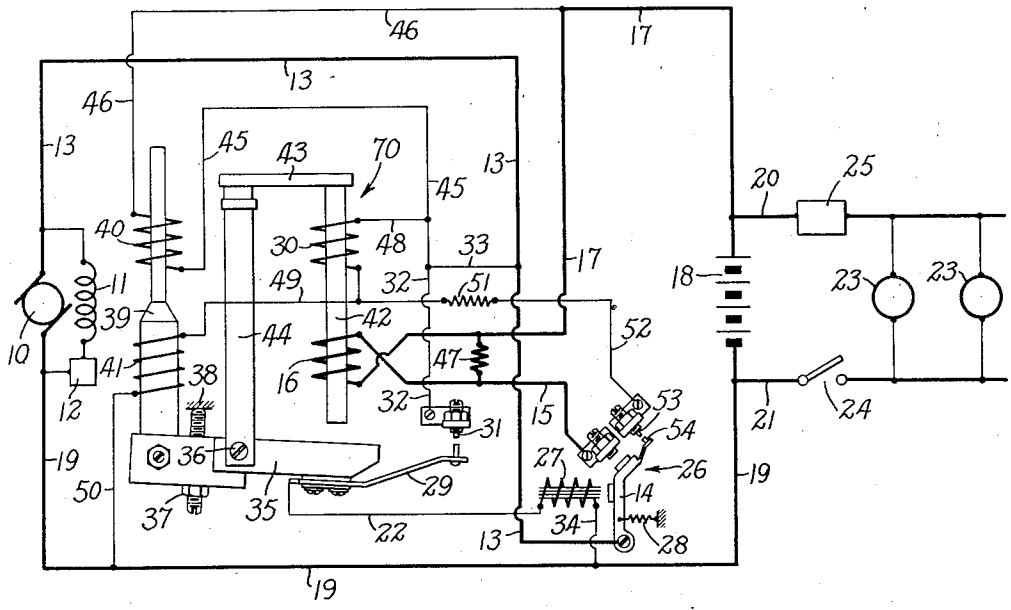
Nov. 14, 1939. L. H. VON OHLSEN 2,179,651

ELECTRICAL SYSTEM

Filed Feb. 9, 1937

Fig. 1.



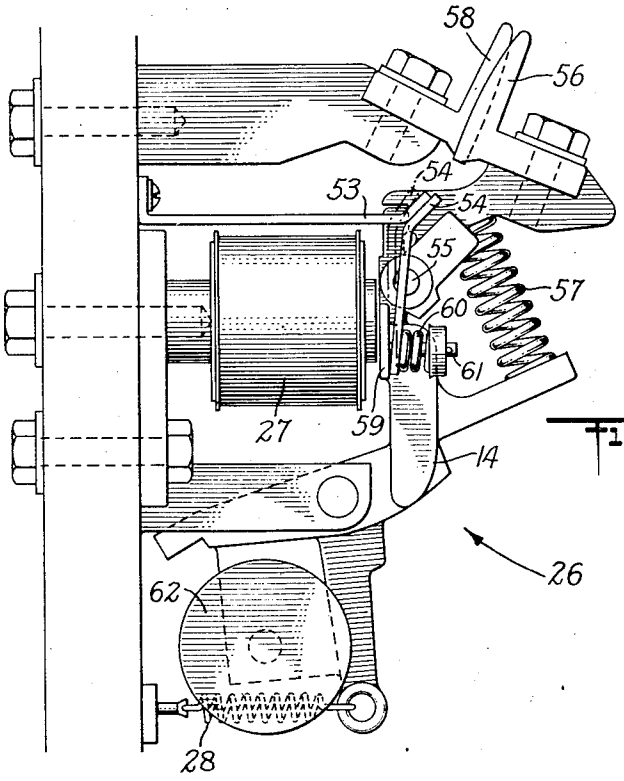


Fig. 2.

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ELECTRICAL SYSTEM

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8 Claims. (Cl. 171—314)

This invention relates to electrical connecting apparatus, and, with regard to the more specific features thereof, to automatic means for the connection and disconnection of a source of current and a storage battery.

One of the objects thereof is to provide apparatus of the above nature of simple and thoroughly practical construction. Another object is to provide apparatus of the above nature of efficient and dependable action. Another object is to provide apparatus of the above nature in which the opening and closing of contacts is brought about with certainty and absence of chattering. Another object is to provide apparatus of the above nature which although ruggedly built is highly sensitive in its action. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangement of parts as will be exemplified in the structure to be hereinafter described and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing in which is shown one of the various possible illustrative embodiments of this invention,

Figure 1 is a diagrammatic plan;

Figure 2 is a side elevation of a contactor and associated parts.

Similar reference characters refer to similar parts throughout both views of the drawing.

As conducive to a clearer understanding of certain features of this invention, it may be noted that in a certain use of apparatus such as is herein dealt with, the conditions of jarring and vibration are severe and the available forces for timely action are small. To provide a ruggedness and simplicity of construction suitable to meet the shocks and jars to which it is exposed and yet such sensitiveness as will utilize the small available forces to cause timely and dependable action, is one of the dominant aims of this invention.

Referring now to Figure 1 of the drawing, there is shown at 10 a generator which may be driven from the axle of a railway car and thus subject to stoppage and a wide variation in speed. This generator is provided with the shunt field winding 11 and suitable regulating apparatus diagrammatically indicated at 12. From one terminal of the generator the lead 13 connects to the swinging member 14 of a contactor adapted to make connection with a conductor 15 leading to a series coil 16 from which the main generator current is led by a conductor 17 to one of the terminals of a suitable storage battery 18. The remaining terminal of the storage battery 18 is connected by conductor 19 to the remaining terminal of the generator 10.

Suitable leads 20 and 21 from the terminals of the battery are adapted to carry current to the load, here indicated as lamps 23, and it is understood that a suitable lamp switch 24 and lamp regulator 25 of the usual construction are employed as indicated.

Referring back to the contactor, indicated as a whole at 26, the main arm governing the completion of the circuits is drawn toward closed position by a coil 27 acting in opposition to spring 28 and/or gravity. This coil 27 is connected by conductor 22 with one of the contacts 29 of a relay indicated as a whole at 70. The coacting stationary contact 31 is connected by the conductors 32 and 33 with the generator lead or main 13. The remaining terminal of the coil 27 is connected as at 34 with the main conductor 19, and hence, upon the closing of the relay, coil 27 is bridged across the generator.

The relay 70 comprises a swinging armature 35 having mounted thereon contact 29. This armature is pivoted at 36 and its swing is limited by the adjustable stop 37 coacting with abutment 38. Pivoted to the free end of the armature 35, remote from contact 29, is a movable core 39 controlled by coils 40 and 41. The forces tending to swing the armature in a counterclockwise direction are due to the effect of the coils 16 and 30 upon a fixed core 42. This core has its magnetic circuit continued by the members 43 and 44 so as to provide an ample magnetic flux when the armature 35 is at or near closed position and enhance the certainty of its closing action.

The coil 40 is connected with the main conductor 13 by means of conductors 33 and 45. The other end of coil 40 is connected by conductor 46 with the main conductor 17. Hence it will thus be seen that this coil 40 is bridged about the main contacts of contactor 26 and the series coil 16 which is provided with the shunt 47 so as to reduce its current flow and permit the use of a small coil. Thus upon the closing of the contactor 26, the coil 40 is substantially short-circuited and without appreciable power.

Coil 30 is connected as at 48 with the conductor 33 and is connected at the other end as by 49 with the coil 41 from which the circuit is led by conductor 50 to the main conductor 19. Thus the coils 30 and 41 are connected across

the generator mains in series with each other.

A suitable resistance 51 is connected with the conductor 49 at one end and at its other end by a conductor 52 with a fixed contact 53 on the contactor 26. Coacting with this contact 53 is another auxiliary contact 54 mounted upon the conductor arm, and these contacts are so formed and disposed as to remain in connection after the circuit between the main contacts has been broken. In this manner when the contactor is closed, a shunt will be completed through the resistance element 51 about the coil 30. This will obviously weaken the flow of current in coil 30 and yet increase the total flow of current in conductor 49 and coil 41.

Referring to Figure 2 of the drawing is a slightly more detailed showing of the elements of contactor 26. It will be seen that the swinging arm 14, diagrammatically indicated in Figure 1, is provided with a pivotal joint 55 so that the movable main contact 56 can yield by compression of the spring 57. This action occurs as the contact is forced into engagement with the coacting stationary main contact 58.

The movable auxiliary contact 54 is yieldingly mounted on a lateral extension of the swinging arm 14 by means of a side flange 59 against which it is held by the coiled spring 60 about the pin 61 in the position indicated in dotted lines in Figure 2. When the main arm 14 swings toward closed position, the contacts 56 and 58 are forced together, as are also the contacts 54 and 53. The contact 54, however, yields throughout a larger portion of its movement than the contact 56, and hence the contacts 53 and 54 will remain in engagement longer than the contacts 56 and 58 when the contactor opens.

A suitable balance weight 62 is mounted on the lower end of the arm 14 and serves to increase the inertia of the moving parts as well as bring their center of gravity into the axis about which the swing and thus reduce the effect of jarring or vibration.

Considering now the action of this apparatus, and assuming it to form a portion of a train lighting system, when the train is at a standstill the contactor 26 must be open to prevent back discharge of the battery. At this stage the coil 40, being bridged about the contacts of the contactor and coil 16, permits back discharge to such an extent as will keep coil 40 alive.

Although this provides a slight drain on the battery, this current flow assures that the generator will build up with the proper polarity when it becomes reactive due to increase in train speed. This current flowing through coil 40 also serves to hold the relay open against shocks and jars. Any current flowing through coil 41, whether due to discharge of battery 18 or the generator voltage, will assist coil 40 in performing this function.

As the generator is started and its speed increases, the current through coils 30 and 41 increases and coils 41 and 40 act cumulatively. However, during this time, the rise in the generator voltage causes the battery discharge current through coil 40 to decrease, and if the generator voltage exceeds the battery voltage this current will actually reverse. Thus, the pull of coil 30 gradually increases and the cumulative pull of coils 40 and 41 gradually decreases until the former becomes great enough to raise armature 35 to close contacts 29 and 31.

Thus it is seen that coils 40 and 41 first act cumulatively, and as the generator voltage gradually increases, the current through coil 40 decreases and actually reverses. If armature 35 remains in open position, the cumulative pull of coils 40 and 41 will decrease to zero when the effect of the reversed current through coil 40 equals the effect of the current through coil 41. At the same time the pull of coil 30 gradually increases with the increase of voltage. By properly designing coils 40, 41, and 30, the effect of these three coils may be adjusted so that armature 35 will be raised to contact-closing position at any value of generator voltage near, but above or below, battery voltage.

The closing of the circuit comprising contacts 29 and 31 leads current directly through the coil 27 and the latter immediately swings the arm 14 to the left, having reference to the drawing. This action closes the circuit, as hereinbefore described, through the series coil 16 and, as the generator should then be at such voltage as to start supplying current to the battery and the load, the current may be assumed to be flowing downwardly through this coil, having reference to the diagrammatic showing in Figure 1. It thus acts cumulatively with respect to the coil 30 holding the relay closed with a force which increases as the charging current builds up.

The closing movement of the arm 14 of the contactor brings together the auxiliary contacts 53 and 54, thus closing the shunt with resistance 51 about the coil 30. The weakening of coil 30, however, and the attendant strengthening of coil 41 are wholly insufficient to cause opening of the relay, particularly as the coil 40 is substantially deenergized by the closing of the main contactor.

Assuming now that the train, and hence the generator, decrease in speed and that the voltage of the latter falls, a condition is approached where the generator and battery voltage are equal. At such time the charging current passes through zero, thus deenergizing coil 16, and the coil 30 is also weakened due to fall of the generator voltage. With this condition the coil 41 exerts a sufficient pull on the movable core 39 to open the relay. This breaks the circuit of coil 27, and, the main contacts of the contactor being separated, the coil 16 is instantly deenergized. The coil 30, furthermore, remains weakened after the opening of the main contacts of the contactor as the movable auxiliary contact 54 is provided with a spring mounting, as hereinbefore explained, which will maintain it in closed circuit position until just after the main contacts are opened. Thus the closing effect of coil 30 is not strengthened by the opening of its shunt until after the armature 35 has moved away from coil 42. The decrease in flux due to the opening of this gap and the deenergization of coil 16 gives such a great preponderance of pull on the left-hand end of the relay (having reference to Figure 1) that the latter swings open without any tendency to chattering or fluttering on its contacts. This dependable and strong opening of the relay definitely terminates the current through coil 27 and the main contactor opens with the same certainty and freedom from chatter.

It will thus be seen that the action of the various parts is thoroughly dependable and may be exactly timed. It will also be seen that the arrangement of coils is such that although the difference between battery voltage and generator voltage may be extremely small or even zero, yet there are available and utilized strong magnetic forces for operating the relay and con-

tactor. It will also be seen that this illustrative apparatus is adapted to achieve the objects of the invention and to meet the hardest conditions of practical use.

As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth it is to be understood that all matter hereinbefore set forth, or shown in the accompanying drawing, is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. The combination with a generator, a battery, and a normally open switch means for connecting said generator and said battery, of electromagnetic means for effecting closure of said switch means comprising a pair of independently magnetizable pole pieces, a rockable armature mounted to be influenced by the magnetic flux present in said pole pieces, a first winding surrounding one of said pole pieces energizable in accordance with the current flowing through said switch means, a second winding surrounding a second of said pole pieces and connected in parallel with said switch means, a third winding mounted with said first winding, a fourth winding mounted with said second winding, said third and fourth windings being connected in series across said generator, a resistance shunt, and circuit means including a switch operative to close a connection through said shunt, said first and third windings cooperating when said generator is charging said battery to hold said armature in one position and said first and third windings opposing each other when said battery is discharging through said generator, said second and fourth windings cooperating to hold said armature in its other position when the battery voltage is above the generator voltage and said second and fourth windings opposing each other when said switch means is open and the battery voltage is below the generator voltage, said shunt and its switch being effective to increase the current through said fourth winding when said switch means is closed and to increase the current through said second winding when said switch means is opened.

2. The combination with a generator, a battery, and a normally open main switch means for connecting said generator and said battery—of electromagnetic means for effecting closure of said switch means comprising, a first electromagnetic unit, a second electromagnetic unit, a rockable armature mounted to be influenced by the flux of said electromagnetic units and thereby be moved between its two positions, a control switch mounted to be opened and closed by the movement of said armature, and a solenoid unit connected to be energized by the closing of said switch and controlling the closing of said switch means; said first electromagentic unit including, a coil energizable in accordance with the current flowing between said battery and said generator when said main switch is closed, and a first generator voltage coil; said second electromagnetic unit including, a shunt coil connected in parallel with said main switch, and a second generator voltage coil connected in series with said first generator voltage coil across said generator; and a shunt circuit means including a resistance unit and an auxiliary switch operative to close a connection through said resistance unit; said shunt circuit means being effective to increase the current through said first generator voltage coil when said switch means is closed and to increase the current through said second generator voltage coil when said switch means is opened.

3. The combination with a generator, a battery, a main switch for connecting said generator and said battery, and switch operating means to control the opening and closing of said main switch—of electromagnetic means for manipulating said switch operating means comprising, a first electromagnetic unit including a voltage coil and a coil energizable in accordance with the current flowing between said battery and said generator, and a second electromagnetic unit including a voltage coil and a shunt coil connected in parallel with said main switch; and a circuit means comprising, means connecting said voltage coils in series across said generator, and a shunt circuit connected in parallel with one of said voltage coils including a resistance unit and an auxiliary switch, said shunt circuit being effective to increase the current through one of said voltage coils substantially when said switch is in closed position and to increase the current through the other of said voltage coils substantially when said main switch is in open position.

4. The combination with a generator, a battery, a main switch for connecting said generator and said battery, and switch operating means to control the opening and closing of said main switch—of electromagnetic means for manipulating said switch operating means comprising, a first electromagnetic unit including a voltage coil and a coil energizable in accordance with the current flowing between said battery and said generator, and a second electromagnetic unit including a voltage coil and a shunt coil connected in parallel with said main switch; and a circuit means comprising, means connecting said voltage coils in series across said generator, and a shunt circuit connected in parallel with one of said voltage coils including a resistance unit and an auxiliary switch, said shunt circuit being effective to increase the current through one of said voltage coils when said switch starts moving toward its closed position and to increase the current through the other of said voltage coils immediately after said main switch has been opened.

5. In apparatus of the general nature of that herein described, in combination: a generator; a storage battery; a main switch to connect said generator to said battery; and operating means for said main switch including, a first voltage coil which when energized tends to cause said main switch to open, a second voltage coil which when energized tends to cause said circuit to close, means connecting said first and second coils in series, and a shunt circuit including a resistance unit and an auxiliary switch mechanically connected to operate substantially when said main switch operates, said shunt circuit being connected to simultaneously strengthen one of said coils and weaken the other of said coils when said switch is operated.

6. In apparatus of the general nature of that herein described, in combination: a generator; a storage battery; a main switch to connect said generator to said battery; and operating means for said main switch including, a first voltage coil which when energized tends to cause said main switch to open, a second voltage coil which when energized tends to cause said circuit to close, means connecting said first and second coils in series, and a shunt circuit including a resistance unit and an auxiliary switch mechan-

ically connected to open immediately after said main switch opens and to close immediately before said main switch closes.

7. In apparatus of the general nature of that herein described, in combination: a generator; a storage battery; a main switch to connect said generator to said battery; and operating means for said main switch including, a first voltage coil which when energized tends to cause said main switch to open, a second voltage coil which when energized tends to cause said circuit to close, means connecting said first and second coils in series, and a shunt circuit including a resistance unit and an auxiliary switch mechanically connected to open substantially when said main switch opens, said shunt circuit being connected to simultaneously increase the current through said second coil and decrease the current through said first coil when said auxiliary switch opens.

8. The combination with a generator, a battery, a main switch for connecting said generator and said battery, and a control switch controlling the opening and closing of said main switch—of electromagnetic means to open and close said control switch comprising, a first solenoid assembly including a first coil which when energized tends to open said switch, a second solenoid assembly including a second coil which when energized tends to close said control switch, and a circuit means connecting said first and second coils in series across said generator, said circuit means including a resistance unit and an auxiliary switch which when closed connects said shunt in parallel with said second coil—whereby the closing of said auxiliary switch simultaneously strengthens said first coil and weakens said second coil.

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