This invention relates to starting and ignition systems for explosive engines, although it is not necessarily restricted to such systems and will find application in connection with other electrical apparatus.

The principal feature of the invention is an arrangement whereby a heavy load on one part of an electrical system is prevented from causing an excessive fall of potential in another part of the system which would interfere with the operation of apparatus included therein. This arrangement is particularly useful in starting and ignition systems for large eight- and twelve-cylinder automobile engines. In starting, especially in cold weather, the starting motor takes a heavy current from the battery. This produces a fall in potential which seriously affects the ignition, the result being especially harmful because it occurs at the very time when the ignition should be most efficient. Tests show that the normal battery potential of about six volts may be reduced during starting to four volts or less, with the result that a very poor spark is obtained, which will make the car hard to start and may prevent starting altogether.

My invention insures the proper potential in the ignition portion of the system regardless of the load on the starting battery, so that starting is certain so long as the engine can be turned over.

I am aware that starting and ignition systems have been designed before now with the object of overcoming the difficulty pointed out above. These prior schemes have, however, all been more or less unsatisfactory. Some of them do not accomplish the end sought, others do so only at the expense of interfering with the functioning of some other equipment, while still others utilize switches, relays, or other apparatus which is liable to get out of order. The plan proposed herein is believed to be free from these objections, providing a highly reliable and economical system of the character described.

Another feature of the invention is a battery unit which comprises in one structure a main starting battery, an auxiliary ignition battery, and a rectifier.

Other features of the invention will be pointed out in connection with a detailed description thereof, reference being had to the accompanying drawing, in which:

Fig. 1 is a diagrammatic circuit drawing showing one form of my invention, while

Fig. 2 is a similar circuit drawing, showing a modified form of the invention, including the unitary battery structure.

Referring to Fig. 1, the reference character 2 indicates the starting motor of an automobile or other engine to which the invention is applied. The reference character 4 indicates the main battery which furnishes current for starting and for other purposes. The battery 4 may be connected with the motor 2 by means of a starting switch 3. The usual fuse panel is shown at 5, while a fuse panel is shown at 6. A generator 7 provides current for charging the batteries and for other purposes while the car is running.

The ignition system includes the ignition switch 11, the induction coil 12, the breaker 13, 15 and the distributor 14. The details of the arrangement for an eight-cylinder engine. The auxiliary battery 9 supplies current for the ignition system during starting, or part of the current at least, as will be explained. The ignition circuit is connected to the generator circuit through a uni-directional current device or rectifier 10, and also a switch 8, although the latter is not essential.

The operation will now be described, it being assumed that the engine is not running and that it is desired to start. The ignition switch 11 is first closed, as indicated in the drawing. The starting switch 3 is now depressed. This connects the motor 2 with the battery 4, causing the motor to start up and crank the engine. When the engine turns over the cylinders start firing and the engine begins to run. The starting switch is then released.

It will be noticed that the main battery 4 and the auxiliary battery 9 are connected in parallel through the ammeter 5, switch 9, and rectifier 10. Current for the ignition system may, therefore, be supplied from these batteries in parallel, the rectifier 10 being arranged to permit current flow from the battery 4 to the ignition circuit. As regards the motor circuit, however, current is supplied exclusively from the battery 4, because the rectifier 10 will not permit current to flow from the battery 8 to the motor circuit. It follows, therefore, that if the motor 2 can turn the engine over only rather slowly, so that there will be a considerable fall in potential at the battery 4, this will not affect the operation of the ignition system, which now gets its current from the battery 8. The rectifier 10 prevents the battery 8 from supplying any current to the motor circuit, and its out-put is delivered to the ignition system at full voltage, or approximately full voltage, the relatively small current re-
quired for the ignition system causing only an insignificant drop.

As soon as the engine picks up speed, the generator 7 is automatically connected up in the circuit including the generator, switch 9, rectifier 10, ignition switch 11, coil 12, and breaker 13. A branch of this circuit extending to the right from the lower terminal of the rectifier supplies current for charging the battery 8. There is also a circuit which extends from the generator through the ammeter 5 for charging the battery 4.

It will be appreciated now that with the generator in operation the batteries 4 and 8 are effectively connected in parallel so as to be charged by the generator. They are also effectively connected in parallel as regards the supply of current to the ignition system when the generator is not running. As regards the supplying of current to the motor circuit, however, the two batteries are effectively isolated and the battery 8 cannot furnish any current to the motor. Excessive fall of potential at the battery 8 is prevented and the ignition is unimpaired even under the most adverse starting conditions.

The switch 9 is not necessary but may be provided if desired. With the switch in the left-hand position as shown, the ammeter will show the charging current of the battery 4. If the switch is thrown to the right, the ammeter will indicate the sum of the currents supplied to the two batteries and the ignition system. The difference between the two readings will be the value of the current 5, supplied to the ignition system and the battery 4, and since the current taken by the ignition system is known the amount of charging current supplied to battery 8 can readily be determined. It may be pointed out also that the ammeter can be observed to detect certain trouble in the rectifier 10 or battery 8. If the rectifier 10 should become short-circuited, the ammeter will give a reading when the starting switch is depressed. Or if the battery 8 should become defective, by reason of a short-circuited cell, the ammeter will show a reading in the reverse direction, with the engine off. Both readings can be checked by throwing the switch to the right, thus cutting out the ammeter.

The rectifier or uni-directional current device may be of the copper-oxide type, or it may be of the liquid type. The battery 8 may be of very low capacity. A little consideration will show that the power output required from battery 8 is inconsiderable. A battery which will supply three or four amperes for as long as ten minutes would be ample for the ordinary case.

It is contemplated that a battery of three cells of the counter-electromotive force type, with plain lead plates, would be satisfactory for most automobiles, starting systems.

Referring now to Fig. 2, the arrangement there shown may be explained. The reference characters 22 and 23 indicate a starting motor and switch, respectively. The reference character 25 indicates the fuse panel, and 27 the generator. The ignition system includes the switch 31, the coil 32, the breaker 33, and the distributor 34. These parts are similar to the corresponding parts in Fig. 1.

The battery 4 is indicated by the reference character 40. For convenience in mounting in the car, both batteries and the rectifier are combined in one unit. This arrangement also has other advantages, including reduction in cost. The cells 41, 42, and 43 constitute the car battery, corresponding to battery 4 in Fig. 1, while cells 44, 45, and 46 compose the auxiliary battery, corresponding to battery 8 in Fig. 1. The rectifier is indicated by 50, and may conveniently be of the liquid type, as its maintenance in connection with the high-tension engine over rapidly even is easily taken care of. A dry rectifier may, however, be used if desired. The drawing is more or less diagrammatic and the relative sizes of the parts are not necessarily exactly as shown. It will be seen that a compact unit has been provided, including two batteries and a rectifier in a single structure. This unit may conveniently be mounted in the space provided in the car for mounting the usual single battery, and requires no special attention. The cost also should not greatly exceed the cost of the ordinary single battery, if, indeed, there is any difference at all. It must be borne in mind that the present practice is to overcome the difficulty of cold weather starting by providing a large battery of sufficient capacity to the car battery and the ignition system, under adverse conditions, so that the fall of potential will not be great enough to impair the ignition. Thus the battery is generally much larger than would be required otherwise. Since my invention insures ignition regardless of how sluggish the starting motor is in turning over the engine, the main battery can be made considerably smaller with satisfactory results.

The operation of the system shown in Fig. 2 is similar to the operation of the system shown in Fig. 1. Hence, it will not be necessary to go over this again.

While I have shown my invention embodied in a starting and ignition system for automobiles, its use is not necessarily confined to such systems, and it can be used to advantage in other systems where similar conditions exist. I do not, therefore, wish to be confined to the exact form of the invention shown and described, but desire to include and have protected by Letters Patent all forms and modifications of my invention which come within the scope of the appended claims.

What is claimed is:

1. In combination, a motor, a battery for supplying current to said motor, an ignition circuit, a second battery for supplying current to said circuit, a connection between said batteries thereby they are connected in parallel while the motor and ignition circuit are in operation, and a uni-directional current device included in said connection for preventing current flow from the second battery to said motor.

2. In combination, two batteries, a connection whereby said batteries are connected in parallel, a motor and means for connecting to said batteries, an ignition circuit and means for connecting to said batteries, the said motor and ignition circuit being connected to said batteries while the parallel connection between the batteries is maintained, and means included in the said connection between the batteries for preventing current flow from one battery to said motor while permitting current flow from the other battery to said circuit.

3. In combination, a source of current, a device consuming a heavy current when connected to said source, a second source and device consuming light current when connected to said second source, means for connecting said devices
to said sources, respectively, a connection between said sources whereby they are both connected in parallel to each of said devices at the same time, and means included in the common connection for preventing current flow from the said second source to the first device.

4. In combination, two circuits each including a source of current and a current operated device, a connection between said circuits, means for closing both said circuits while said connection is maintained, and a uni-directional current device included in said connection which prevents one current source from supplying current to the device in the other circuit when permitting the other source to supply current to the devices in both circuits.

5. In combination, two circuits each including a battery and a current operated device, a circuit connecting said batteries to said devices in parallel while said two circuits are closed, a generator and means for connecting it to said third circuit for charging said batteries in parallel, and a uni-directional current device included in said third circuit which prevents current flow from one battery to the device in the circuit of the other battery and permits current flow from the generator to the said one battery.

6. In combination, two circuits connected in parallel, a source of current in each circuit, means for connecting a load in each circuit while the parallel connection is maintained, one load being intermittent and relatively heavy, and means for preventing the heavy load when connected to its circuit from producing a fall of potential in the other circuit, said means including a device in the parallel connection between said sources which permits the light load to draw current from both circuits and which prevents the heavy load from drawing current from the source in the said other circuit.

7. The method of operating an electrical system comprising two circuits connected in parallel while both circuits are closed, the first circuit including an intermittent load and the second circuit including a comparatively steady load, and each circuit including a source of current, which consists in supplying current to the steady load from both sources at times when the other load is off, in supplying current to the loads from the sources in their respective circuits when both loads are on, and in preventing the source in the second circuit from supplying any current to the load in the first circuit in the event that the potential of the source in the first circuit should fall below the potential of the source in the second circuit.

8. In an electrical system comprising two current sources connected in parallel, the method of operating said system to supply a steady voltage to a relatively light load and at intervals to carry a heavy load without reducing the voltage at the light load although the parallel connection is maintained, which consists in supplying the light load from both sources in parallel when the heavy load is off, in supplying the loads from the said sources separately when both loads are on, and in preventing the source supplying the light load from supplying any current to the heavy load in case the voltage of the other source is reduced by the heavy load.

9. In an electrical system comprising two circuits connected in parallel, the first circuit including a heavy intermittent load and a principal current source, the second circuit containing a relatively light load and an auxiliary current source, the method of preventing the application of the heavy load in the first circuit from causing a fall in the potential applied to the light load due to the existence of the parallel connection, which consists in restricting the current flow in the parallel connection between said circuits to a direction from the first circuit to the second circuit, thereby permitting the principal source to supply current to the light load when the heavy load is off, and preventing the auxiliary source from supplying current to the heavy load when it is on.

10. In a system comprising a source of current and two load circuits connected thereto in parallel, the load in the second circuit being intermittent and relatively heavy, the method of preventing the application of the heavy load from lowering the potential supplied to the other load due to the existence of the parallel connection, which consists in providing a second current source, in supplying current to the said other load from said second source when the heavy load is on, or from both sources in parallel depending on whether the heavy load lowers the potential of said first source or not, and in preventing said second source from supplying any current to the heavy load.

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