This invention relates to railway signaling systems preferably of the light signal type, and more particularly to a power-off circuit arrangement for supplying the light signals with direct current derived from a battery in the event the alternating current voltage drops a small percentage below normal.

Modern light signal systems for railways usually include the provision of an alternating current transmission line extending along the railway track, with suitable rectifying means for charging local storage batteries located at the various signal locations. Although the light signals could be operated directly off of such trickle-charge battery, it is more expedient to supply the light signal with-alternating current when such is available and to transfer to the battery source in the event that alternating current supply is interrupted entirely or the voltage of the alternating current source drops below a certain value. It is of course understood that a power-off relay supplied by alternating current from the transmission line could be used to connect the light signal circuits to the alternating current source when such relay is energized and to connect said light signals to the battery when such relay is de-energized, this is however, very unsatisfactory in that it is desirous to make such change-over not only upon a failure in the alternating current supply but also upon a slight decrease in the voltage transmitted.

In accordance with the present invention it is proposed to use a series power-off relay connected in the charging circuit of the rectifier, this having a marginal advantage in that the change in charging current flow is very pronounced as compared with the change in the alternating current voltages applied, and for this reason, the series power-off current relay may be designed to transfer the load from the alternating current source to the battery upon a very small change in the alternating current voltage. A further advantage in the proposed construction is present in that it permits the use of a direct current relay which has closer pick-up and release margins of operation than has an alternating current relay.

Other objects, purposes, and characteristic features of the present invention will in part be pointed out in the description hereinafter and in part be apparent from the accompanying drawings. In describing the invention in detail reference will be made to the accompanying single drawing showing one embodiment of the present invention.

Referring to the drawing the rails 1 of a railway system have been shown divided into blocks by insulating joints 2, of which the adjacent ends of the blocks I and J only have been shown. The entrance to the block J is provided with a three-position light signal S including light signal units to indicate clear, caution, and danger and designated G, Y, and R, respectively. Although these signals, of which the signal S only has been shown, may be controlled in any suitable way, for illustrative purposes they are controlled by a polar neutral track relay T adapted to supply energy to the green lamp G under clear traffic conditions, apply current to the caution lamp Y under caution traffic conditions, and apply current to the red lamp R when the track relay T is de-energized, namely, under danger traffic conditions.

As shown, the light signal S receives its energy from the secondary winding of the transformer 5 when the power-off relay P is energized, and receives its energizing current from the battery 6 when the power-off relay P is de-energized.

The battery 6, constituting a reserve source of current supply is charged through the medium of the rectifier R connected to the secondary winding of the transformer 7. This rectifier R is preferably one of the copper-oxide lead type, and preferably comprises four rectifying elements 11, 12, 13, and 14. During the time that the right-hand terminal of the secondary winding of transformer 7 is of positive polarity current will flow to the battery 6 through the following circuit,—beginning at the right-hand side of the secondary winding of transformer 7, wire 16, rectifying element 11, wire 17, relay P, wire 18, battery 6, wire 19, rectifying element 12, wire 20, back to the secondary wind-
ing of transformer 7. During the next half of the cycle when the left hand terminal of the secondary winding of transformer 7 is of positive polarity current will flow from the transformer 7 to the battery 6 through the following circuit:—beginning at the left hand terminal of the secondary winding, wire 20, rectifier element 14, wire 17, relay P, wire 18, battery 6, wire 19, rectifying element 18, wire 16, back to the secondary winding of transformer 7. The series power-off relay P in practice contains sufficient ohmic resistance to serve as the usual ballast resistance used in rectifying circuits, so that the energy supplied to this relay P may be charged off for this purpose.

This series power-off relay P not only serves as a series resistance to keep the charging current within certain bounds, but also serves to transfer the light signal circuits from the secondary winding of transformer 5 to the battery 6 in case the charging current falls below a certain value. By reason of the fact that the charging current is dependent upon the difference between the voltage of the battery and the voltage delivered by the rectifier R, it readily appears that only a very small drop in voltage on the transmission line 10 will cause the charging current to vary to a much greater extent, or in other words, a slight change in the voltage of the transmission line is manifested in the charging circuit by a big variation in charging current. By reason of this characteristic of the circuit arrangement shown it is possible to transfer the light signal circuits from the transformer 5 to the battery 6 automatically in response to a very small change in transmission line voltage. In this connection it is desired to point out that the relay P is preferably externally adjustable to pick up and drop on different current values depending on the particular adjustment in effect. This feature enables very precise functioning of the system to be accomplished.

In the event that alternating current supply ceases entirely, the power-off relay P will nevertheless remain de-energized even though it is connected across the battery 6 in a closed circuit. The reason the power-off relay P remains de-energized is, that it is contained in a closed circuit including the rectifier R, which rectifier has its rectifying elements so poled in the circuit as to restrict the flow of current therein. The circuit arrangement shown is a very efficient one, in that the power-off relay requires no additional energy by reason of the fact that if such power-off relay were not used a series ballast resistance of substantially equal resistance would be required. It may be pointed out that the power-off relay P is preferably designed to function on such pickup and drop-away currents as not to drop to its de-energized position when the battery 6 is fully charged, although if desired this power-off relay P may be so designed. In this latter event the light signal S would be transferred to the battery 6 in the event the battery 6 is fully charged and would again be transferred to the transformer 5 when the battery 6 has been discharged to a slight extent.

Having thus shown one specific embodiment of the present invention, and having illustrated a rectifier of a particular type, it is desired to be understood that rectifiers of any suitable type may be employed, and that such rectifiers may be either of the single wave or double wave rectifying type, and may be either of the electrolytic, thermionic or coppexide type; it is further desired to be understood that other additions and modifications may be made to adapt the invention to the particular problem encountered in practicing the same, all without departing from the spirit or scope of the present invention or the idea of means underlying the same, except as demanded by the scope of the following claims.

What I claim as new is:—

1. In a light signal system for railroads, the combination with a light signal, and of means for supplying electrical energy for illuminating said light signal comprising, an alternating current source, a battery, a rectifier for charging said battery from said source of alternating current through a charging circuit, a power-off relay included in said charging circuit, and contacts on said relay for connecting said light signal to said alternating current source when said relay assumes its de-energized position.

2. In a light signal system for railroads, the combination with a light signal, and of means for supplying electrical energy for illuminating said light signals comprising, an alternating current source, a battery, a rectifier for charging said battery off of said alternating current source through a charging circuit, a power-off relay included in said charging circuit and contacts on said relay for connecting said light signal to said alternating current source when said relay assumes its de-energized position.

3. In a light signal system for railroads, the combination with a light signal, and of means for supplying electrical energy for illuminating said light signal comprising, an alternating current source, a battery, a rectifier for charging said battery off of said alternating current source through a charging circuit, a power-off relay included in said charging circuit and contacts on said relay for connecting said light signal to said alternating current source when said relay assumes...
its attracted position and connecting said light signal to said battery when said relay assumes its retracted position, said power-off relay being designed to assume its detracted position upon a decrease of the charging current to a predetermined extent.

4. In a light signal system for railroads, the combination with a light signal, and of means for supplying electrical energy for illuminating said light signal comprising an alternating current source, a battery, a rectifier for charging said battery from said source of alternating current through a charging circuit, a power-off relay included in series in said charging circuit and contacts on said relay for connecting said light signal to said alternating current source when said relay assumes its energized position and connecting said light signal to said battery when said relay assumes its de-energized position, said power-off relay being designed to assume its de-energized position upon a decrease of the charging current to a value lower than the charging rate existing with normal alternating current voltage applied and the battery fully charged.

5. In a signal system for railroads, the combination with an electrically operated signal, and means for supplying electrical energy for operating said signal comprising, an alternating current source, a battery, a rectifier for charging said battery from said source of alternating current through a charging circuit, a power-off relay included in said charging circuit, and contacts on said relay for connecting said signal to said alternating current source when said relay assumes its energized position and connecting said signal to said battery when said relay assumes its de-energized position.

6. In a signal system for railroads, the combination with a signal having an incandescent lamp associated therewith, and of means for supplying electrical energy for illuminating said lamp comprising, an alternating current source, a battery, a rectifier for charging said battery from said source of alternating current through a charging circuit, a power-off relay included in said charging circuit, and contacts on said relay for connecting said incandescent lamp to said alternating current source when said relay assumes its energized position and connecting said incandescent lamp to said battery when said relay assumes its de-energized position.

7. In combination, a battery for supplying current for railway signaling purposes, a source of alternating current, a rectifier for charging said battery from said alternating current source, and current responsive means included in series with said rectifier for varying the rate of charging of said battery by said rectifier in accordance with the degree to which said battery has been charged.

8. In combination, a battery for supplying current for railway signaling purposes, a source of alternating current, a rectifier for charging said battery from said alternating current source, a current consuming device, and means responsive to the degree of charge of said battery for causing said current consuming means to consume current from said battery if said battery has been charged to a predetermined extent.

9. In combination, a battery for supplying current for railway signaling purposes, a source of alternating current, a rectifier for charging said battery from said alternating current source, a current consuming device, and means responsive to the degree of charge of said battery for causing said current consuming means to consume current from said battery if said battery has been charged to a predetermined extent.

10. In combination, a battery for supplying current for railway signaling purposes, a source of alternating current, a rectifier for charging said battery from said alternating current source, a current consuming device, and current responsive means included in series with said rectifier for varying the rate of charging of said battery by connecting said current consuming device across said battery when said battery is charged to a predetermined extent.

11. In combination, a railway track, a signal for governing movement of trains over said track, a battery for supplying current to said signal, a source of alternating current for supplying current to said signal, a rectifier for charging said battery from said alternating current source, and means effective upon failure of said alternating current source to disconnect said signal from said alternating current source and connect said signal to said battery and effective to connect said signal to said battery irrespective of the presence of said alternating current source when said battery has been charged to a predetermined extent.

In testimony whereof I affix my signature.

JOSEPH E. WILLING.