This invention relates to protective systems for high voltage lines supplying current to a plurality of low voltage lines such as consumer's lines.

It is highly desirable to restrict a disturbance on one of a plurality of low voltage or consumer's lines to that particular line to prevent interruptions in continuity of service to other lines and to prevent tripping of the high voltage circuit breaker upon the occurrence of a short circuit in one of the low voltage lines. The devices for operating the high voltage circuit breaker are usually of the quick-acting type to minimize the damage due to a short circuit in the high voltage line and the low voltage protective devices may have the same or a longer time delay period to operate but cannot be permitted to operate on a shorter time delay period than that of the high voltage circuit breaker itself. Disconnection of the high voltage circuit breaker upon the occurrence of a short circuit in one of the low voltage lines supplied thereby may, however, be prevented if means are provided for preventing the operation of the high voltage circuit breaker releasing device upon the occurrence of a short circuit in one of the low voltage lines.

It is, therefore, among the objects of the present invention to provide a protective system to prevent disturbance in a high voltage system supplying a plurality of low voltage or a consumer's supply lines upon the occurrence of a short circuit in one of the low voltage lines.

Another object of the invention is to provide a system which will prevent disconnection of the high voltage line supplying a plurality of low voltage lines by preventing operation of a device for releasing a circuit breaker connecting the high voltage and the low voltage lines.

Another object of the invention is to provide a protective system for high voltage lines supplying a plurality of low voltage lines in which an additional voltage is applied to the voltage coil of a relay controlling operation of the high voltage circuit breaker, upon the occurrence of a short circuit in a low voltage line, which voltage is dependent in amount and phase position on the short circuit current in the low voltage line while in case of a short circuit in the high voltage line the voltage coil of the circuit breaker releasing the relay is acted upon by a voltage proportional to that of the high voltage line.

Objects and advantages, other than those above set forth, will be apparent from the following description and the drawings which show a diagrammatic representation of an embodiment of the invention illustrating a high voltage line supplying a group of low voltage lines.

Referring more particularly to the drawing by characters of reference, the reference numeral 1 indicates a high voltage line or bus bar connected to a low voltage line or bus bar 2 from which are taken a plurality of feeder or consumer's lines 3 and 4, of which only 3 and 4 are shown. The high voltage line 1 and the low voltage line 2 are connected by a high voltage circuit breaker 6, a transformer 7 and a low voltage circuit breaker 8.

The high voltage circuit breaker 6 is opened through the action of a circuit breaker releasing coil 9 supplied from a source of current 11 through the action of an armature 12 actuated by a voltage coil 13 and a current coil 14. The current coil 14 is supplied with current from a current transformer 16 connected into the line between the high voltage circuit breaker 6 and the transformer 7 and the voltage coil 13 is supplied from an auxiliary low voltage bus bar or line 17 which is connected with and supplied from the high voltage line 1 by the transformer 18. Impedances 21, 22, and 23, each of which may comprise a reactance or a resistance or both, are connected into the lines between the transformer 18 and the low voltage auxiliary bus bar 17. The impedances 21, 22 and 23 are connected in series with current transformers 26, 27 and 28, placed in the line between the transformer 7 and the low voltage circuit breaker 8.

Under the usual practice in arranging circuit breaker operating relays to protect lines of the above described character from the effects of excessive short circuits, a short circuit in the low voltage bus bar 2 causes a drop of voltage in the load transformer 7 so that
the voltage in the high voltage bus bar 1 and in the voltage coil of the relays operating the circuit breakers likewise drops. The relay operating the high voltage circuit breaker being normally set for a shorter period of time than the relays in the low voltage line the high voltage circuit breaker was usually operated first thereby entirely disconnecting the low voltage bus bar and cutting the service off from all of the low voltage feeders.

If the voltage in the voltage coil of the high voltage circuit breaker operating relay can be maintained upon the occurrence of a short circuit in the low voltage side, the high voltage circuit breaker will not be operated and the service to the feeder lines, not affected by the short circuit, will not be cut off. The present invention provides a circuit or system in which an additional voltage is supplied to the voltage coil of the high voltage circuit breaker operating relay to prevent such relay from operating to open the circuit breaker so that the slower relays (not shown) in the feeder line affected may operate to cut off the affected line. The high voltage circuit breaker operating relay is, accordingly, supplied by a voltage component dependent on the low voltage line short circuit current by the use of impedances which keep the voltage above a value permitting operation of the high voltage circuit breaker so that a sufficient length of time is available to permit the slower low voltage circuit breaker relays to operate.

When a short circuit occurs in the low voltage feeder lines supplied from a low voltage bus bar in the system, according to the invention, the voltage in the auxiliary bus bar 17 is maintained, by the impedances 21, 22, and 23, at a value proportional to the current passing through the current transformers 26, 27 and 28 so that the voltage supplied from the auxiliary bus bar 17 to the voltage coil 13 of the high voltage circuit breaker releasing relay is maintained above the value at which such relay would cause operation of the high voltage circuit breaker.

The present system accordingly permits the affected feeder or consumer's line to be disconnected without cutting off the high voltage bus bar.

Although only a few embodiments of this invention have been illustrated and described, it will be understood that various other embodiments are possible, and that various changes may be made without departing from the spirit of the invention or the scope of the appended claims.

The invention claimed is:

1. In a protective system for high voltage transmission lines supplying a plurality of low voltage lines, a high voltage circuit breaker, a relay supplied with potential from said high voltage line for controlling the opening of said high voltage circuit breaker, and means for supplying an additional voltage to said relay to prevent operation of said circuit breaker upon occurrence of a short circuit in one of the low voltage lines, the additional voltage being dependent in amount and phase position on the current in the short circuit in the low voltage line.

2. In a protective system for high voltage transmission lines supplying a plurality of low voltage lines, a high voltage circuit breaker, a relay for controlling the opening of said circuit breaker, said relay being operable by a voltage proportional to that of the high voltage lines upon occurrence of a short circuit current therein, and means for supplying an additional voltage to said relay to prevent operation of said circuit breaker upon occurrence of a short circuit in one of the low voltage lines.

3. In a protective system for high voltage transmission lines supplying a plurality of low voltage lines, a high voltage circuit breaker, a relay supplied with potential from and operable in dependence upon the potential of the high voltage line for controlling the opening of said circuit breaker, and means comprising impedances for controlling the supply of an additional voltage to said relay in dependence on the current in a short circuit in the low voltage lines, the additional voltage preventing operation of said relay due to the low voltage line short circuit.

4. In a protective system for high voltage transmission lines supplying a plurality of low voltage lines, a high voltage circuit breaker, a relay having a voltage coil for controlling the opening of said circuit breaker, a low voltage line for supplying voltage to said relay, impedances connected with said relay supply line, and current transformers connected with the low voltage lines and said impedances for controlling the voltage in said relay supply line in dependence on the current in a short circuit in one of the low voltage lines to prevent operation of said circuit breaker.

5. In a protective system for high voltage transmission lines supplying a plurality of low voltage lines, a circuit breaker disposed in the said high voltage line and operative to effect connection and disconnection of said high voltage line with and from said low voltage lines, and means comprising an element responsive to flow of current in said high voltage line operative to cause said disconnection and an element responsive to flow of current in said low voltage lines operative to prevent said disconnection operation of the said circuit breaker upon occurrence of a short circuit in any one of said low voltage lines.

In testimony whereof I have hereunto subscribed my name this 26th day of November A. D. 1929.

Dr. GUNTRAM LESCH.