Feb. 13, 1940. W. KALBSKOPF 2,189,905

RECTIFIER DEVICE

Filed June 17, 1938

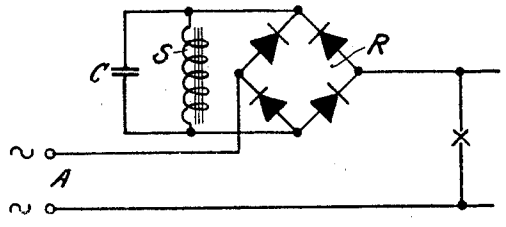


Fig.1

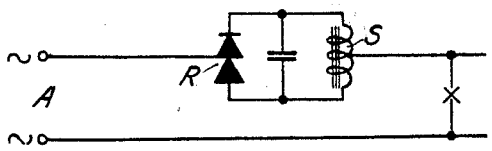


Fig.2

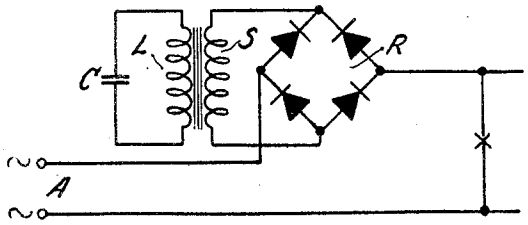


Fig.3

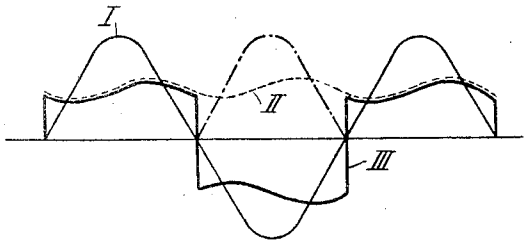


Fig.4

Inventor:
Walter Kalbskopf
by E. D. Kinney
Attorney

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RECTIFIER DEVICE

Walter Kalbskopf, Nuremberg, Germany, assignor to Suddeutsche Apparatefabrik, Nuremberg, Germany, a company

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4 Claims. (Cl. 171—97)

The present invention relates to electrical networks including rectifier devices, and more particularly to rectifier circuit arrangements adapted to change an alternating current of one wave shape to an alternating current of the same frequency but of different wave shape.

It is frequently desirable to feed glow lamps such as filament lamps with a low frequency alternating current, e. g., of 16⅔ cycles per second, as usually employed in electric railway operation. As a matter of fact, an alternating current of customary wave shape e. g. sinusoidal, generated with a periodicity of only 16⅔ cycles per second is not well adapted for supplying such lamps so that the light therefrom is free of flickering since the heat inertia of the lamp filament generally will be insufficient for securing a steady light. This heat inertia may be increased by simultaneously increasing the cross sectional area of the filament and decreasing the supply voltage. The flickering tendency of the glow lamp filament diminishes in proportion to the decrease of the supply voltage at a given power. If the voltage for any reasons cannot be kept at a sufficiently low value, means must be provided in order to obtain a more uniform amplitude characteristic of the lamp current with respect to time so as to prevent flickering of the emitted light.

Such correction of the alternating current may be performed by rectifying and smoothing the total alternating current energy. The resulting rectified and smoothed current is then applied to the glow lamps. However, the technical solution of this problem makes it necessary to dimension the rectifiers so as to withstand the total amperage and total voltage of the load current, a requirement which introduces considerable expenditure with respect to rectifying means and which involves inevitable power losses.

It is true that with respect to a plural-phase alternating current the requirements of the smoothing means necessary for securing a non-flickering lamp light are less than in the case of single phase current operation. However the total expenditure is considerable also in plural phase systems on account of the additional switching equipment for obtaining the plural phase displacement.

The above conditions also apply substantially to other load devices such as high power switching means or similar apparatus which must be arranged so as to prevent vibrations of the armature of such apparatus. Heretofore this has been achieved by electrically or mechanically damping the apparatus itself or by the agency of alternating current phase shifting means.

The present invention provides the possibility of obtaining a steady light from glow lamps fed by an alternating current of low periodicity, or of operating relays with an alternating current of normal frequency without the disagreeable hum. These features are obtained according to the invention by substantially less expensive equipment than heretofore.

The invention is founded on the idea that a non-flickering operation does not require rectification and subsequent smoothing of the total alternating current power so as to energize the load device with a unidirectional current; on the contrary, by changing the alternating current wave shape so as to aproach a rectangular shape the desired non-flickering results are obtained, since the current alternation from its positive to its negative maximum amplitude would so rapidly take place that a glow lamp filament energized thereby would find no time for cooling. An approximate rectangular shape of the alternating current wave shape would thus provide a suitable measure for avoiding flickering of glow lamps. The same applies to high power switching relays and the like operated with an alternating current of the above mentioned form.

The corresponding conversion of the alternating current wave shape into an approximately rectangular shape is accomplished according to the present invention by the provision of a rectifier bridge in one side of the load circuit supply line, said bridge having a choke coil connected to the direct current diagonal thereof.

The invention will be more readily understood from the following description taken in conjunction with the accompanying drawing, in which

Fig. 1 is a diagram representing one embodiment of the invention, Fig. 2 diagrammatically illustrates a modification over the arrangement shown in Fig. 1, Fig. 3 is a diagram showing still a further modification according to the invention, while Fig. 4 shows the change of the alternating current wave shape which is obtained according to the invention.

The rectifier valves R intended for insertion in one side of the load circuit are interconnected in a full wave rectifier bridge fashion, similar to the so-called Graetz circuit as shown in Fig. 1, or in push-pull as shown in Fig. 2. These valves must be dimensioned so as to withstand the total current flowing in the load circuit, while their dimensioning with respect to the voltage merely necessitates an accommodation to the effective

voltage of the harmonics of the rectified current flowing through the choke coil S so that the rectifier itself may be kept relatively compact.

The circuit arrangement as illustrated in Fig. 2 involves the advantage that at the same current intensity merely half as many rectifier valves R are required as compared with the arrangement shown in Fig. 1, but the choke coil S must be provided with a center tapping point.

Fig. 4 shows the change with respect to the form of the alternating current wave shape resulting from interposing the rectifier valve and the smoothing choke coil in the load circuit. The thin continuous curve I represents the wave shape of the alternating supply voltage. If the load is non-inductive, the current will be in phase with this curve. The dash-dotted line II illustrates the current through the choke coil at complete rectification and sufficient smoothing.

In the arrangement according to the invention, a direct current flow takes place in the choke coil S only, and such choke coil will fully exert its smoothing action upon this direct current, while the alternating current character of the current still prevails externally with respect to the combined rectifier and choke coil assembly, that is, in the load circuit. However, the individual half-waves of the alternating current are so flattened and simulated to rectangularity by the agency of the smoothing action of the choke coil S that the alternation from the positive to the negative half-wave, and vice versa, is effected with an utmost rapidity as indicated by the full curve III.

A still further perfection with respect to the smoothing and hence of the rectangular shape of the alternating current characteristic as illustrated by the curve III of Fig. 4 may be achieved by shunting a condenser C across the choke coil S as shown in Figs. 1 and 2, said two elements constituting an oscillatory circuit tuned to the frequency of the alternating current. Since the condenser of this oscillatory circuit would have to be of considerable size at higher current intensities, an oscillatory circuit comprising a condenser C and an inductance L may be inductively coupled to the choke coil S as shown in Fig. 3 by simultaneously stepping down the voltage so as to permit application of a condenser of smaller capacity.

The rectifier circuit arrangement according to the present invention for obtaining non-flickering operation of electric glow lamps supplied by a low frequency current, the characteristic of which is subjected to a suitable correction involves essential features over the known arrangements of this kind since the same results are obtained at a minimized expenditure of rectifying means.

The arrangement heretofore disclosed and particularly as described and as shown in the drawing is applicable in all cases where an alternating current is desired, the characteristic of which presents a very steep and sudden alternation from the positive to the negative maximum amplitude, and vice versa.

What is claimed is:

1. In combination, a source of alternating current having a wave shape with a gradual slope from positive maximum to negative maximum, a load device to be energized from said source said device having such little inertia that it responds substantially in proportion to the instantaneous value of the applied waves, and means to convert the alternating current into an alternating current of the same frequency but with an abrupt slope between positive maximum and negative maximum, the last-mentioned means including a plurality of rectifier units arranged in the form of a bridge for full-wave rectification and connected only in one side of the alternating current supply line and a choke coil connected in one diagonal of said rectifier bridge.

2. In combination, a source of alternating current having a substantially sinusoidal wave shape, a load device to be energized from said source said device having so little inertia that it responds substantially proportionately to the instantaneous value of the applied alternating current, and means to convert the alternating current from said source into an alternating current of the same frequency but with a substantially rectangular wave shape, the last-mentioned means including a plurality of rectifier units of the dry rectifier type interconnected in push-pull fashion and connected in only one side of the alternating current supply line, and a choke coil shunted across said rectifiers.

3. The combination according to claim 1 in which a condenser is shunted across said choke coil to form an oscillatory circuit tuned to the frequency of the alternating current supply.

4. The combination according to claim 1 in which an oscillatory circuit comprising an inductance and a condenser tuned to the frequency of said alternating current supply is inductively coupled to said choke coil.

WALTER KALBSKOPF.