C. FELDMANN.

ELECTRIC LIGHTING SYSTEM.

APPLICATION FILED MAY 24, 1907.

922,410.

Patented May 18, 1909.

Fig. 1

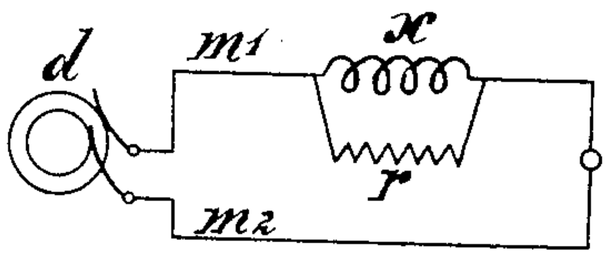
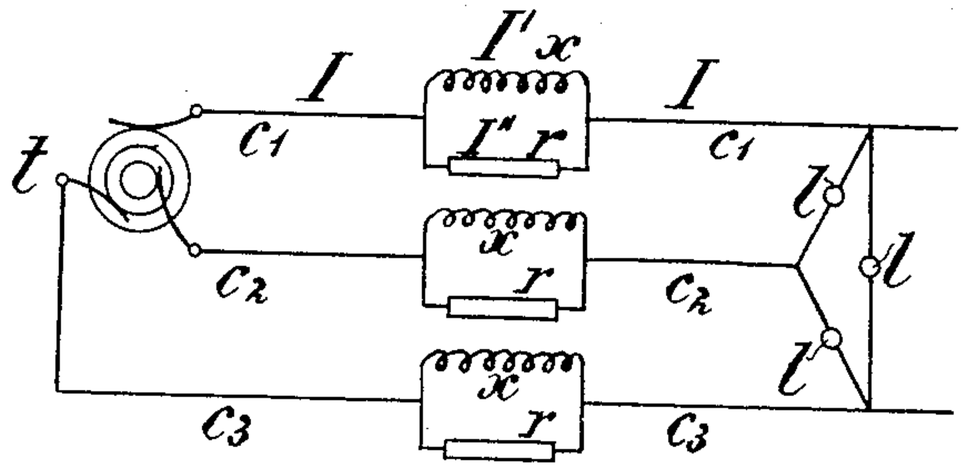


Fig. 2



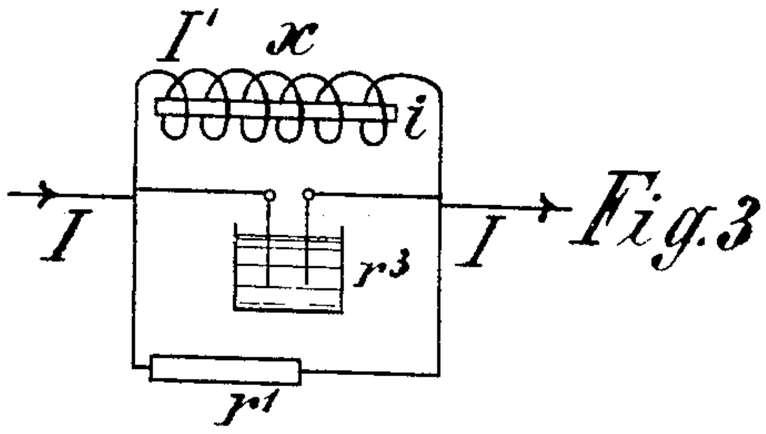


Fig. 3

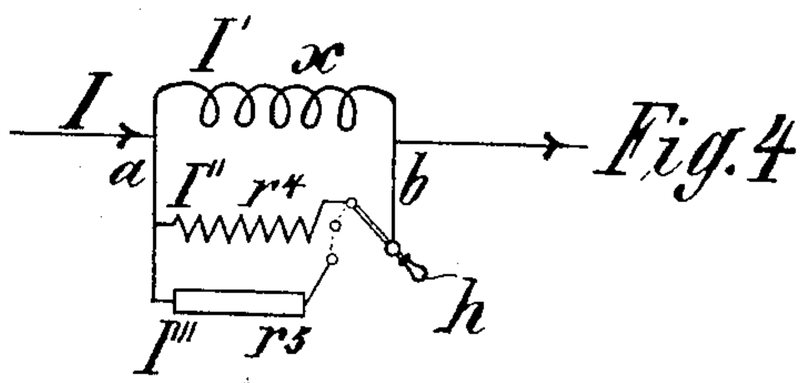


Fig. 4

Fig. 4a

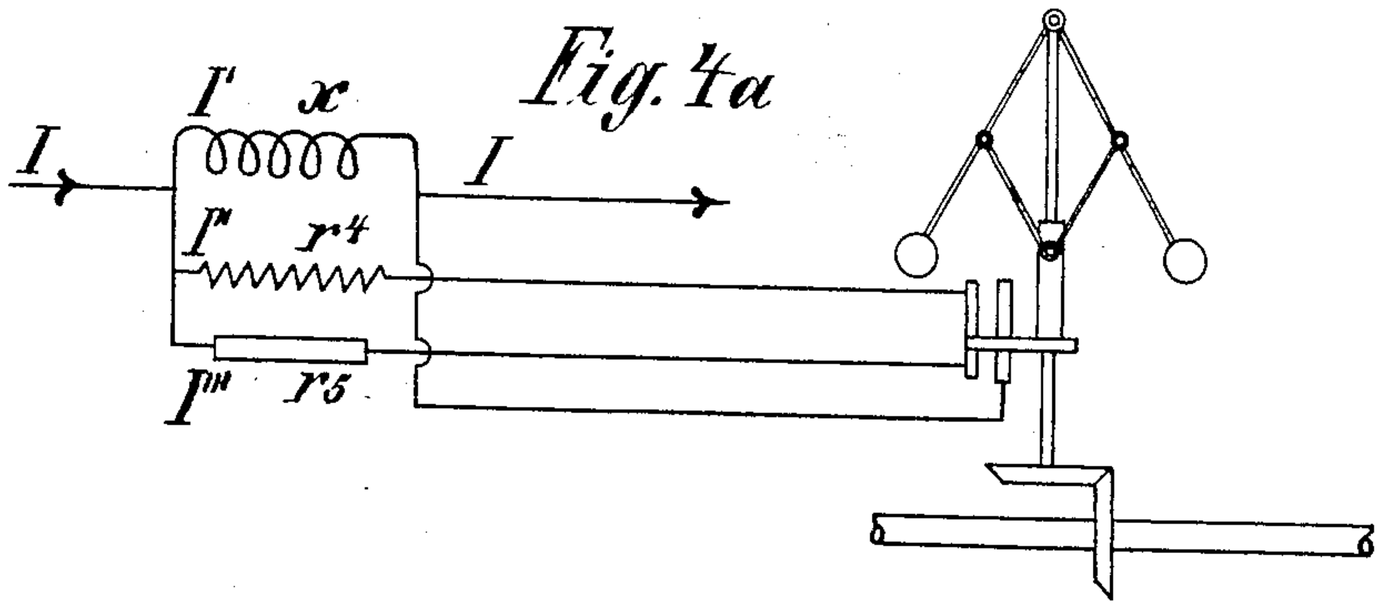
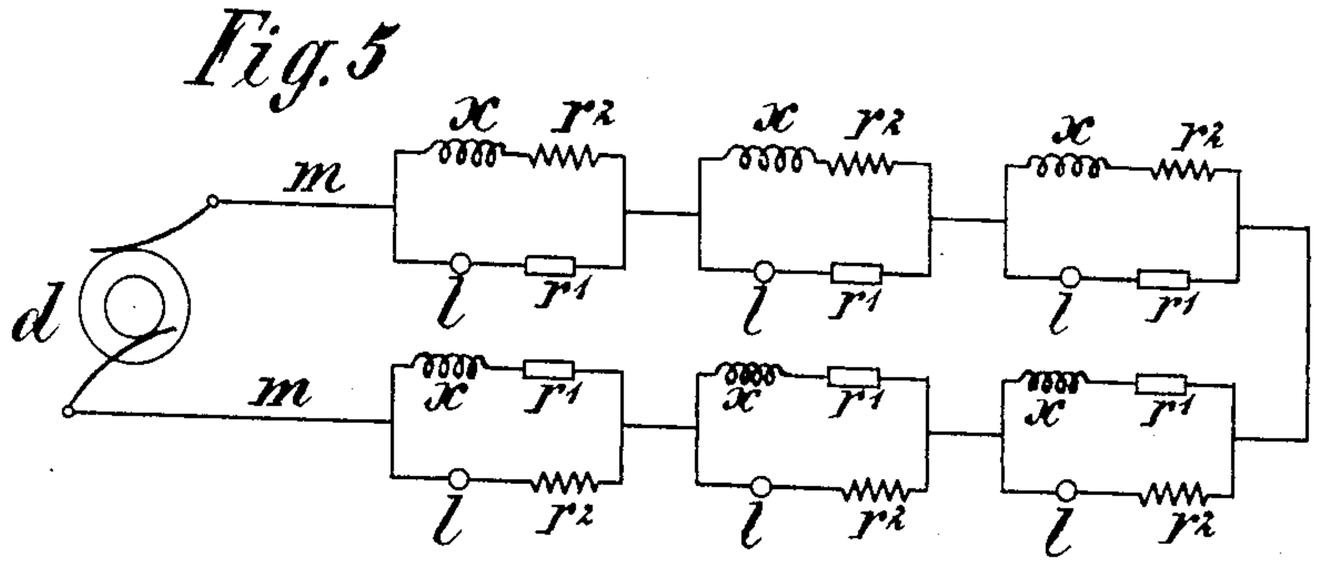


Fig. 5



Witnesses:

Max Zirbel

A. Ernest Kaye

Inventor:

Clarence Feldmann

by Eustace W. Hopkins

Attorney

UNITED STATES PATENT OFFICE.

CLARENCE FELDMANN, OF DELFT, NETHERLANDS.

ELECTRIC-LIGHTING SYSTEM.

No. 922,410. Specification of Letters Patent. Patented May 18, 1909.

Original application filed June 22, 1906, Serial No. 322,908. Divided and this application filed May 24, 1907. Serial No. 375,793.

To all whom it may concern:

Be it known that I, CLARENCE FELDMANN, a citizen of the German Empire, and residing at No. 11 Hertog Govert Gade, Delft, Netherlands, have invented new and useful Improvements in Electric-Lighting Systems, of which the following is a description.

The present invention relates to certain improvements in those systems of electrical distribution by alternating currents produced by monophase or polyphase generators which provide for operating electric lamps, motors or rotary converters and whose frequency varies on account of variations in the speed of shaft driving the generators. In such a case the voltage will vary in exact proportion to the variation of the frequency if the excitation remains unaltered and the current fed into the consuming devices will vary in proportion thereto.

The object of the invention is to provide means for weakening or increasing the current ensuing according to an alteration of frequency at a rate which is less or more but not equal to the rate of alteration of the frequency. Thus, for example, it may be desired to light a car by alternating currents produced say from a generator driven from the axle of the car wheels; if now the speed of the car and therefore the frequency drops to one half or one third, the voltage of the alternator will drop proportionally, but the present invention provides means to diminish the effect on the lamps, for instance, to one fourth or one sixth, *i. e.* to half of the value expected. Or to put it more generally, the object of the present invention is to alter an impedance not in proportion to, but less or stronger than proportional to the variation of the frequency of the current feeding the impedance or passing through it in order to improve thereby the quality or constancy of the light produced.

In the drawings Figure 1 is a diagram explanatory in a general way of the nature of the invention. Fig. 2 shows the application of the invention as applied to a circuit with consuming devices in parallel, Figs. 3, 4 and 4ª show other modifications of the invention and Fig. 5 shows it applied in different ways to a series circuit.

Fig. 1 shows an alternator d feeding through conductors or mains m_1, m_2 a non-inductive resistance r connected up in parallel to a reactance x which is here represented as a choking coil. This reactance may be formed by a choking coil with iron core or by the synchronous reactance as represented by a motor, in short by a reactance or impedance with a high time constant. It is immaterial whether instead of a purely inductive resistance x, an impedance is chosen having an ohmic component in addition to its purely inductive component the main thing being that its time constant be of high value. It is also a matter of indifference whether the resistance r is adjustable by hand or automatically, or whether the reactance x is always constant or is also variable. Very simple embodiments will result, if an iron wire or generally a resistance r which increases on an increase of temperature, is connected up in parallel to the impedance x, particularly when it is required to increase the effect of the reactance x with increasing periodicity in a greater proportion than would correspond with the increase of the periodicity.

In Fig. 2 t represents a threephase generator or generally speaking any multiphase generator feeding through conductors c_1, c_2, c_3 consuming devices for instance lamps l connected up in parallel only one lamp is shown it being understood however that groups of lamps may be used instead. Into each of the conductors a reactance x is inserted, connected up in parallel to a resistance r made of iron wire. Then the whole current I of each conductor, which however with varying load need not be the same for all of the three conductors, will be divided into one current I′ flowing through x and one part I″ flowing through r. With increasing frequency the reactance will increase proportional to the alteration of the frequency say to a value I′ and thus for a constant value of I′ the voltage would be $I'x' = I''r$. But now r increases also on account of the stronger current passing through it and on account of the great positive temperature coefficient of iron say to a value r' and therefore the resulting impedance formed by the increased reactance x' in parallel to the increased resistance r' will be increased in a proportion greater than $x' : x$. If, on the other hand it is desired to reduce the increase of the resulting impedance with increasing periodicity a resistance may be connected up in parallel, which is reduced to a smaller value mechanically or automatically by the cur-

rent or the tension to be regulated. Thus, for instance, the switch lever of a rheostat may be adjusted by hand or by a centrifugal governor device, so as to decrease with increasing frequency the governor being driven, for instance, by the generator and sliding over contacts in any of the different ways well known to those skilled in the art. Or a carbon filament r' or a liquid resistance r^3, whose negative temperature coefficient will make it decrease with an increase of current, (Fig. 3) or both may be connected up in parallel to x. Such arrangements may be employed among other things, in connection with the working of rotatory transformers with constant or varying periodicity. This new regulating process may, of course, be employed in connection with known regulating means. Thus, for instance, the effect of the choking coil x (Fig. 4) may be first increased, then left uninfluenced and finally weakened, by switching in parallel to it, by means of a switch lever h or in other manner, with the aid of relays, first an increasing resistance r^4, *i. e.* one with positive temperature coefficient, then an infinitely great one and finally a decreasing resistance r^5, *i. e.* one with negative temperature coefficient thereby altering for a constant total current I the amount of the current I′ passing through x or the voltage consumed between the points a and b more than proportional, directly proportional or less than proportional to the alteration of the frequency or of x alone. Figs. 3 and 4 only show the regulating device which may be inserted into the circuit of a monophase generator as in Figs. 1 and 5 or into one or all of the circuits of a polyphase generator as in Fig. 2. Fig. 4ª shows the arrangement of Fig. 4 in connection with a governor device. Or as shown in Fig. 5 in connection with a monophase generator d feeding through mains m m a series arrangement of lamps l having choking coils x connected up in parallel thereto, the resistances r', which increase as the current increases, may be connected up in series to the lamps l and the resistances r_2 which decrease on an increase of current, may be connected up in series with the choking coils x, in order to improve or to increase the range of the regulation by increasing the choking or throttling effect as the strength of current grows. If on the other hand it is desired to decrease the throttling or choking effect on an increase of strength of current, then the resistances r_2, which decrease as the current increases would have to be connected up in parallel to the choking coils, and the resistances r' which operate in the opposite direction would have to be connected up in series to the lamp coils. This may for instance, be useful when the system possesses a certain moderate self regulation, owing to a corresponding saturation of the cores of the choking coils, and then the possibility of switching out a part of the lamps l, without lowering the efficiency of the system would be considerably increased.

In addition to the possibilities of employment herein set forth as instances, the present process may be employed in a great variety of other ways, particularly for instance, in connection with alternating current generators for railway carriage lighting, the periodicity of which varies or is varied either by accident or intentionally.

It is immaterial whether the process is employed in connection with monophase or polyphase, coupled or uncoupled alternating currents.

I claim as my invention:—

1. In a system of electric power distribution, the combination of an alternating current generator, driven with widely varying speed, mains to feed the consuming devices and a regulating device connected in series to said mains consisting of a resistance altering with the current and a choking coil varying in reactance with the frequency in order to diminish the influence of the alterations of the frequency on the consuming devices.

2. In a system of electric lighting or power distribution, the combination with an alternating current generator driven at a varying speed, resistances having small time constants and reactances having great time constants connected up in parallel to the said resistances, substantially as described.

3. In a system of electric lighting or power distribution, the combination with an alternating current generator of iron resistances and choking coils connected up in parallel with each other, substantially as described.

4. In a system of electric lighting and power distribution the combination with an alternating current generator of choking coils and of lamps, connected up in parallel with said choking coils and of iron resistances connected up in series with the lamps substantially as described.

In testimony whereof I affix my signature in the presence of two witnesses.

CLARENCE FELDMANN.

Witnesses:
JONANNES P. JANSEN,
IERG. F. WHAACH.