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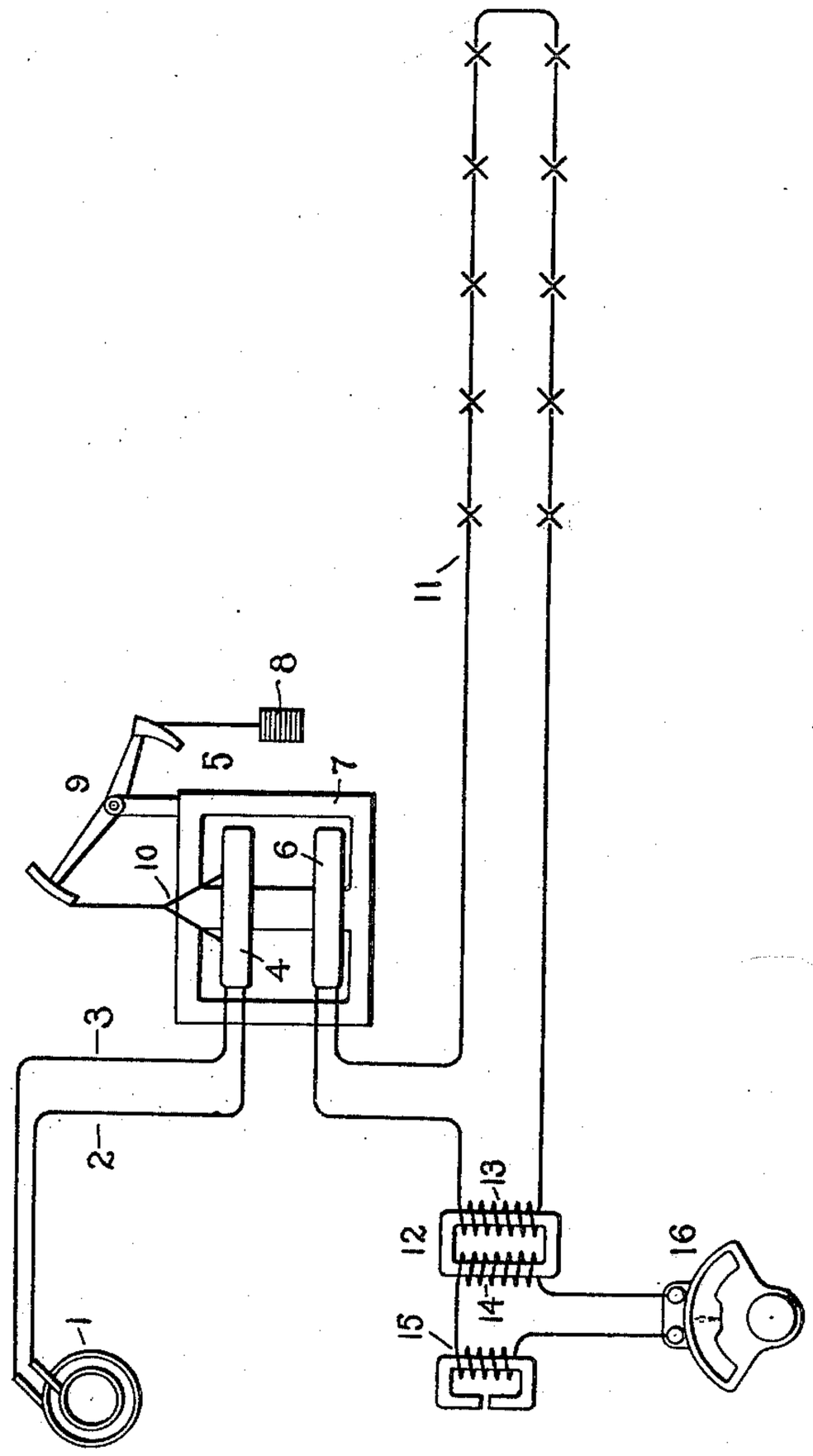
R. FLEMING.

ELECTRIC INDICATING INSTRUMENT.

(Application filed Nov. 21, 1901.)

(No Model.)



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UNITED STATES PATENT OFFICE.

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ELECTRIC INDICATING INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 696,427, dated April 1, 1902.

Application filed November 21, 1901. Serial No. 83,150. (No model.)

To all whom it may concern:

Be it known that I, RICHARD FLEMING, a subject of the King of Great Britain, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Electric Indicating Instruments, (Case No. 2,508,) of which the following is a specification.

In alternating-current arc-light systems, and particularly in those making use of constant-current-regulating devices, it has been found that the wave shape of the current supplied to the lamps varies with changes in the load. Thus, for example, in a constant-current-transformer system at heavy loads when the relatively movable coils of a constant-current-regulating device are close together and the inductance of the same therefore comparatively small the current-wave has a peaked form, due to the predominating effect of the pulsating resistance of the arcs. At light loads when the coils of the constant-current-regulating mechanism are more or less widely separated and the inductance of the mechanism is therefore considerable the wave to a certain extent approximates a sine wave, or at least is much less peaked, this result being due to the then minor influence of the pulsating resistance of the arcs, which, as has been mentioned, tends to produce a peaked wave. The effect of the change in wave form above noted is to cause a resulting change in the voltage of the arcs. Thus although the equivalent sine wave of current for two waves having different maxima may be the same the action of the two waves upon the regulating mechanism of the lamps is different. In the lamps the core of the series magnet is usually worked at high magnetic densities. The top portion of a peaked wave would under these circumstances have comparatively little effect upon the magnetic induction in the core, so that the wave itself would produce less pull upon the core than would a wave of current of equivalent value, but with a lower maximum. For this reason when non-peaked wave-current is flowing, as at small loads, the pull upon its core of the series coil of a lamp is greater and the voltage at the arc also greater than is the case at heavy loads, when the wave form of the current is peaked.

It is the aim of my invention to produce an indicating instrument which shall be responsive to changes in the wave form of alternating current and also to the frequency of the current. The desirability of frequency compensation for the indicator arises where the instrument is required for use in connection with an alternating-current system such as referred to above. Where the lamps are of the differential type, a rise in frequency obviously causes a decreased flow of current through the shunt-magnets, thereby permitting the series magnets to lengthen the arc. The indicating instrument which I have invented for use more particularly in connection with a system or systems of the character above mentioned is therefore compensated both for frequency and wave-form variations, so that if the system be regulated to maintain a given deflection on the instrument the current flowing will at all times be such as to maintain proper voltage at the arcs as the load or other factor or factors change.

The drawing illustrates an application of my invention to an alternating-current arc-light system.

In the drawing, 1 indicates a source of substantially constant potential alternating current, from which extend the supply-leads 2 3, shown in this case as connected to the primary winding 4 of a constant-current transformer 5 of a type now well known in practice. The secondary winding of the transformer is represented at 6, and both of these windings are mounted in a usual manner in relation to the core 7 of the transformer. The primary winding in this instance is represented as movable, the weight of the winding being partially counterbalanced by the weight 8, acting through a lever mechanism 9 upon the supports 10, carrying the winding 4. The secondary winding 6 supplies approximately constant alternating current to a series distribution system 11, including arc-lamps of any usual type—such, for example, as differential-arc lamps. In the drawings these lamps are merely indicated conventionally by crosses.

The current-indicating mechanism which I use in connection with the system above described consists of a transformer 12, having a primary winding 13 in series with the cir-

cuit 11 and a secondary winding 14, connected through the winding 15 of an inductance-coil to a suitable indicating device—such, for example, as an ordinary inclined-coil alternating-current voltmeter 16, the construction of which does not differ in any respect from such instruments now in common use. The core of the transformer 12 and its primary winding 13 are relatively proportioned in a manner well understood in the art, so that the iron is worked at a high magnetic density. Under these conditions if the wave shape of the alternating current flowing through the primary winding should change, even though the equivalent sine wave of current should remain unchanged, the result would be a less magnetization for a peaked wave than for a flatter wave. The voltage produced by the secondary winding 14 would therefore be less for a peaked wave than for a flat wave and the deflection of the instrument 16 would therefore vary to correspond. By adjusting the regulating action of the constant-current transformer so as to vary the current in the constant-current circuit and bring the deflection of the device 16 back to its normal value the result will be to bring the voltage of the lamps in the constant-current system back to normal value. The indicating device 16 therefore shows by a given deflection the point to which the current in the circuit must be adjusted to secure uniform voltage of the arcs at all times. With a change in frequency of the source 1 it is obvious that the secondary voltage of the transformer 12 increases, thereby increasing the deflection of the indicating device 16. It may happen that this increased deflection is so great that when the needle is brought back to normal position by varying the regulating effect of the constant transformer the voltage of the lamps on the system is less than normal. To overcome this overcompensating effect for frequency, I make use of the inductance-coil 15, which reduces the effect of changes of voltage of the secondary 14 due to changes of frequency. By a suitable proportioning of the parts the indicating device 16 indicates by its deflection from a normal position any changes either of frequency or wave form which require adjustment of the constant-current-transformer lamp to bring the voltage of the lamps in the consumption-circuit back to normal, the proper voltage being obtained when the needle of the indicating device is brought back by a suitable regulating action to its normal position.

In the drawing I have illustrated the circuit of the indicating instrument as connected across the secondary of a transformer with a saturated core. In place of the transformer, however, I may employ an inductance-coil or a compensator, the cores in either case being saturated. The use of a transformer offers the advantage that to some extent it separates the static effect of the high-potential lines from the instrument, so that the deflections of the latter are not interfered with.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination with a current-indicating device, of means for causing the indications of said device to change with change of wave shape of current by which it is influenced.

2. The combination of an arc-light circuit, means for supplying thereto a substantially constant current, a current-indicating device for said circuit, and means for causing the indications of said device to change with change of wave shape of current in said circuit.

3. The combination of an electric circuit, a magnetic core magnetized to saturation by current flowing in said circuit, a current-indicating device, and means for impressing upon said device an electromotive force which varies in response to variation of magnetization of said core.

4. The combination of an electric circuit, a transformer having its primary in series with said circuit and so proportioned that its magnetic core is magnetized to saturation or near saturation, an indicating device, and connections between the secondary of said transformer and said indicating device.

5. The combination of an electric circuit, a transformer having its primary in series with said circuit, an indicating device connected to the secondary of said transformer, and a device possessing reactance connected in circuit between the said secondary and said indicating device.

6. The combination of an electric circuit arranged to carry in normal operation a substantially constant current, a magnetic core, a winding supplied with current from said circuit and mounted on the said core, said core being so proportioned that the difference of potential at the terminals of said winding varies with varation of wave shape of the current in said circuit, and an indicating device operatively related to said winding.

7. The combination with an electric circuit, of a current-indicating device therefor, and means for causing said indicating device to respond not only to changes in the amount of current flowing, but also to changes in the wave shape of the current.

8. The combination with an electric circuit, of a current-indicator therefor, and means for causing said current-indicator to respond not only to changes in the amount of current flowing in said circuit but also to changes of frequency of said current and to changes of wave shape of said current.

In witness whereof I have hereunto set my hand this 15th day of November, 1901.

RICHARD FLEMING.

Witnesses:
DUGALD MCK. MCKILLOP,
JOHN J. WALKER.