No. 706,798. Patented Aug. 12, 1902.

# P. E. CHAPMAN.

## ELECTRIC TESTING APPARATUS.

(Application filed Dec. 4, 1901.)

(No Model.)

Fig. 1.

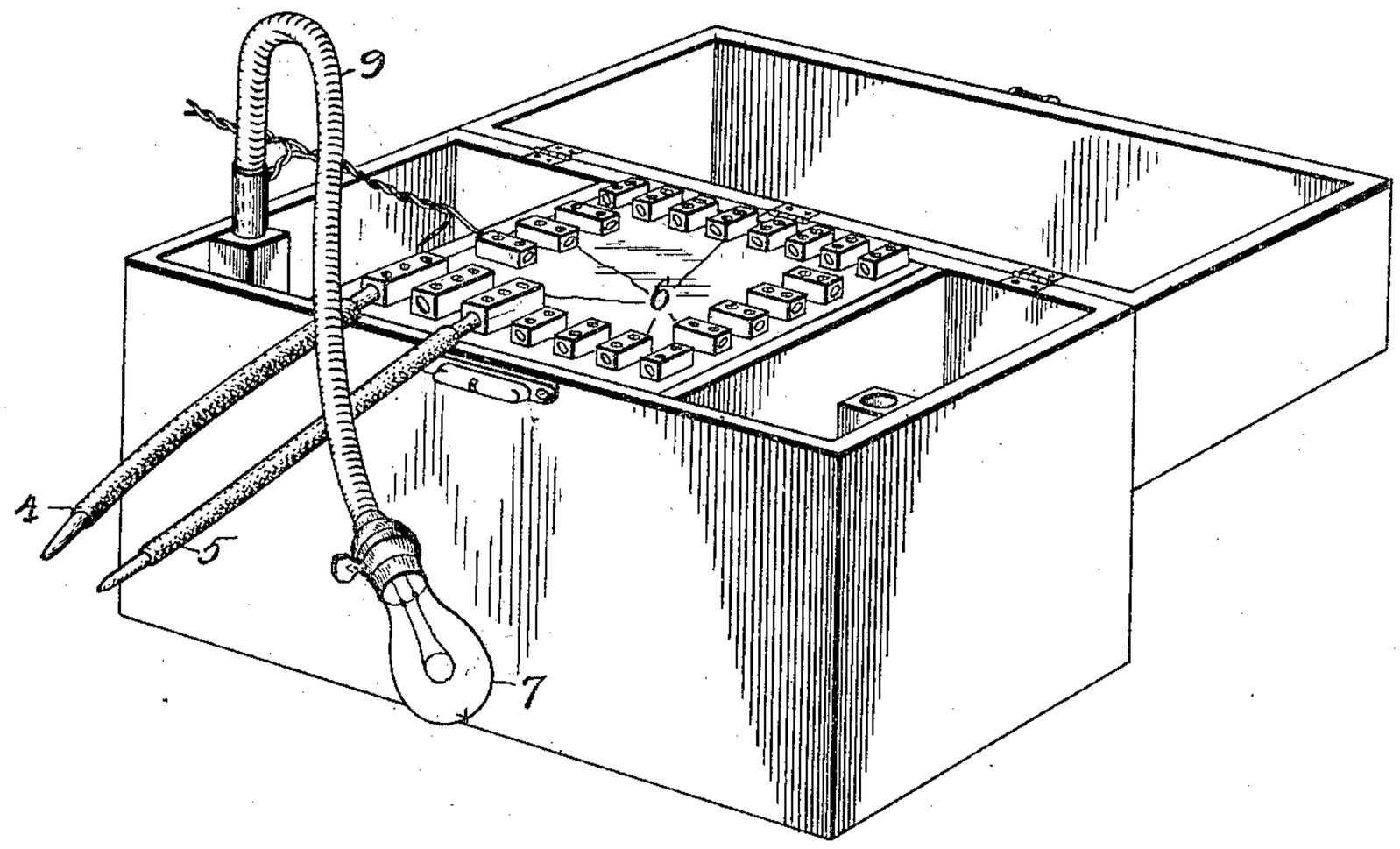
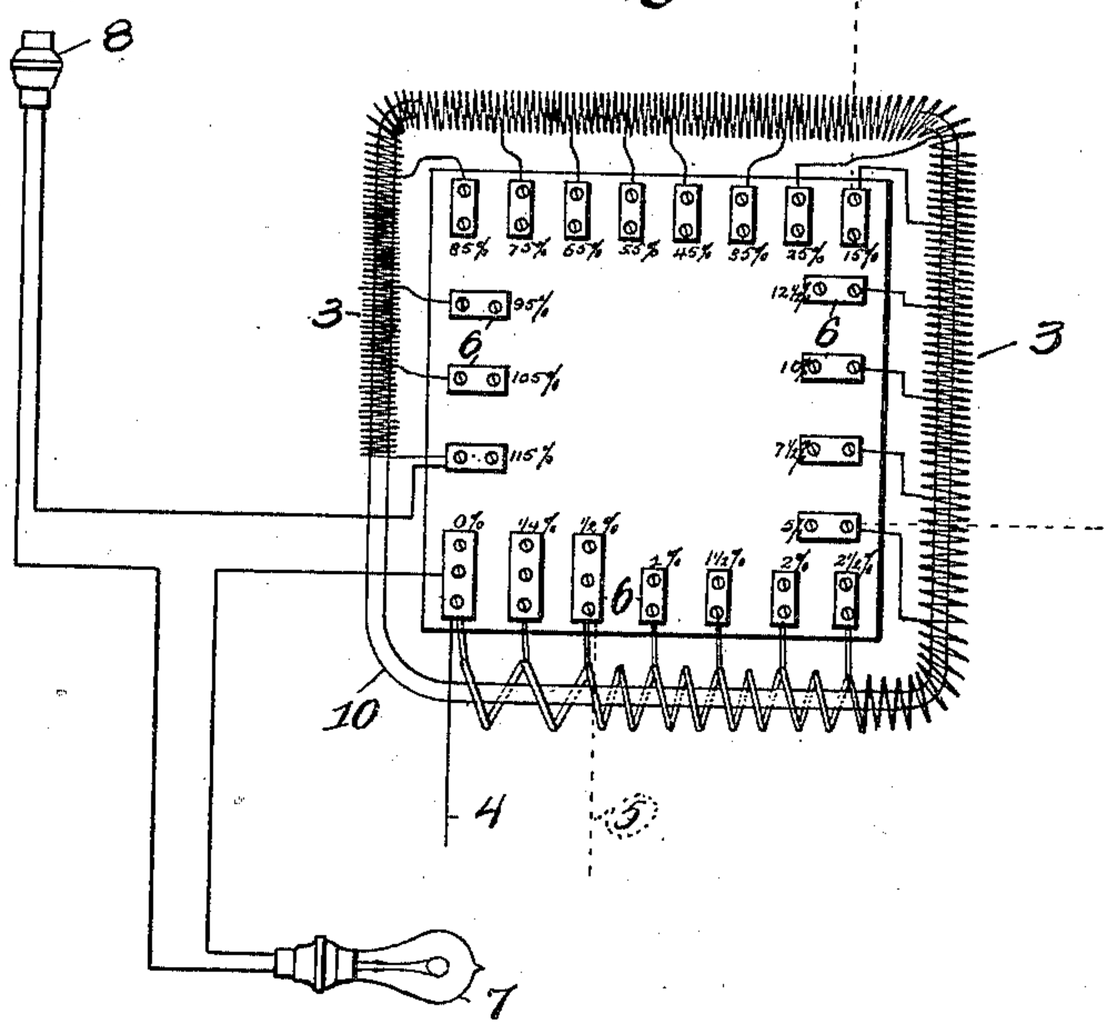



Fig. 2.

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# UNITED STATES PATENT OFFICE.

PENROSE E. CHAPMAN, OF ST. LOUIS, MISSOURI.

## ELECTRIC TESTING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 706,798, dated August 12, 1902.

Application filed December 4, 1901. Serial No. 84,631. (No model.)

*To all whom it may concern:*

Be it known that I, PENROSE E. CHAPMAN, of the city of St. Louis, State of Missouri, have invented certain new and useful Improvements in Electrical Testing Apparatus, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention relates to electrical testing apparatus; and it consists of the novel construction, combination, and arrangement of parts, as will be more fully hereinafter described and claimed.

My object is to construct a testing apparatus of so simple and easy operation and use that workmen unskilled in the use of instruments may use same continuously with the best of results for such purposes as locating short circuits, open circuits, cross-connections, loose connections, &c., in such work as armature-fields and all other circuits or apparatus where there may be a difference of resistance or self-induction, or both, in relative parts of the work without in any way disconnecting, uncovering, or damaging the work.

My invention consists in its simplest form of the combination of an alternating-current transformer, an incandescent lamp in series with the transformer, and a source of energy for lighting the lamp, with means for short-circuiting the transformer at various graduated points through the work and as required to regulate the ratio of transformation for the various sizes and classes of work mentioned above.

My invention consists, further, of the combination of an alternating-current transformer with any device of sufficient impedance in series with its source of supply to prevent excessive currents flowing upon short-circuiting any part or all of the transformer and any current-indicating device, as an ammeter, either having inherent or auxiliary impedance, substantially as above described.

My invention consists, further, of the combination, with the testing-coil or transformer, as above described, of means for readily adjusting and holding the incandescent lamp in a position convenient to the operator, such device being either attached to the testing-coil or transformer or to a suitable clamp for attachment to adjacent objects, such as benches, trestles, &c.

My invention consists, further, of a combination with a testing-coil, a lamp or other device, as described, with a rotary converter suitable for transforming direct to alternating current and supplying the testing-coil.

My invention consists, further, of the novel features hereinafter shown, described, and claimed.

Figure 1 is a view in perspective of the box, showing the adjustable light and the terminals. Fig. 2 is a diagrammatic view showing the circuits.

I use the well-known responsiveness of an incandescent lamp when testing in series with work of a resistance bearing an appreciable ratio to that of the lamp—such, for instance, as five-hundred-volt fan-armatures. This effect is at a maximum when the impedance of a normal portion or section of the work is such that a lamp in series will burn at about half-voltage. Short circuits will then show by a brightening of the lamp, open circuits by either wholly or partially extinguishing the lamp, &c. This phenomenon is observed when any current-indicating device with inherent or additional resistance is used, as above specified. This action, however, ceases to be noticeable when the impedance of the work becomes small or great in comparison with that of the lamp or other device used.

My invention consists in placing a transformer, preferably of the auto type, in series with an incandescent lamp and by means of an adjustable ratio of transformation transform the lamp-current to a value that will be greatly effected by the impedance of the work, be its value great or small, and react on the lamp in a manner substantially as above described when work is of proper impedance to effect a lamp in series, as above specified and below claimed.

By this invention it becomes possible to locate short circuits, open circuits, grounds, wrong connections, and other irregularities in such work as armatures, fields, and other electrical apparatus without in any way disturbing or damaging connections, covering,

or other parts of the work and with ease and rapidity, thereby enabling new and completed work to be tested.

The testing-coil or transformer illustrated is an auto transformer with suitable windings and terminals marked in percentage of the windings. The normal design and winding is for one-hundred to one-hundred-and-fifteen volt work at seven thousand two hundred alternations. Description of operation below will be based on this capacity. The apparatus being an auto transformer may be used for a great variety of work other than that claimed below and can be used as a testing-coil under other than normal conditions, such as fifty-volt to two-hundred-and-twenty-volt circuit, three thousand alternations, and one hundred and ten volts to sixteen thousand alternations, and, say, three to four hundred volts or less, of course following all the laws of such transformer.

In the illustrations, Fig. 2, 3 is the winding of the transformer, proportioned as above specified and below claimed. 10 is the iron core. 6 represents the terminals or binding-posts. 7 is the lamp; 8, an ordinary attachment-plug.

In Fig. 1, 4 and 5 are testing leads or cables for carrying the transformed or secondary current to the work. 9 is a flexible bracket or arm, such as the "Almond," for holding the lamp immediately in front of the operator.

The manner of operation is as follows: For the sake of clearness a concrete case is assumed—say twenty-five or thirty horse-power five-hundred-volt armature wound with No. 10 wire and ninety-five sections, four turns each, four-pole. My testing-coil is placed close to the operator and lamp adjusted as close to his hands and immdiately in front of them as possible. Alternating current is obtained from any source convenient. One line is connected to terminal marked 115%, the other to lamp and thence to terminal 0%, with one-hundred-and-ten to two-hundred-and-twenty volt circuits and lamps, or to terminal 55%, with fifty-volt current and lamp. Suitable leads are then connected one to terminal 0% and for the work assumed the other to terminal $2\frac{1}{2}$%. Current being turned on, the lamp will not light or, at least, only barely show red. The leads 4 and 5 are then short-circuited, and if everything is all right the lamp will brighten to nearly its full candle-power. A pair of leads with an area about equal to No. 6 Brown & Sharpe gage are selected. The leads are then placed across a section of the armature. If the lamp burns at half-voltage, the combination is at its maximum sensitiveness. Should it, however, burn brighter, move lead No. 5 to terminal 2. This will dim lamp. If too dim, reverse the procedure. For optical reasons a dark background for the lamp is desirable. The armature is then tested a section at a time. If a short circuit is encountered, the lamp will brighten more or less, according to its relative value. One turn in the above armature short-circuited will produce quite a noticeable brightening of the lamp, an open circuit either completely extinguishing or partially dimming, according to its nature. Wrong connections will act according to their nature. Where the impedance of the work is low, loose contacts will show a dimming of the lamp. Grounds are located by finding the section which shows brightest. A different adjustment will generally be required to locate grounds than for short circuits in coils. Should all sections give exactly the same brilliancy, the work is satisfactory. The location of coils on an armature may be ascertained without disconnecting—viz., by exploring with a pin or needle or pointed terminal—their other ends being held in contact with a commutator-bar. By comparing the brilliancy of the lamp work of almost any kind may be tested where there are several parts or sections of approximately the same impedance. The apparatus is so sensitive that a variation of two or three per cent. in the work is noticeable when adjusted as above directed.

The terminals used will be selected proportionately to the work, high resistance requiring greater values. Extremely high resistance, such as field-coils, will occasionally require that the testing-coil be used to step up and not down, as in the above tests.

Where alternating current is not available, a small rotary transformer of any of the various kinds may be used for transforming direct current to alternating current and the testing-coil supplied therefrom.

I claim—

1. In a testing-coil, an incandescent lamp, a circuit for operating the lamp, a transformer in the lamp-circuit, and means of taking current from any desired portion of the transformer, substantially as specified.

2. In a testing-coil, an incandescent lamp, a circuit for operating the lamp, a transformer in the lamp-circuit, said transformer being subdivided and graduated so that any desired amount of the transformer may be short-circuited or loaded, substantially as specified.

3. In a testing-coil, an incandescent lamp, an adjustable stand supporting the lamp, a circuit for operating the lamp, a transformer in the circuit sufficient to reduce the brilliancy of the lamp to a desired extent, and means of short-circuiting or loading a desired amount of the transformer, substantially as specified.

4. In a testing-coil, an incandescent lamp, a circuit for operating the lamp, a transformer in the circuit to reduce the brilliancy of the light, so that when a part of the transformer is short-circuited the light will increase in brilliancy proportionately to the value of the short circuit, substantially as specified.

5. In a testing-coil, or transformer, an incandescent lamp, a circuit for operating the lamp, a transformer in the lamp-circuit to materially reduce the brilliancy of or extin-

guish the light, means of subdividing and graduating the transformer, and leads adapted to be attached to the transformer at any desired point so that said leads may be used in testing, the effect of the leads being to carry current to the work, and as means for short-circuiting a predetermined amount of the transformer to increase the brilliancy of the light, substantially as specified.

6. In a testing-coil, an incandescent lamp, a circuit for operating the lamp, a transformer in said circuit, said transformer being subdivided and graduated, binding-posts connected to said subdivisions, and leads adapted to be connected to said binding-posts, substantially as specified.

7. In a testing-coil, an incandescent lamp, a transformer, a circuit for operating the lamp, and a rotary transformer or other device for transforming direct current to alternating current suitable for supplying alternating current to the testing-coil, substantially as specified.

8. In a testing-coil, a transformer, a circuit for operating same substantially as above described, and an ammeter or other current-indicating device having sufficient impedance inherent or auxiliary, substantially as specified.

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

PENROSE E. CHAPMAN.

Witnesses:

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EDWARD E. LONGAN.