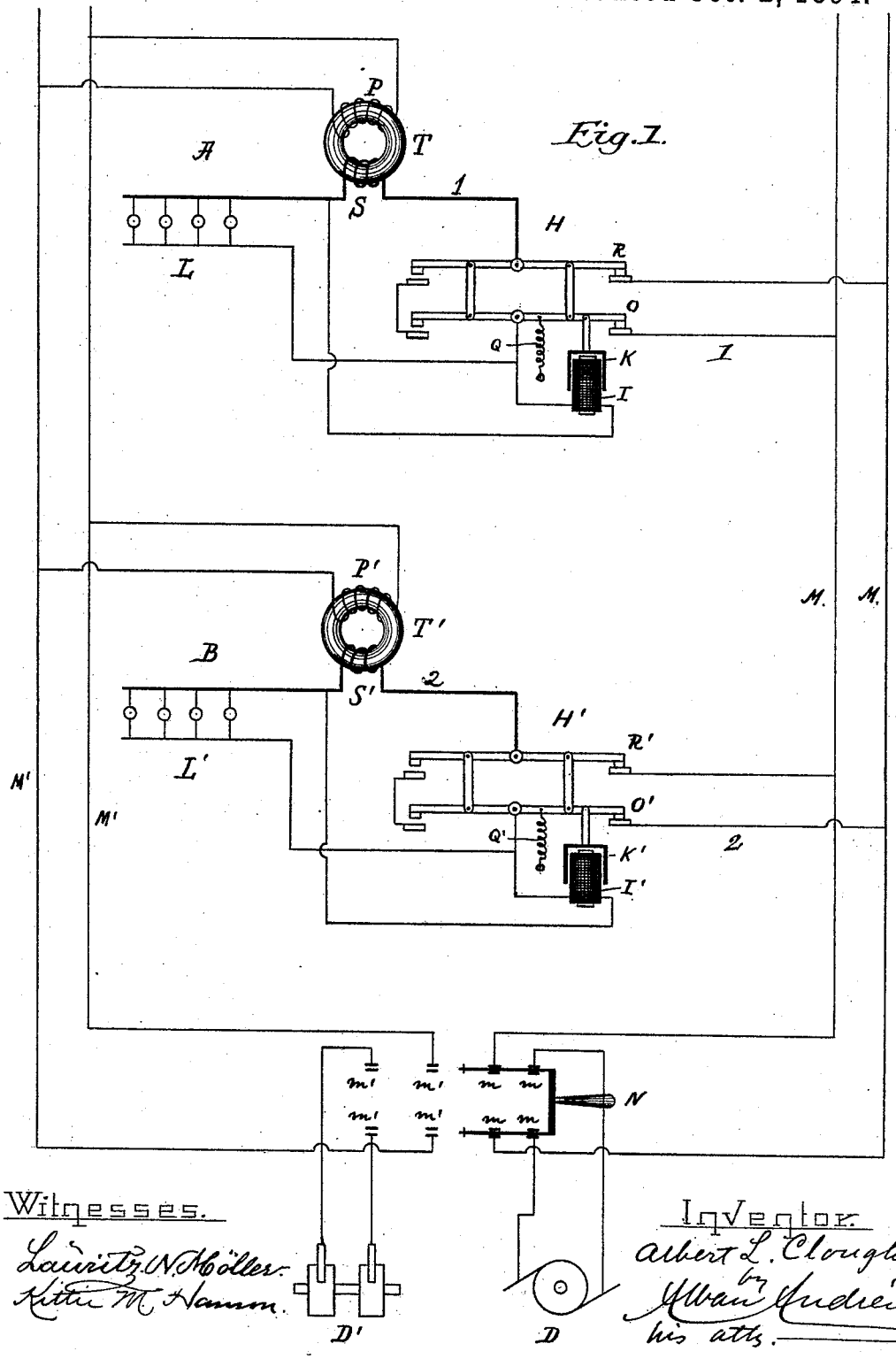
(No Model.) 2 Sheets—Sheet 1.

A. L. CLOUGH.

COMBINED SYSTEM OF ALTERNATING AND DIRECT CURRENT DISTRIBUTION.

No. 526,992. Patented Oct. 2, 1894.

Fig. 1.



Witnesses.

Lauritz N. Möller.

Kittie M. Hamm.

Inventor.

Albert L. Clough

by Albert Andrews

his attys.

(No Model.) 2 Sheets—Sheet 2.

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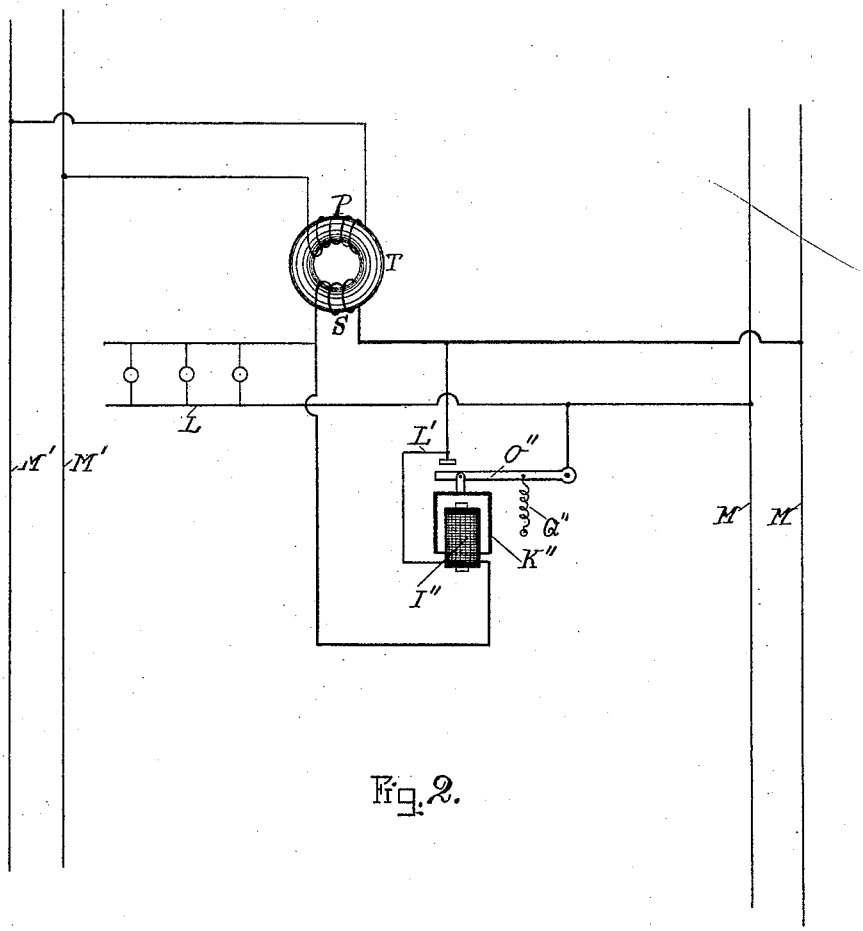

Fig. 2.

Witnesses.
Laurits N. Møller
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UNITED STATES PATENT OFFICE.

ALBERT L. CLOUGH, OF MANCHESTER, NEW HAMPSHIRE, ASSIGNOR OF ONE-HALF TO JOSEPH BRODIE SMITH, OF SAME PLACE.

COMBINED SYSTEM OF ALTERNATING AND DIRECT CURRENT DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 526,992, dated October 2, 1894.

Application filed May 15, 1894. Serial No. 511,289. (No model.)

To all whom it may concern:

Be it known that I, ALBERT L. CLOUGH, a citizen of the United States, and a resident of Manchester, in the county of Hillsborough and State of New Hampshire, have invented new and useful Improvements in a Combined System of Alternate and Direct Current Distribution, of which the following, taken in connection with the accompanying drawings, is a specification.

This invention relates to improvements in electrical distribution and it consists in a combined system of alternate and direct electric current distribution adapted for use in connection with electric lamps or other translating devices, and it has for its object to obviate the losses which are met with in the ordinary methods of supply. This is attained by the use of a combination of both the alternating and direct current as will hereinafter be more fully shown and described reference being had to the accompanying drawings which represents a diagram of the improved system of current distribution.

In supplying electrical energy by the alternating current system, a constant loss is experienced, due to the hysteresis and eddy currents in the iron of the transformers which are employed. This loss takes place no matter whether there are many or few lights in operation, and amounts at all times to a considerable fraction of the total transformer capacity connected. While this loss is not particularly serious at times when a large amount of energy is being distributed, it becomes so during periods when the call or current is small, amounting at such times to several times the useful energy sent out. It is to do away with this loss during light loads by the use of direct current during the period, that the following method is devised.

Although the method makes use of a pair of extra wires for the supply of the direct current the amount of current called for during the time when they are in use is so inconsiderable that their cross section need be but small.

The advantage of this system is that the interest on the added amount of copper which it is necessary to install, is but a small part only of the saving in energy which should be brought about by the prevention of the constant transformer losses during a large part of the time.

In the drawings—Figure 1 represents the apparatus arranged not only to short-circuit but to absolutely disconnect the branch from the system as a whole. Fig. 2 shows an arrangement designed simply to short-circuit the branch without disconnecting it from the rest of the system.

Referring to Fig. 1:—D D′ are sources respectively of direct and alternating current, and M and M′ are the respective mains leading from them to the consumers' stations A, B.

T T′ represent the transformers of the two stations of which P P′ are the primaries, connected to the alternating mains and S S′ are the secondaries. The transformer secondary of each station is inserted into one side of the branch leading from the direct current mains to the translating devices.

H H′ represent short circuiting devices of any suitable construction either manual or automatic, designed to be operated by the alternating current and to short circuit the direct current mains and thus to furnish a return for the alternating current when it is in use; but to remain open at all other times so as not to short circuit the direct current mains when the direct current is on them.

The short circuiting devices shown are of the automatic variety, and each is so arranged as to not only short-circuit the particular branch in which it is placed, but to absolutely disconnect said branch from the rest of the system. This is accomplished by means of the alternating current acting upon repulsion devices H H′ which consist of the respective electro-magnets I I′ provided with conducting cylinders K K′ fitting freely about them, the induced currents in said cylinders being repelled by the electro-magnets. The cylinders are suitably connected to the respective levers O, R, O′ R′ which carry the contacts which, co-operating with the fixed contacts, accomplish the short circuiting and disconnection by means of the arrangement of connections shown. The repulsion devices are not capable of being operated by direct current

and so the levers and movable contacts are constantly held in the position shown, by the action of the respective springs Q Q′ as long as the direct current is in use, giving the branch a connection to the direct current mains in the usual manner. When however the alternating current is applied, the repulsion device acts and overcomes the spring, the lever and its contacts move to the opposite position and the short circuiting and disconnection are accomplished.

It is not necessary, although it may be advisable that a short circuiting device be placed in each branch, as such devices distributed upon the main conductors at convenient points might be preferable and it is not necessary although it may be desirable that the devices disconnect as well as short circuit the branches. Their function may simply be to short circuit and thus form a return path for the alternating currents, without separating the branch from the rest of the system and they may be operated by hand or any other means.

The apparatus is shown in Fig. 2 in the condition in which it would remain while the direct current is in use. Upon the application of the alternating current, however, the repulsion device K″ would act, raising the pivoted lever O″ into contact with the fixed contact L″, thereby affecting the short-circuit through the path as shown, as long as the alternating current is applied, the short-circuit being broken by the action of spring Q″ as soon as the alternating current ceases and the apparatus remaining unaffected by the direct current.

It is designed to connect the transformers in such a way that about the same number will be poled in each direction on the mains M thus reducing the current flowing in them even perhaps to the extent of doing away with most or all of the short circuiting devices. As an illustration of this method of poling the transformers, reference may be had to Fig. 1, where the two transformers T and T′ are seen to have their corresponding primary wires connected to the same primary mains. Their corresponding secondary wires are therefore of the same instantaneous polarity, but they are shown necessarily connected to the mains M, M, the wire 1 of T going to one of the direct current mains while the wire 2 of T′ goes to the other direct current main. These two transformers may be regarded as the representatives of the two groups into which all the transformers of the system would be divided, each group to have, as nearly as possible, the same capacity.

In the application of this system the alternating current would be in use and the direct current cut off, during the period of heavy load which usually takes place in the evening. The alternating system would then be operating at its maximum efficiency while the heaviness of the load at this time would preclude the use of the direct current system owing to the large size of the mains which would be required to operate at the low voltage used on the transformer secondaries. During the light loads of the rest of the day the direct current would be in use and the alternating current cut off, thereby avoiding the large transformer loss which would otherwise take place, while the small call for current which is experienced during these portions of the day would allow the use of quite small direct current mains without too great loss.

For the purpose of changing the current from the alternating to the direct source or vice versa I employ a suitable switch N adapted to establish communication from the direct source D to the main M by means of the contacts *m*, *m*, as shown in the drawings, or from the alternating source D′ to the main M′ by means of the contacts *m′ m′* when the switch is turned in an opposite direction as may be required during the working of the system as above mentioned.

What I wish to secure by Letters Patent and claim is—

The combination of a source of direct and of alternating currents of conductors for the distribution of said currents, of branches to connect the translating devices to the direct current mains, of transformers having their primaries connected to the alternating current mains, and each having its secondary included in one side of its appropriate branch, and of devices to short circuit said direct current mains when the alternating current is on and to remove the short circuit when the alternating current is off, substantially as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 28th day of April, A. D. 1894.

ALBERT L. CLOUGH.

Witnesses:
ALBAN ANDRÉN,
KITTIE M. HANSON.