No. 675,323. Patented May 28, 1901.

E. B. CLARK.

LIFTING MAGNET.

(Application filed May 22, 1900.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

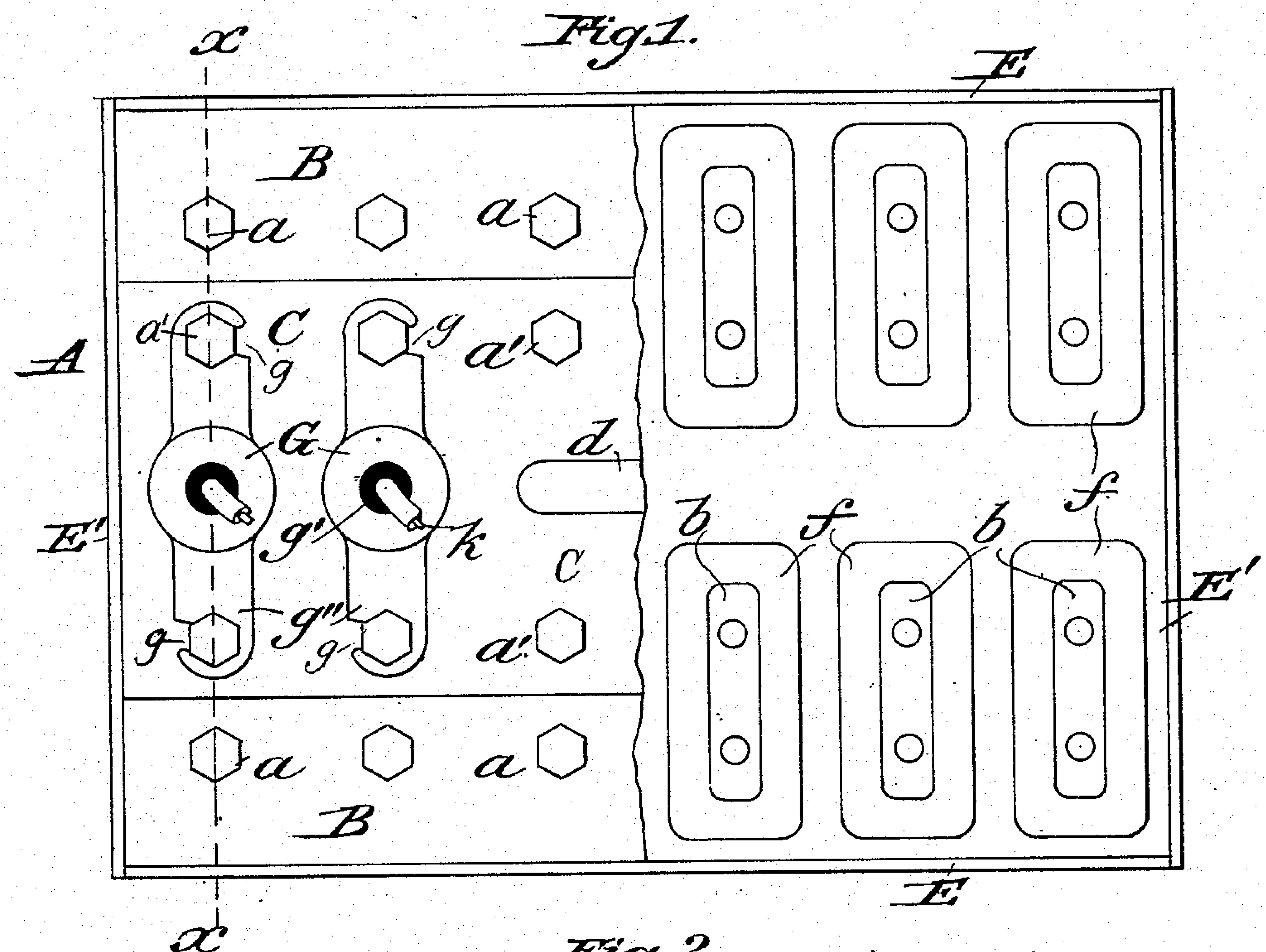
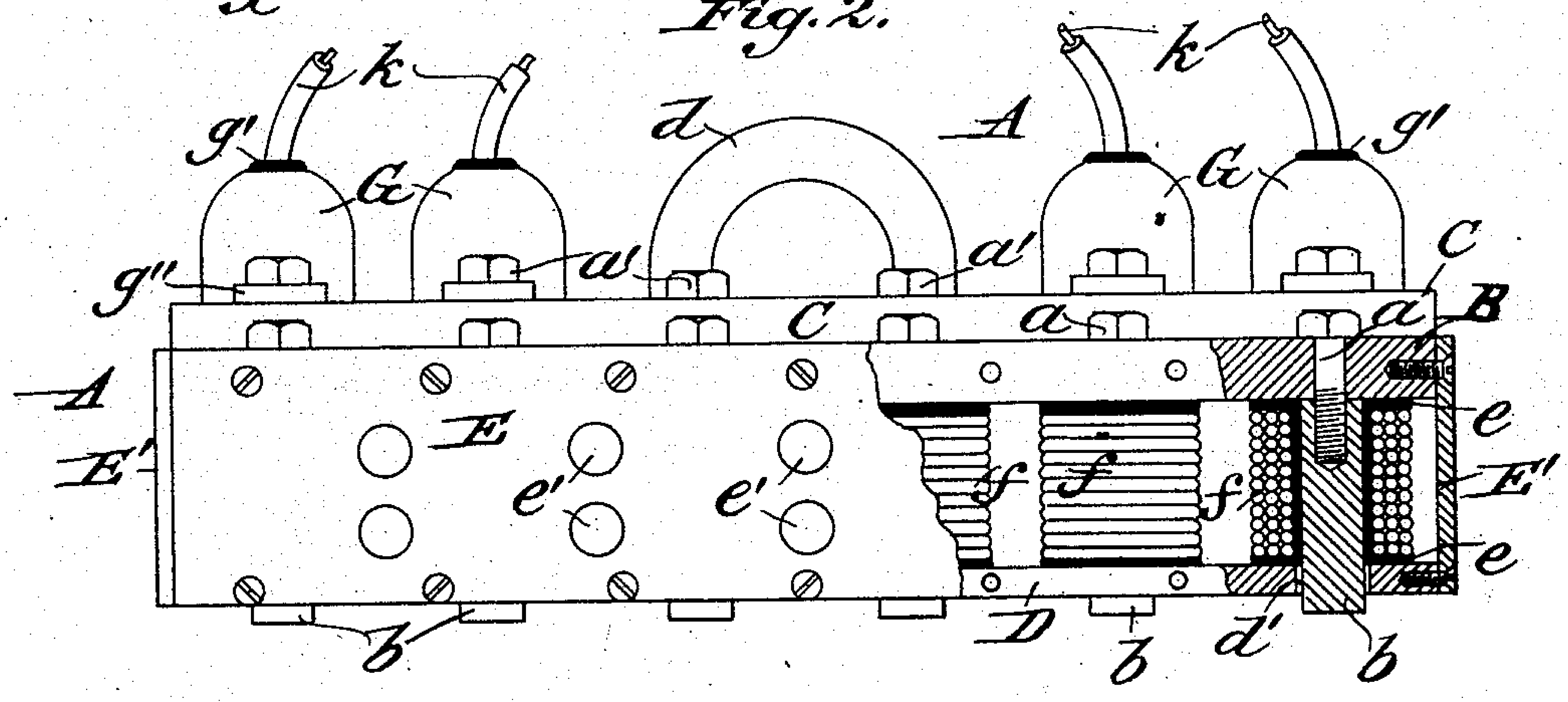


Fig. 2.



WITNESSES:
M. R. McFrayser
Wm H. Chaffey

INVENTOR
Eugene B. Clark
BY
E. B. Clark
ATTORNEY.

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Fig. 3.

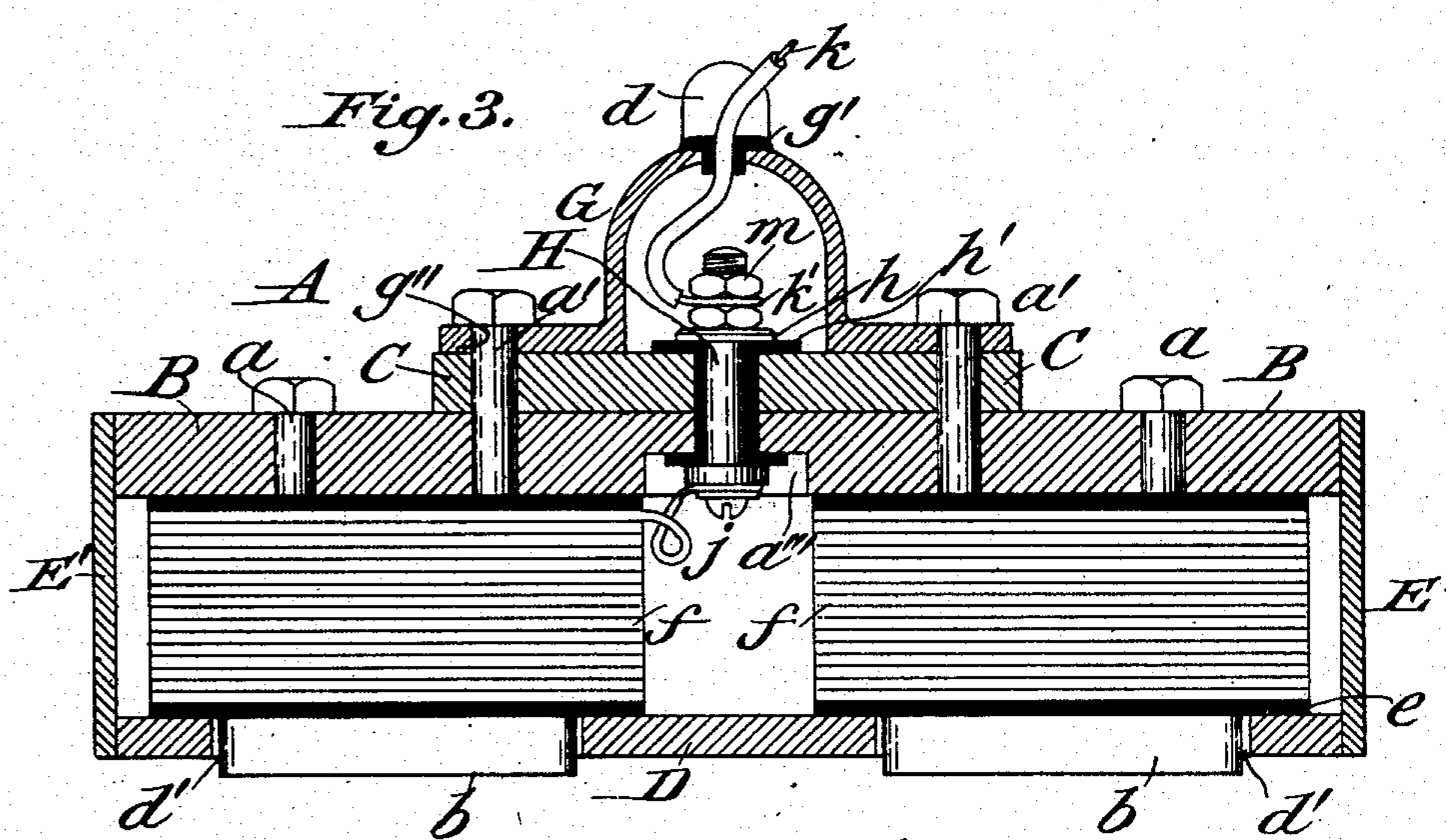
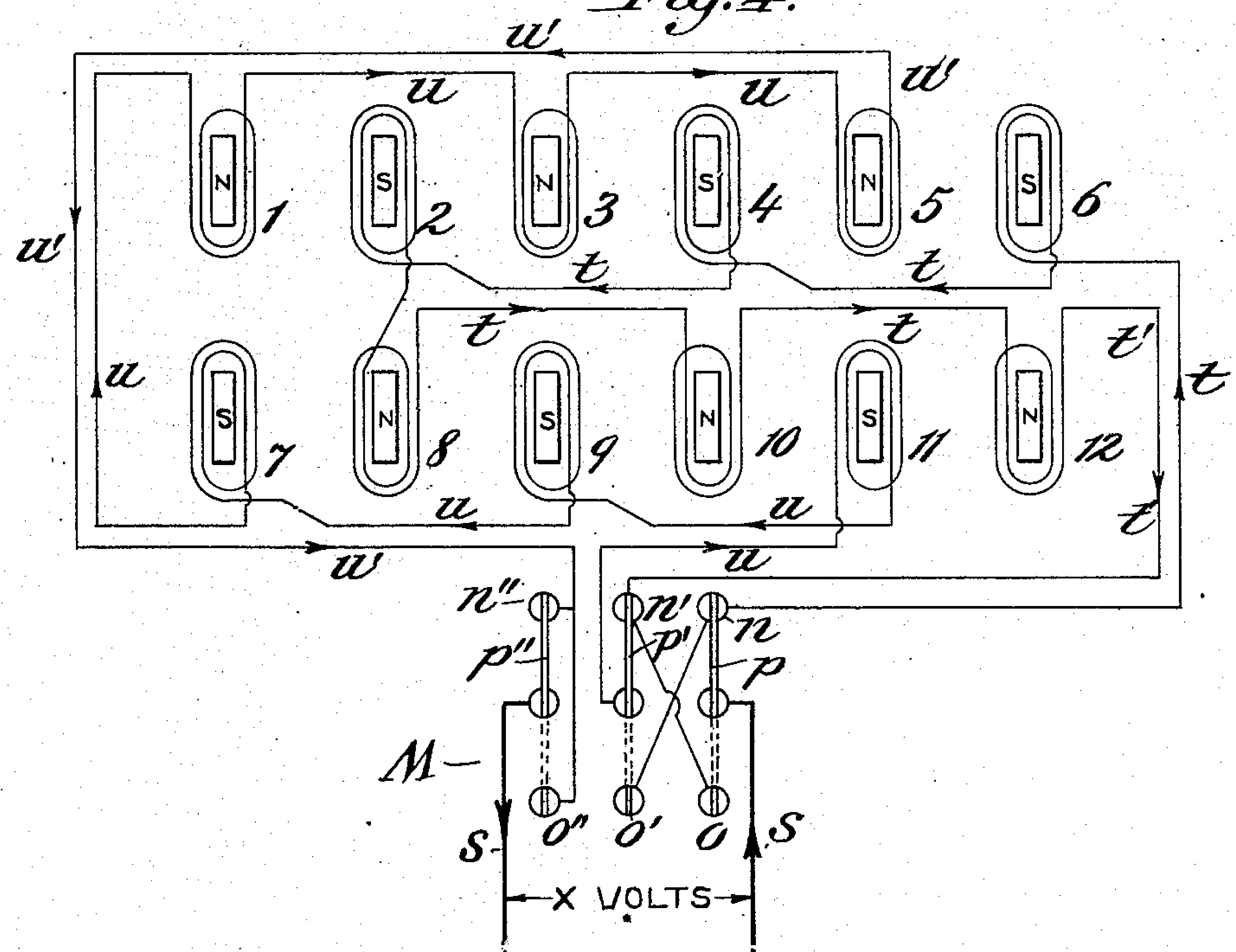


Fig. 4.



WITNESSES:

M. R. M. Frayser.

Wm. H. Chafney

INVENTOR

Eugene B. Clark

BY

E. B. Clark

ATTORNEY.

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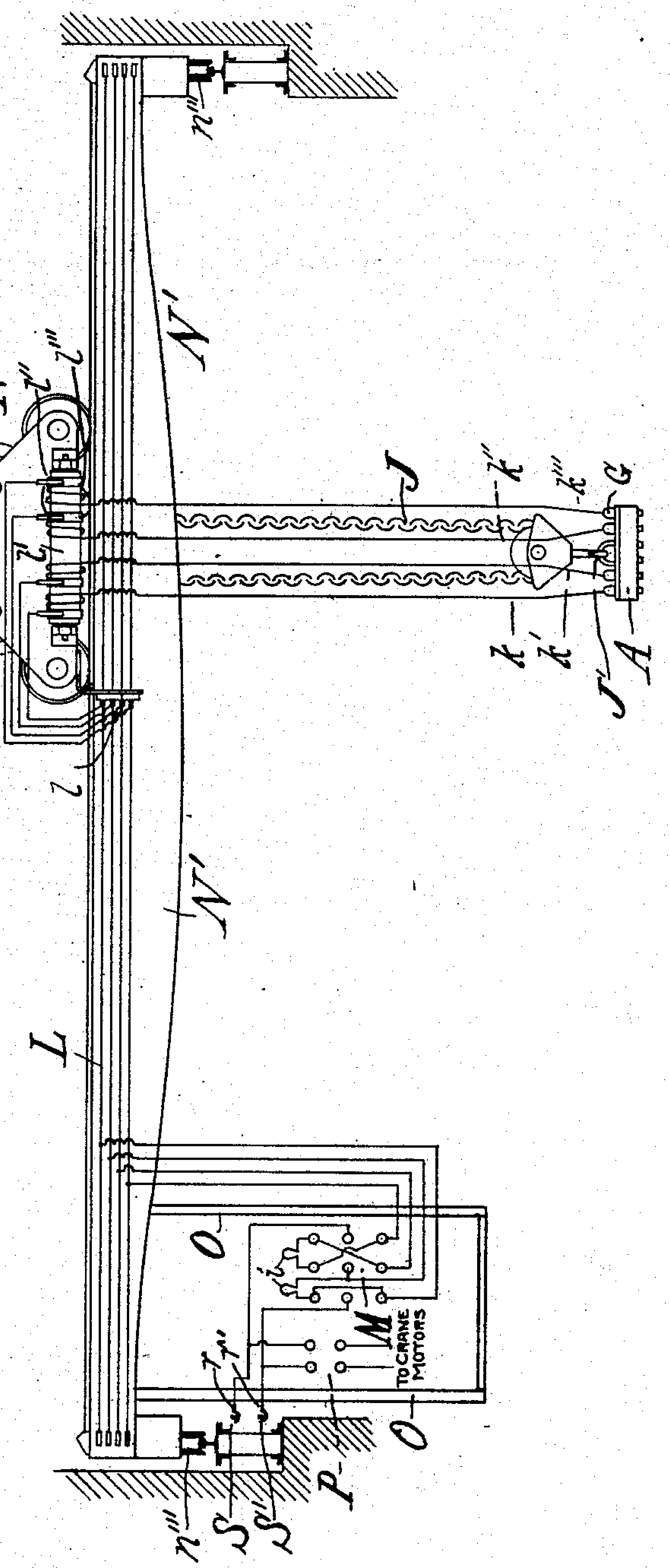
(No Model.) 3 Sheets—Sheet 3.

Fig. 5.



WITNESSES:

M. R. M. Frayser.

Wm. H. Capel...

INVENTOR.

Eugene B. Clark

BY

E. B. Clark

ATTORNEY.

UNITED STATES PATENT OFFICE.

EUGENE B. CLARK, OF CHICAGO, ILLINOIS.

LIFTING-MAGNET.

SPECIFICATION forming part of Letters Patent No. 675,323, dated May 28, 1901.

Application filed May 22, 1900. Serial No. 17,551. (No model.)

To all whom it may concern:

Be it known that I, EUGENE B. CLARK, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Lifting-Magnets; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a lifting-magnet for use in connection with a traveling crane, conveyer, or hoisting machinery for picking up and transferring metallic plates, billets, slabs, or other magnetic material.

One object of my invention is to provide for the construction of a lifting-magnet of reduced weight and of greatly-increased efficiency for a given cost of manufacture or of greatly-reduced cost for a given efficiency or power; also, to provide in a multipolar lifting-magnet means for quickly changing the polarity of different groups of the cores or pole-pieces to adapt the magnet for different kinds of work.

Another object of my invention is to provide for quickly and conveniently attaching the lead-wires of different circuits to terminal posts which are secured in the top plate, but insulated therefrom, of the lifting-magnet, and having permanently connected to their lower ends the wires of the different coils or windings of the pole-pieces below; also, to provide guard-caps for the terminal posts and connections of the lead-wires so that the connection shall not be broken or disarranged in the use of the magnet.

Another object is to provide for readily renewing the worn eyelet or eyelets and the eye-piece to which the hook of the hoisting apparatus is attached without removing or renewing the whole top plate of the magnet.

The matter constituting my invention herein will be set forth in the claims.

I will now describe the details of construction of my improved lifting-magnet by reference to the accompanying drawings, in which—

Figure 1 represents a top plan view of the magnet, part of the top plate being broken away for showing the cores and coils below. Fig. 2 represents a side elevation thereof partly in vertical section. Fig. 3 represents a transverse vertical section, on enlarged scale, on line $x\,x$, Fig. 1. Fig. 4 represents a diagrammatic plan view of an arrangement of cores, coils, circuits, and switch device or controller, illustrating the general method of and means for changing the polarities of several poles of a group to accomplish different classes of work. Fig. 5 represents a side elevation of an overhead traveling crane, showing my lifting-magnet and switch or controller applied thereto.

I construct my lifting-magnet with a plurality of cores and connected coils, providing a number of magnetic circuits, so that each pair of poles can be caused to act in unison with all the others and the whole group forms one complete magnet. One of the principal advantages of this construction and arrangement consists in the cheapness or reduced cost for a given efficiency of power, owing to the more efficient use of copper wire in winding the coils. Other distinctive features and advantages of my invention will be pointed out after the detailed description of the multipolar lifting-magnet.

By my improved method of construction I have found that I can build a magnet for less than one-half the cost of a two-pole magnet of the same capacity; also, that I am able to reduce the weight to about one-fourth of that heretofore required for the same capacity.

I have discovered that different kinds of work require a different arrangement of the poles. For instance, to pick up a single large plate without picking up other plates directly beneath it the polarity of the adjacent cores should alternate, plus and minus, right through the series, while to pick up several small plates one on top of another there should be a row of plus poles on one side and a row of minus poles on the other side of the series. In order to change a pole from plus to minus—that is, positive to negative—it is only necessary to change the direction of the current in the coil around that pole or core. In the construction of my lifting-magnet, therefore, I provide for securing various combinations of poles or for changing the polarities of groups of the cores or poles in the same magnet at will by carrying out more than one electric circuit and connecting the circuits to a switch or some other controlling device, preferably located in the cage of the crane, by means of which the operator can produce various combinations or arrangements of polarities at will. This will be more fully described and illustrated by reference to Figs. 4 and 5 of the drawings.

The multipolar lifting-magnet A is constructed with a shell or casing inclosing the cores and coils, and consists of a top plate B, of soft steel, the side and end plates E and E', and a bottom plate D. The side plates are of soft steel or of hard sheet-brass and the bottom plate is preferably of hard sheet-brass. The pole-pieces or cores *b* are of soft steel and are secured to the top plate B by screw-bolts *a*. A separate eye-plate C is secured to the top plate B substantially throughout its length by screw-bolts *a'*, which also pass down and screw into the cores *b*. A separate eye-plate C is used for the reason that the eyelets therein or the eyepiece *d*, which is riveted therein, is apt to become worn, rendering the eyepiece insecure. When this occurs, a new eye-plate C, having riveted thereto the eyepiece *d*, can be readily applied to the top plate B after removal of the worm-plate without disturbing the top plate B and its connections with the cores, or a new eyepiece can be riveted in the eye-plate C. The eye-plate C is preferably made substantially of the same length as the top plate B and secured thereto by bolts, as described, for giving it the desired strength and rigidity and distributing the lifting strain throughout the magnet. The bottom plate D is made with as many openings *d'* as there are cores, so that the latter may project a short distance through the plate, as clearly shown in Figs. 2 and 3. The two side plates E and the two end plates E' are secured by screws to the top and bottom plates, as shown in Fig. 2. The usual insulating-casing *e* is placed around the cores, and copper wire is wound thereon, forming the coils *f*, which are suitably connected in pairs for forming circuits.

For the purpose of conveniently changing the polarity of groups of the cores I connect a number of lead-wires with the coils and also with a switch or controller, preferably located in the operator's cage O of the crane, as shown in Fig. 5. In order to make quick connections of the lead-wires to the coils and properly protect such connections, I provide brass terminal posts H, passing through the eye-plate C and top plate B. Any suitable insulating material *h'* is placed between the post H and the plates and also between the brass washer *h* and plate C, as shown in Fig. 3. The lower end of the terminal post H is seated in a recess *a'''* in the under side of the top plate B. To the lower end of post H are connected wires of the coils by means of the binding-screw *j*. Over the top of each binding-post is placed a guard-cap G of any suitable metal, having an opening at the top and provided with an insulating-bushing *g'* of hard rubber. The guard-cap G is provided at the bottom with lateral arms *g''*, having at their ends and on opposite sides the notches *g*, as shown in Fig. 1. The screw-bolts *a'* pass through the notches for securing the guard *g* in place. It will be evident that by slightly unscrewing the bolts *a'* the cap G can be slightly turned to the left, thereby turning the notched ends of the arms *g''* from under the heads of the bolts *a'*, permitting the guard-cap to be lifted up for giving access to the terminal-post H for attaching or detaching the lead-wire *k*. The cap G is readily secured in place by giving it a slight turn, thereby sliding the notched ends of its arms *g''* under the heads of the bolts *a'* and then screwing down the bolts. The lead-wires *k* are passed through the openings in the bushings *g'*, and their terminals *k'* are secured to the binding-posts H by lock-nuts *m*. End wires of the coils are permanently secured to the lower end of post H, where they will be so protected that they will not be broken or deranged. A new lead-wire *k* can be quickly and conveniently connected to the post H in case one is broken in the operation of the magnet.

Both of the side plates E are provided with openings *e'* between the coils *f*, so that there may be free circulation of air through both side plates and between the coils for conveying off heat and keeping down the temperature of the coils.

In Fig. 4 is represented diagrammatically twelve cores or coils, from 1 to 12, inclusive, with the connections and circuits so arranged as to produce alternate plus and minus poles throughout the series. A triple-pole double-throw switch M is used. This is composed of the blades *p p' p''*, the upper contact-terminals *n n' n''*, and the lower contact-terminals *o o' o''*. To these contacts are connected three circuits, one of which is the power-circuit *s*, and the other two, as *t t'* and *u u'*, are circuits entering the magnet and embracing the coils. When the current flows as indicated by the arrows *t t'* and *u u'*, the polarity will be made as indicated by the letters N and S—that is, the cores numbered 1, 3, 5, 8, 10, and 12 will be north or plus, and the cores numbered 2, 4, 6, 7, 9, and 11 will be south or minus. With this arrangement the magnet is best adapted for lifting a large plate without affecting the plate, which is directly below it. By throwing the switch down, as indicated by dotted lines, so that the blades make contact with the terminals *o*, *o'*, and *o''*, the current will be reversed through one of the magnetic circuits while it is not reversed in the other. The result is that the polarities of six of the poles are reversed, making the group numbers 1, 2, 3, 4, 5, and 6 plus or north and the group numbers 7, 8, 9, 10, 11, and 12 minus or south. With this arrangement the magnet is best adapted for picking up a number of small plates one on top of another. The multiple-series arrangement is conducive not only to economy of power consumption, but to quickness of operation, for if it is desired to make the magnet pick one piece from the top of a pile it can be done with precision and ease, and if a number of pieces are wanted they may be picked up and handled just as readily.

The double-throw switch shown in Fig. 4 will in practice be located in the operator's cage of the crane or other hoisting and conveying machine in order that the operator may control the performance of the magnet. The necessary conducting wires or circuits will connect the switch device from the cage of the crane to the lifting-magnet, as shown in Fig. 5.

The magnet A is suspended by means of the chain J, the pulley, and hook J' from the carriage or trolley N, mounted upon the traveling crane N', having wheels n''', resting upon the usual track. The wires $k\, k'\, k''\, k'''$ connect the magnet A with the reel l' of the trolley on which they are coiled and connect with the connecting-rings l''' thereon, to which are applied the brushes l'', which in turn connect with the collecting shoes or brushes l on the trolley. An operator's cage O is secured to the main girder of the crane N', and in it is preferably placed the switch or controller M for the lifting-magnet. The crane-switch P is also located in the cage O. The main conducting-wires S S' are strung adjacent to the girder which supports the rails for the crane, and to such rails are applied the brushes or shoes $r\, r'$, which connect with the switches M and P. The current is taken from the wires S S' to the crane-switch and the magnet-switch in parallel. From the bottom of the magnet-switch M wires lead, as shown, to the trolley-wires L on the crane-girders. The collecting-shoes l, connecting with the trolley N, take the current from the wires L and conduct it by wires to the reel l', which is geared in with the hoisting mechanism of the crane-trolley. The two incandescent lamps i, connected to the top of the switch M, are provided to offer a non-inductive resistance in multiple with the magnet-windings to prevent sparking at the switch.

The operation of the crane and of the lifting-magnet are well understood in practice.

As a result of my improved construction I secure a number of distinctive features and advantageous results in the construction and use of my magnet, as follows: Owing to the reduced amount of copper and iron entering into the construction of the magnet, the cost of the material is much decreased. The weight of the magnet for a given lifting power is also much decreased, and this is an important feature when it is considered that the magnet itself must be raised and lowered with every piece of metal it picks up. The cost of repairs and maintenance are much reduced, owing to the separate and removable eye-plate, the protected terminal posts, the subdivided windings, and easily-accessible coils. The principal repairs on a magnet are caused by worn eyebolts, terminal wires broken off close to the top plate, and "grounded" windings. My improved construction provides for easy and quick repairs of such breaks as occur and prevents many breaks and defects which have heretofore occurred in the magnets in use. By reason of the ventilation of the windings and the subdivision of the whole magnet-winding into several coils it is possible to increase the radiating-surface of the coils to a very large extent, thereby allowing more heat loss in the coils, and therefore a higher current density in the copper wire, without dangerous heating. The result is less copper required, and therefore less weight of coils. My improved arrangement of cores and coils or pole-pieces provides an increased area (of plate of billet being handled) through which magnetic lines are passed. This is due to the fact that from each N or positive pole lines pass in every direction to the adjacent S or negative poles, and in the same manner the lines pass into each negative pole from every direction. Thus by spreading the poles over a considerable area all of that area is subjected to magnetic influence instead of just the area between a pair of positive and negative poles. Therefore a greater gain is effected than would be by using a number of small two-pole magnets, even though that would be a big gain over one large two-pole magnet equal in capacity to the combined capacity of the smaller ones. Another very decided advantage of the multiple-pole construction lies in the fact that it can be readily adapted for various grades and classes of work, as partially illustrated in Fig. 4.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a lifting-magnet, the combination with the top plate, of a multipolar arrangement of cores or pole-pieces and coils, circuits embracing different groups of coils and means for changing the polarities of groups of cores to adapt the magnet for different kinds of work, substantially as described.

2. In a lifting-magnet, the combination with the top plate and a plurality of cores and coils, of a switch connecting with the power-circuit and two or more circuits which embrace different groups of coils on the cores for changing the direction of the currents therein and thereby changing the polarities of groups of the cores, and adapting the magnet for different kinds of work, substantially as described.

3. In a lifting-magnet the combination with the top plate B, having cores and coils secured thereto, of a separate eye-plate C, having an eyepiece d, and extending substantially the length of plate B for strengthening the same, and detachably secured thereto, whereby a worn eye-plate with its eyepiece can be readily removed from the magnet for repair or a sound plate inserted without disturbing the

connections of the top plate with the cores of the magnets, substantially as described.

4. In a lifting-magnet, the combination with the top plate having cores with coils secured thereto, of a terminal post and interposed insulating material secured to said plate, the wires of different coils connecting to the inner end of said post and a lead-wire detachably connecting with the outer end thereof, substantially as described.

5. In a lifting-magnet having a plurality of cores and coils, the combination with one of the plates in the shell, of a terminal post and interposed insulation, the wires of different coils connecting with the inner end of said post and a lead-wire detachably connecting with the outer end thereof, substantially as described.

6. In a lifting-magnet comprising a multipolar arrangement of cores and coils, the combination with one of the plates in the shell of an insulated terminal post having wires of the coils and a lead-wire connecting respectively to its inner and outer ends, and a guard-cap secured to the plate over the outer end of said post, substantially as described.

7. In a lifting-magnet, the combination with the insulated terminal post in the shell, of a removable guard-cap, having lateral notched arms and screw-bolts engaging in the notches of said arms, whereby said cap can be readily removed or secured in place over the terminal post, substantially as described.

8. The combination with the top plate having cores with coils secured thereto, of an insulated terminal post in said plate, having wires of the coils and a lead-wire connecting respectively to its inner and outer ends, the removable guard-cap, having lateral arms provided with notches in their opposite edges, and screw-bolts engaging in said notches for quickly securing or removing said cap, substantially as described.

9. The combination with a lifting-magnet comprising a multipolar arrangement of cores and coils, of a controller device connecting with the power-circuit and separate circuits embracing different groups of the coils and connecting with the controller, whereby the direction of the current may be changed in groups of the coils and the polarities of their cores thereby changed, adapting the magnet to pick up, either a single plate or a number of superimposed plates in a pile, substantially as described.

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

EUGENE B. CLARK.

Witnesses:
SAMUEL E. HITT,
HOLLIS A. FOX.