

F. MACKINTOSH.  
RESISTANCE UNIT.

APPLICATION FILED JUNE 11, 1906.

Fig. 1.

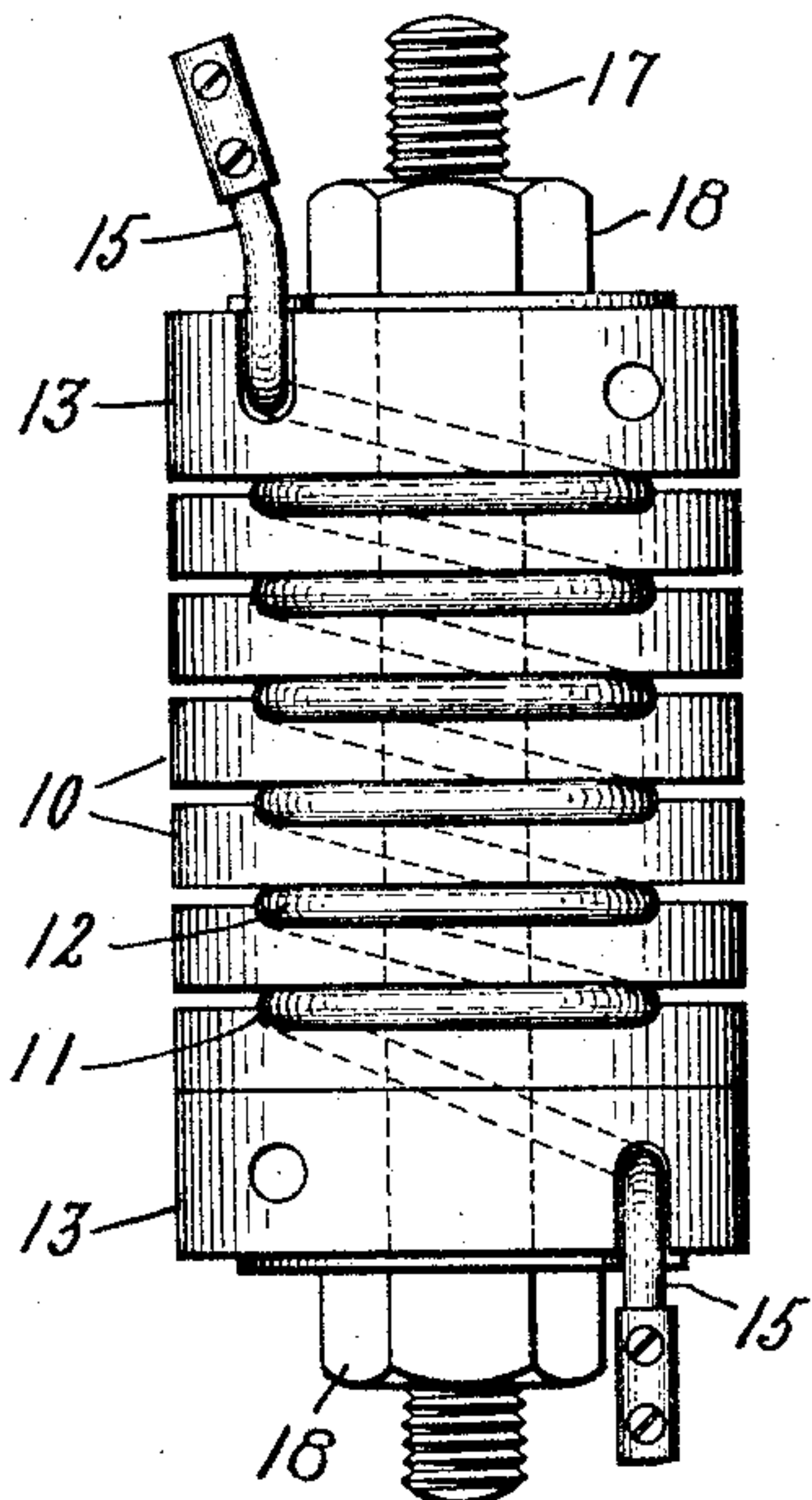


Fig. 2.

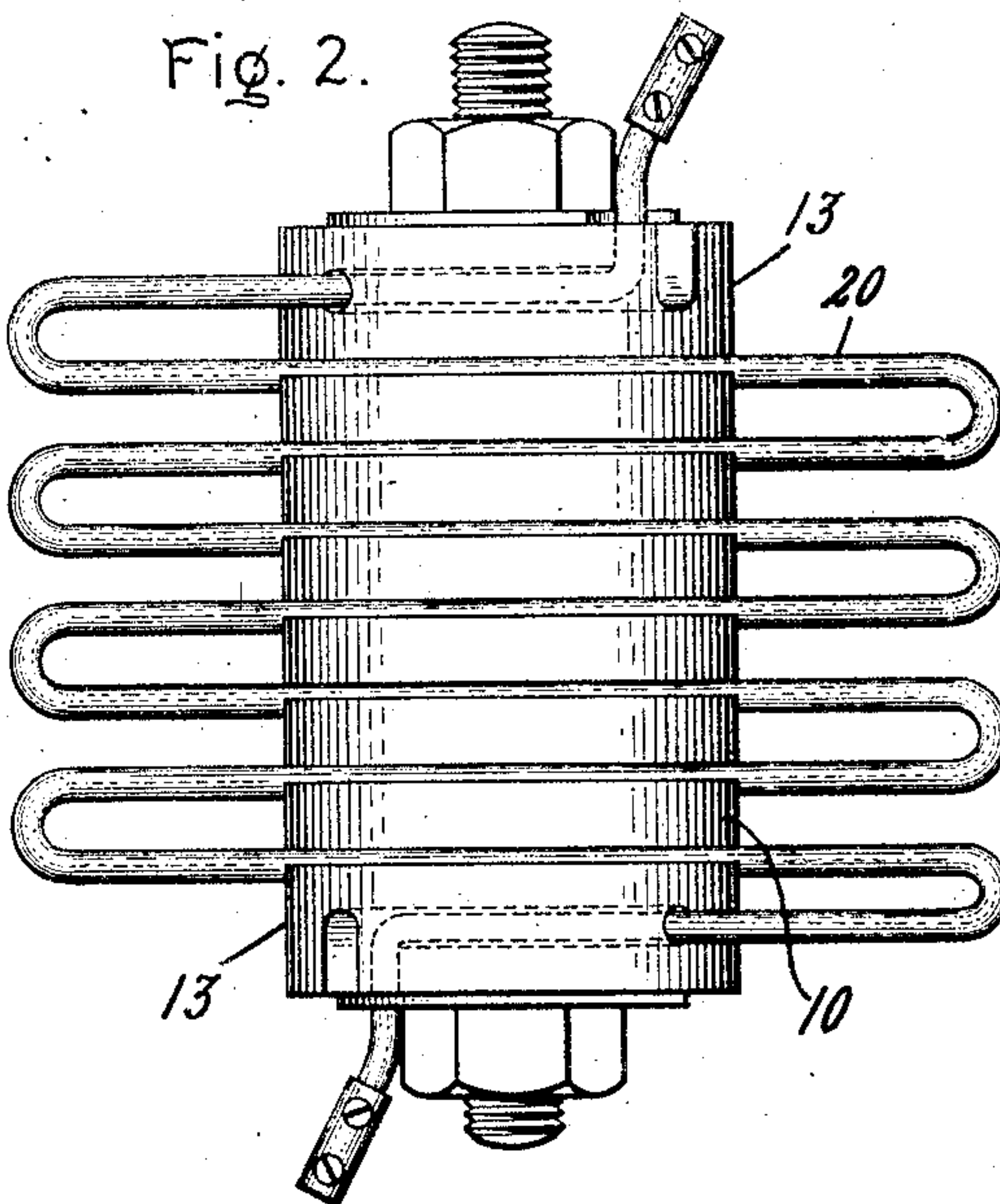


Fig. 4.

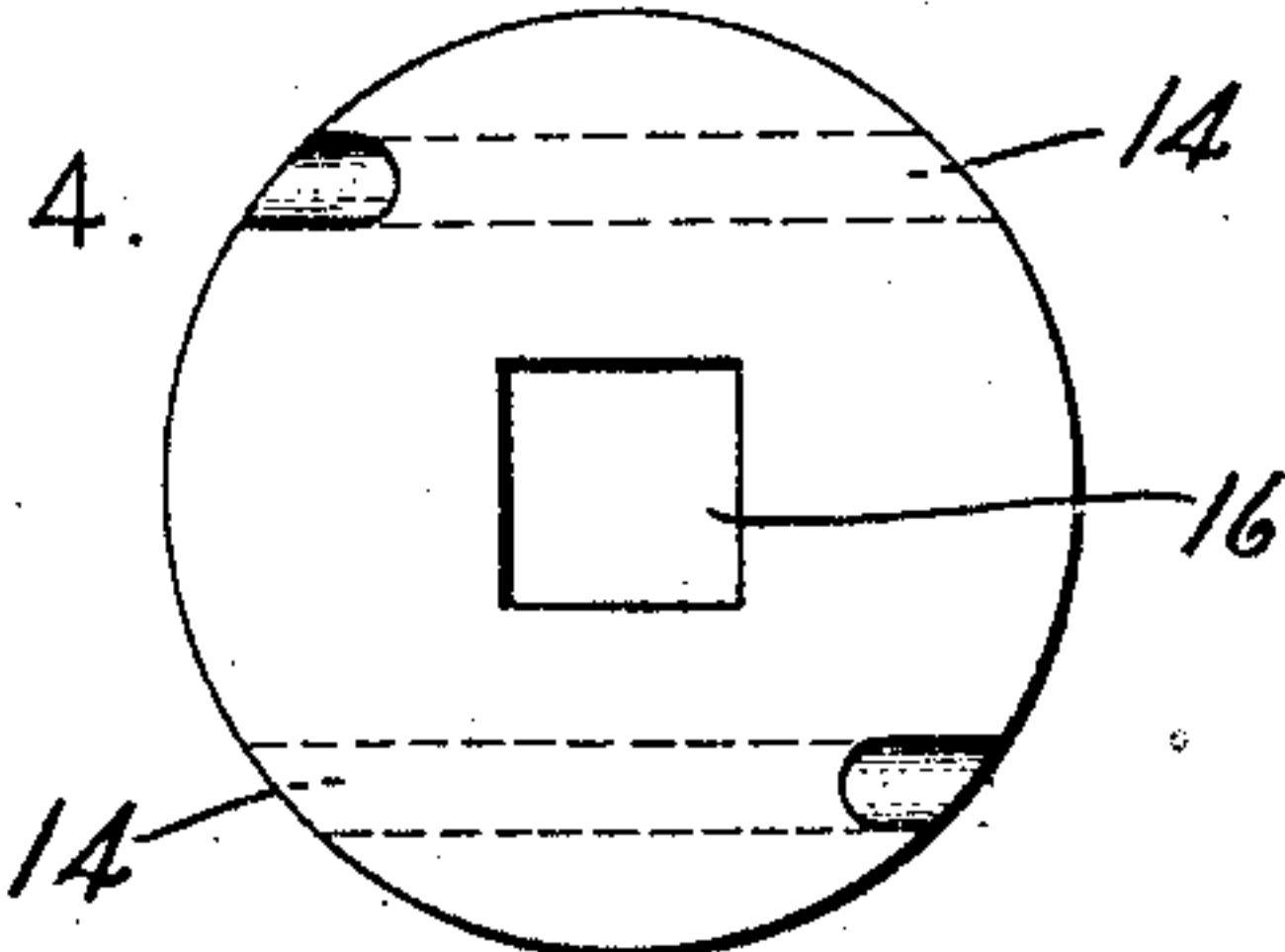


Fig. 3.

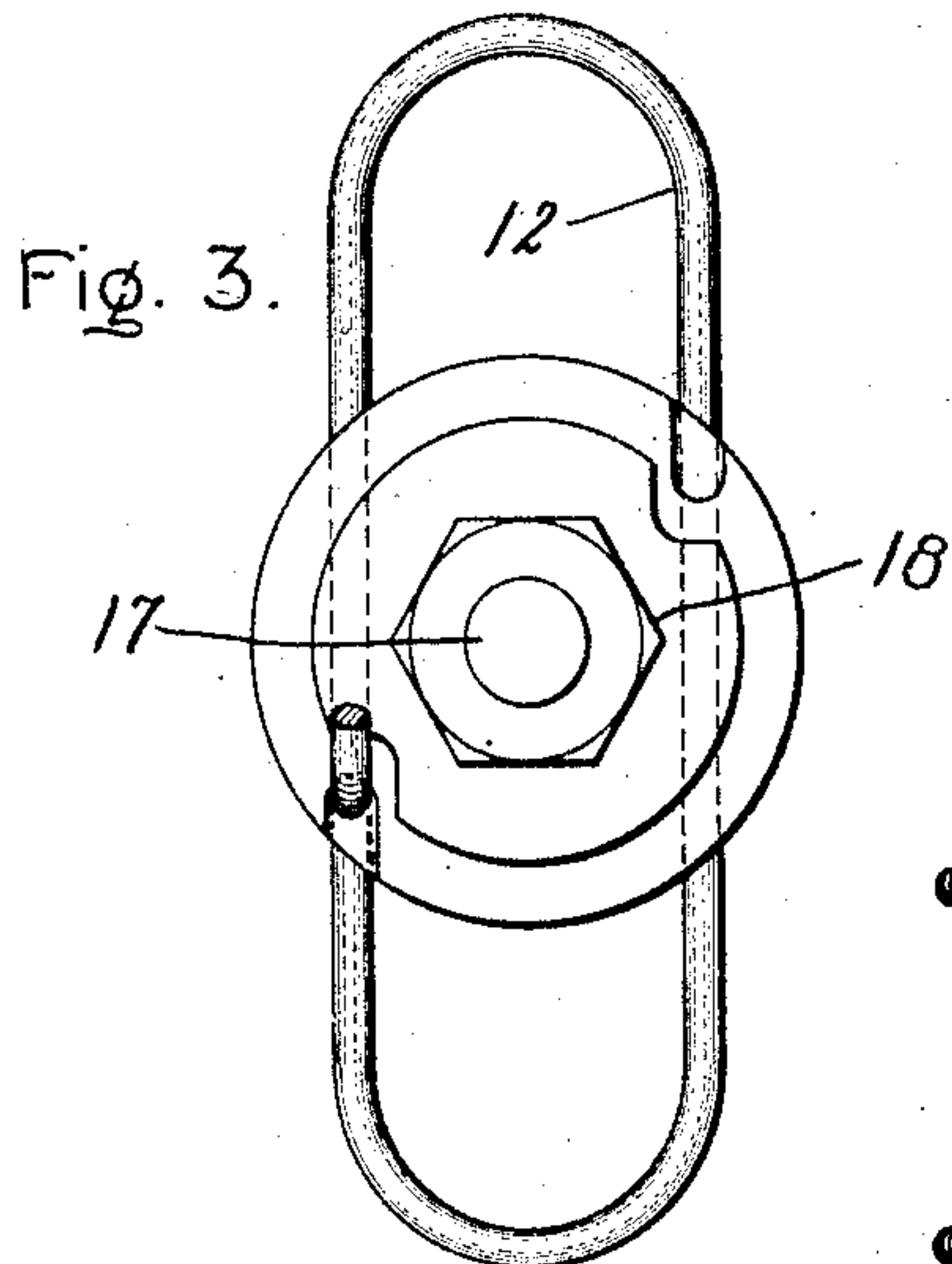


Fig. 5.

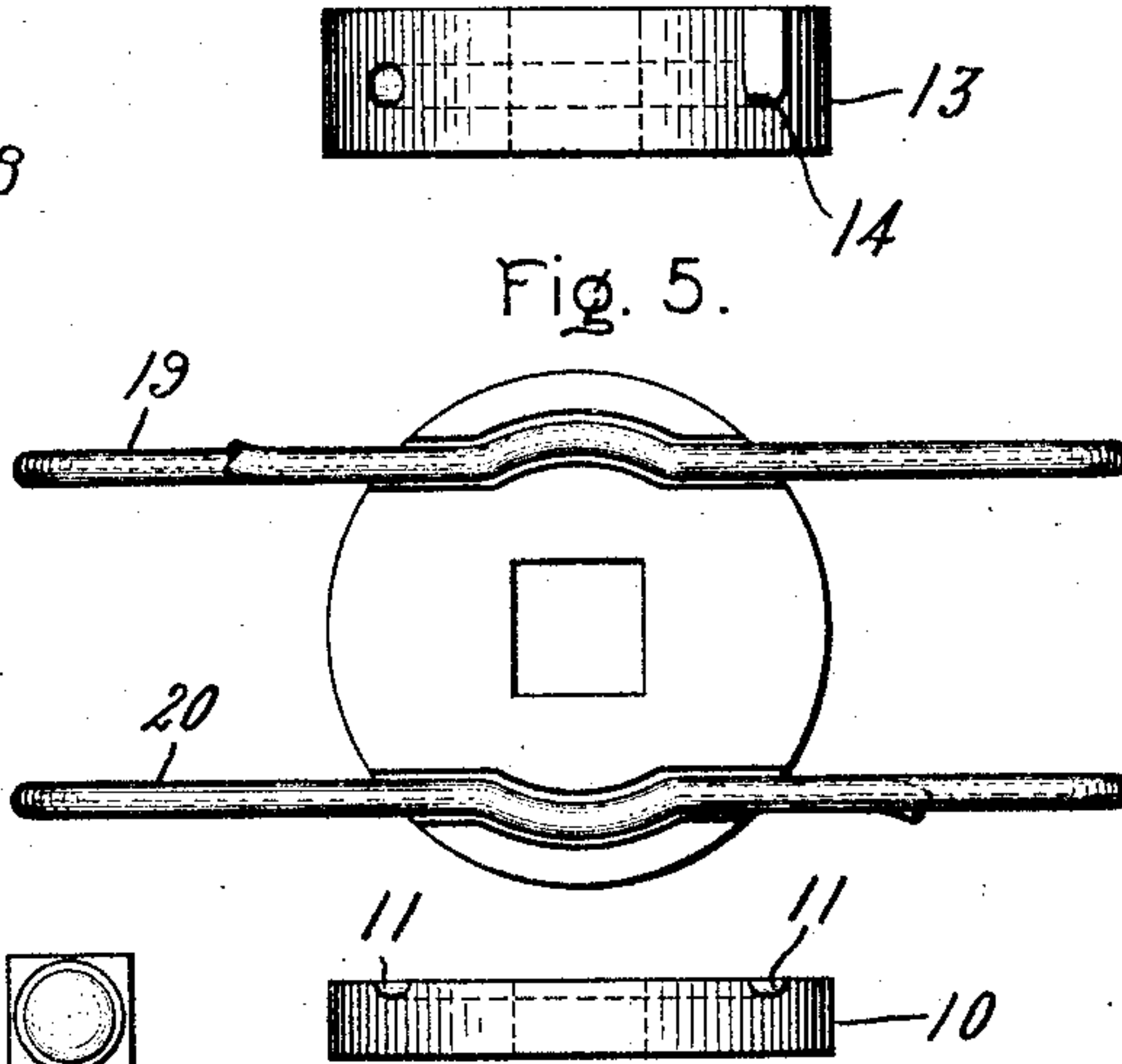


Fig. 6.



Witnesses:

*George H. Tilden.*  
*Allen Ouford*

Inventor:

Frederick Mackintosh,  
by *Albert G. Davis*  
Att'y.



# UNITED STATES PATENT OFFICE.

FREDERICK MACKINTOSH, OF SCHENECTADY, NEW YORK, ASSIGNOR TO  
GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## RESISTANCE UNIT.

No. 854,748.

Specification of Letters Patent.

Patented May 28, 1907.

Application filed June 11, 1906. Serial No. 321,106.

*To all whom it may concern:*

Be it known that I, FREDERICK MACKINTOSH, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Resistance Units, of which the following is a specification.

This invention relates to resistance devices for electric circuits and has for its object the provision of a device of this character which may be produced at a very low cost and which will be of high resistance and of such good radiation that it can be run at high current density.

My invention relates more specifically to resistance devices of the type commonly known as resistance grids. As usually constructed these grids are cast or built up of cast elements with a view to making the devices exceedingly cheap and having good radiating power. In order, however, to make these grids sufficiently light for portable use, it is necessary that they be made quite thin. It is, therefore, difficult to give them the necessary stiffness.

In carrying out my invention I use a resistance wire which is bent back and forth on itself and clamp the strands of wire together by insulating washers secured in place by a securing bolt. I have found that the construction of this form is very stiff and the radiating power very high.

My invention therefore consists in the features of construction and in the arrangement and combination of elements hereinafter set forth and particularly pointed out in the claims annexed to and forming a part of this application.

In the accompanying drawings in which are shown embodiments of my invention, Figure 1 is an elevation of one form of my resistance grid; Fig. 2 is an elevation of a slightly different form; Fig. 3 is a plan view of the form shown in Fig. 1; Fig. 4 shows a plan and elevation of the end washers; Fig. 5 shows a plan and elevation of the intermediate washers; and Fig. 6 shows a side and end view of the securing bolt.

Referring to the drawings (Figs. 1 and 3), 10 represents a series of washers which may be of any desired insulating material, preferably porcelain. These washers are circular and provided with grooves 11 which are sub-

stantially parallel as shown in Fig. 5. The grooves, however, are slightly curved midway of their length concentric with the outline of the washers themselves. These washers are grooved on one face only while the opposite faces are plain. The resistance wire 12 is bent back and forth through these grooves, the washers being arranged one above the other and the wire stepping up on to the next washer above as shown in dotted lines in Fig. 1. The washers are similarly arranged so that the wire is clamped between a groove of a washer on one side and the flat surface of a washer on the other. The end washers 12 and 13 of the series have both faces flat as shown in Fig. 4, but are provided with perforations 14 so that the ends 15 of the resistance wire are brought through these perforations to hold them in place. Both washers 13 and 10 have center openings 16, preferably square, for admitting a securing bolt 17 provided with nuts 18 for clamping the washers in place. This bolt may be rectangular as shown or any other arrangement may be made to prevent the turning of the washers. In this form it will be seen that a single resistance wire traverses back and forth through the grooves so that the bends of the wire are in the plane of the washers. In Fig. 2, however, with the same arrangements of parts two separate conductors 19 and 20 are used one on each side of the center bolt, the bends being made at right angles to the plane of the washers. Either arrangement may be used at will depending upon their use and the locality in which they are placed. It will be seen that these arrangements are particularly well adapted for giving a high radiation. By the placing of the grooves on one side of the washer the conductor is held securely in place, while the other side being flat an opportunity for good circulation is afforded.

The arrangement is exceedingly cheap and the parts easily assembled while any desired resistance may be obtained depending upon the number of washers and the length of wire between turns.

It will be understood of course that many modifications of the arrangement above described will suggest themselves to those skilled in the art without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.



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

1. A resistance unit, comprising a reflex resistance conductor, and insulating washers locking the several loops into a rigid unit.
2. A resistance unit, comprising a resistance conductor bent back and forth in parallel turns, insulating washers between said turns, and a securing bolt passing through the center of said washers.
3. A resistance unit, comprising a resistance conductor bent back and forth into adjacent turns, insulating washers between said turns provided with grooves to receive said conductors, and means for securing said washers together.
4. A resistance unit, comprising a resistance conductor bent back and forth into adjacent parallel turns, insulating washers between said turns provided with grooves to receive said conductor, and a securing bolt passing through said washers.
5. A resistance unit, comprising a plurality of insulating washers, a securing bolt passing therethrough, and a resistance conductor between said washers and engaging the same on opposite sides of said bolt.
6. A resistance unit comprising a resistance conductor bent back and forth into adjacent turns, insulating washers between said turns, end washers perforated to receive the terminals of said conductors, and means for securing said washers together.
7. A resistance unit comprising a resistance conductor bent back and forth in parallel turns, insulating washers between said turns and grooved to receive said conductor, end washers perforated to receive the ter-

minals of said conductor, and a securing bolt passing through said washers. 40

8. A resistance unit, comprising a plurality of insulating washers, a securing bolt passing therethrough, and resistance wire bent back and forth into adjacent turns between said washers and engaging the same on opposite sides of the bolt. 45

9. A resistance unit, comprising a plurality of insulating washers having substantially parallel grooves therein, a securing bolt passing through said washers and between said grooves, and resistance wire engaging said grooves and bent back and forth in parallel turns. 50

10. A resistance unit, comprising a plurality of similarly arranged insulating washers each having one face plane and the other provided with substantially parallel grooves, a securing bolt passing through said washers and between said grooves, and resistance wire engaging said grooves and bent back and forth in parallel turns. 55 60

11. A resistance unit, comprising a plurality of insulating washers having substantially parallel grooves therein, a securing bolt passing through said washers and between said grooves, a resistance wire engaging said grooves and bent back and forth in parallel turns, and end washers perforated to receive the terminals of said wire. 65

In witness whereof I have hereunto set my hand this 9th day of June, 1906. 70

FREDERICK MACKINTOSH.

Witnesses:

BENJAMIN B. HULL,  
HELEN ORFORD.