

No. 733,951.

PATENTED JULY 21, 1903.

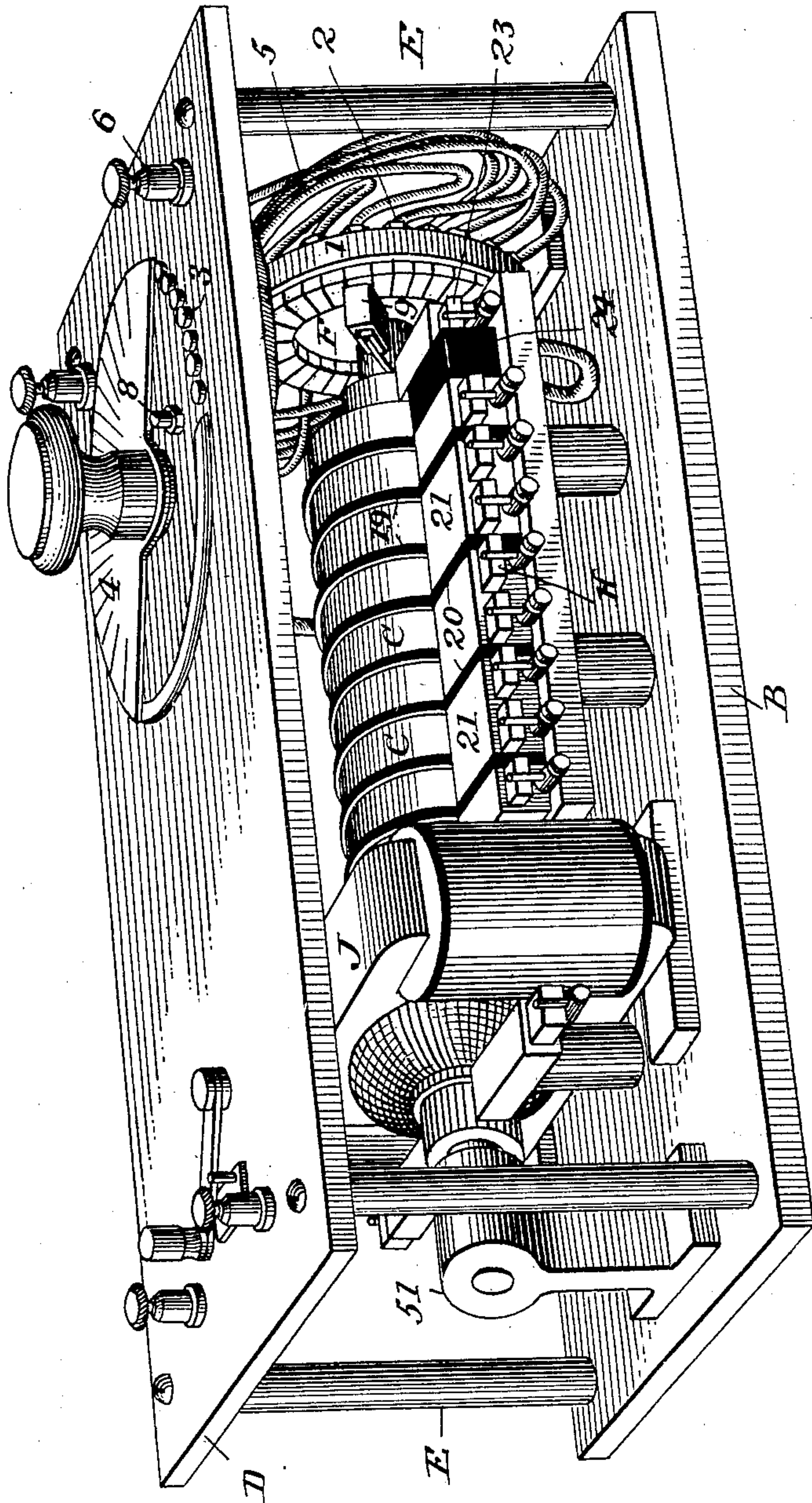
J. P. ERIE.  
CURRENT REGULATOR.

APPLICATION FILED DEC. 9, 1901. RENEWED DEC. 26, 1902.

NO MODEL.

5 SHEETS—SHEET 1.

Fig. 1.



Witnesses

*J. H. Hinkel*  
*Wm. G. H. Hinkel*

Inventor

*James Philip Erie*

By

*Emory V. Freeman,*

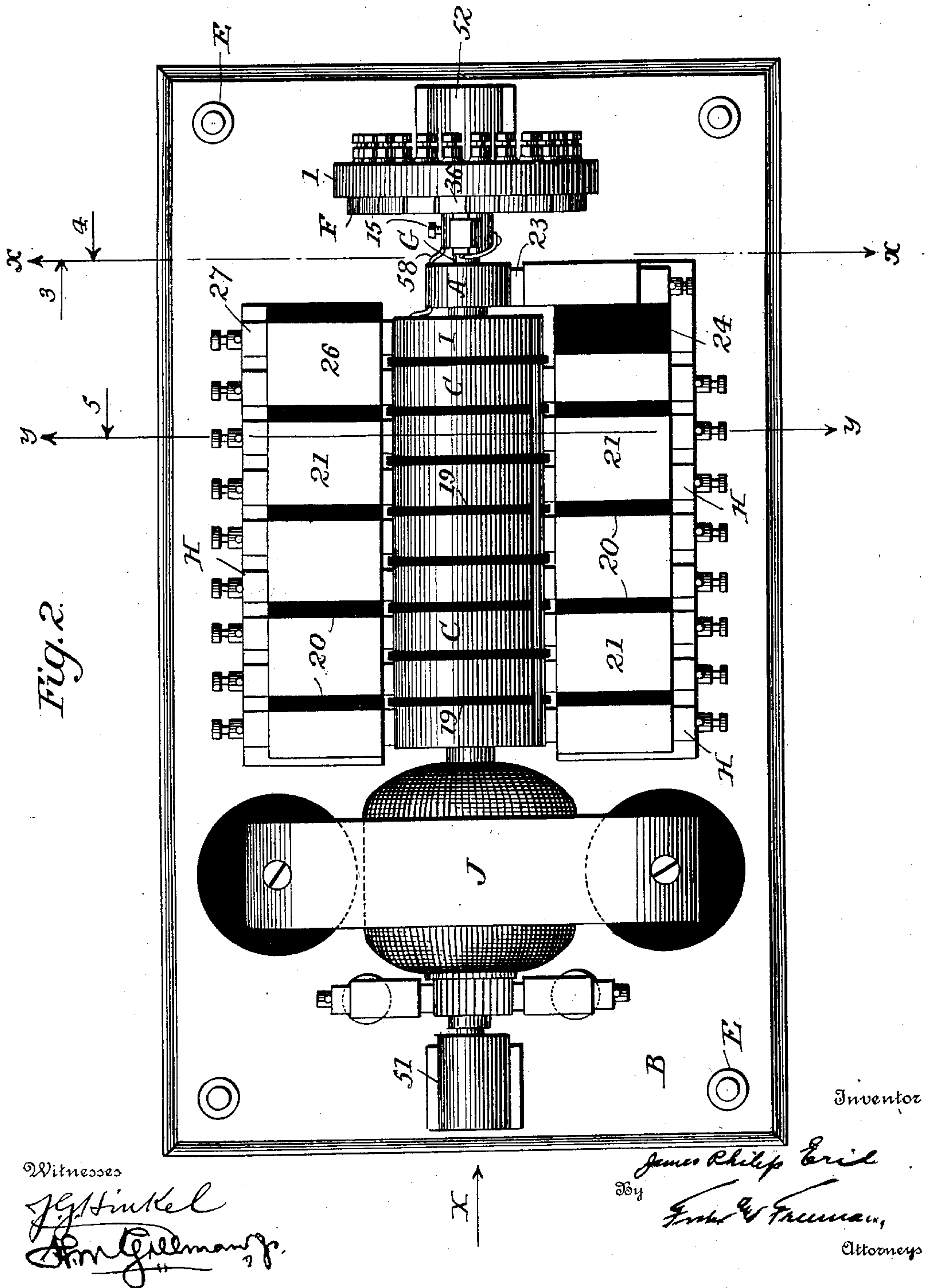
Attorneys

J. P. ERIE.  
CURRENT REGULATOR.

APPLICATION FILED DEC. 9, 1901. RENEWED DEC. 26, 1902.

NO MODEL.

5 SHEETS—SHEET 2.





J. P. ERIE.  
CURRENT REGULATOR.

APPLICATION FILED DEC. 9, 1901. RENEWED DEC. 26, 1902.

NO MODEL.

5 SHEETS—SHEET 3.

Fig. 3.

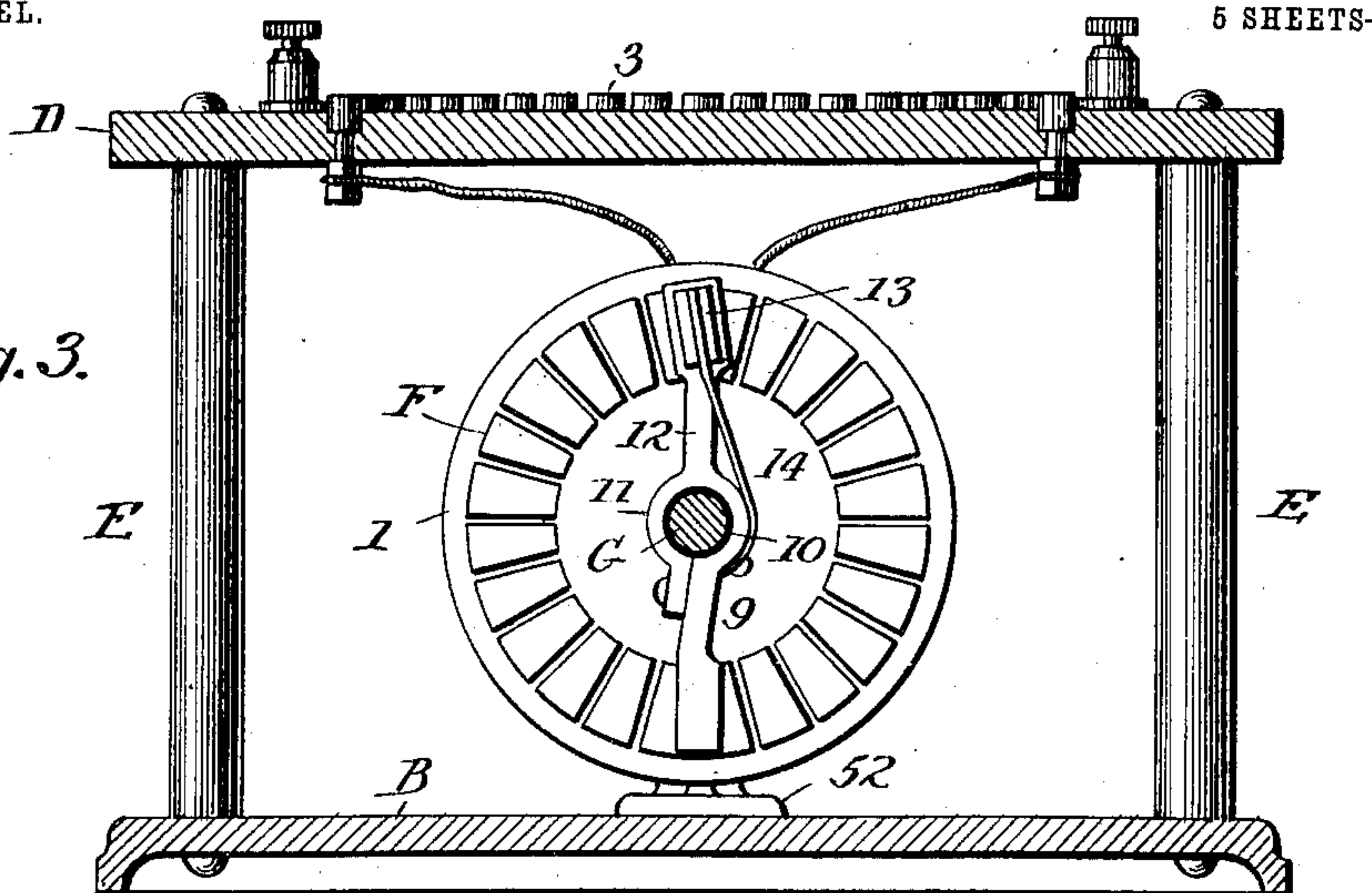


Fig. 4.

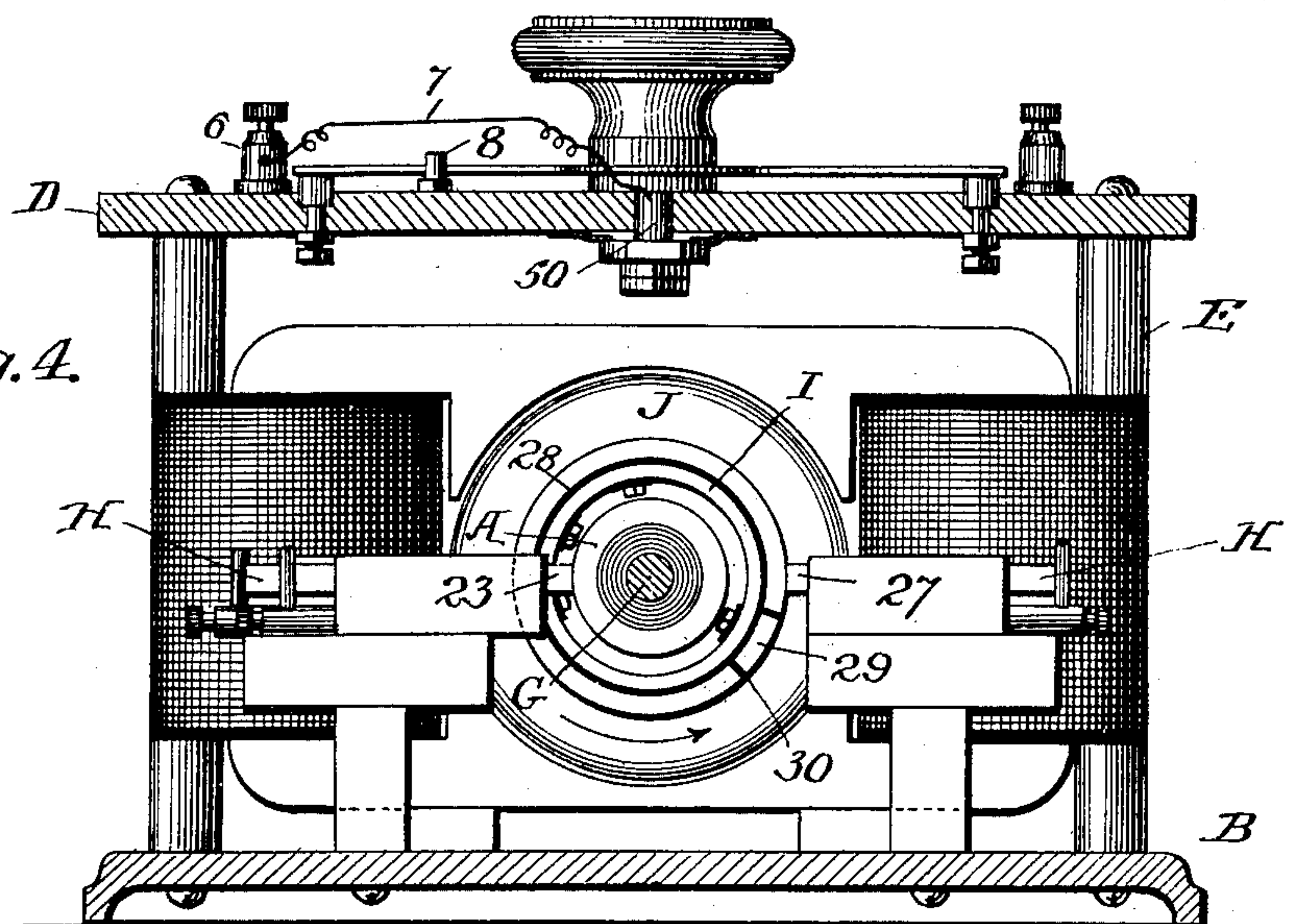
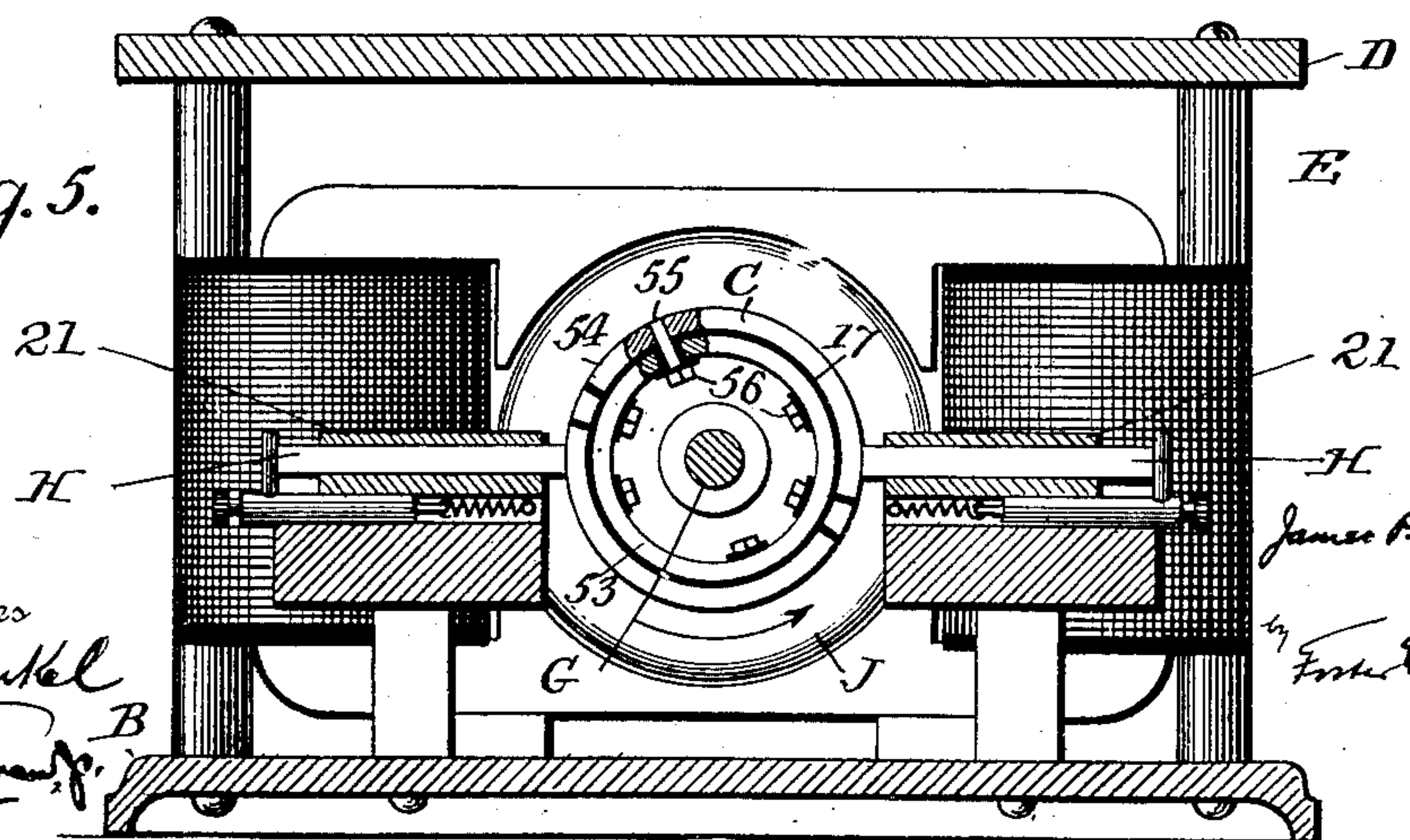


Fig. 5.



Witnesses  
J. G. Hinkel  
B. J. Gillman

Inventor  
James Philip Erie

by Frank E. Freeman,

Attorneys

J. P. ERIE.  
CURRENT REGULATOR.

APPLICATION FILED DEC. 9, 1901. RENEWED DEC. 26, 1902.

NO MODEL.

5 SHEETS—SHEET 4.

Fig. 7.

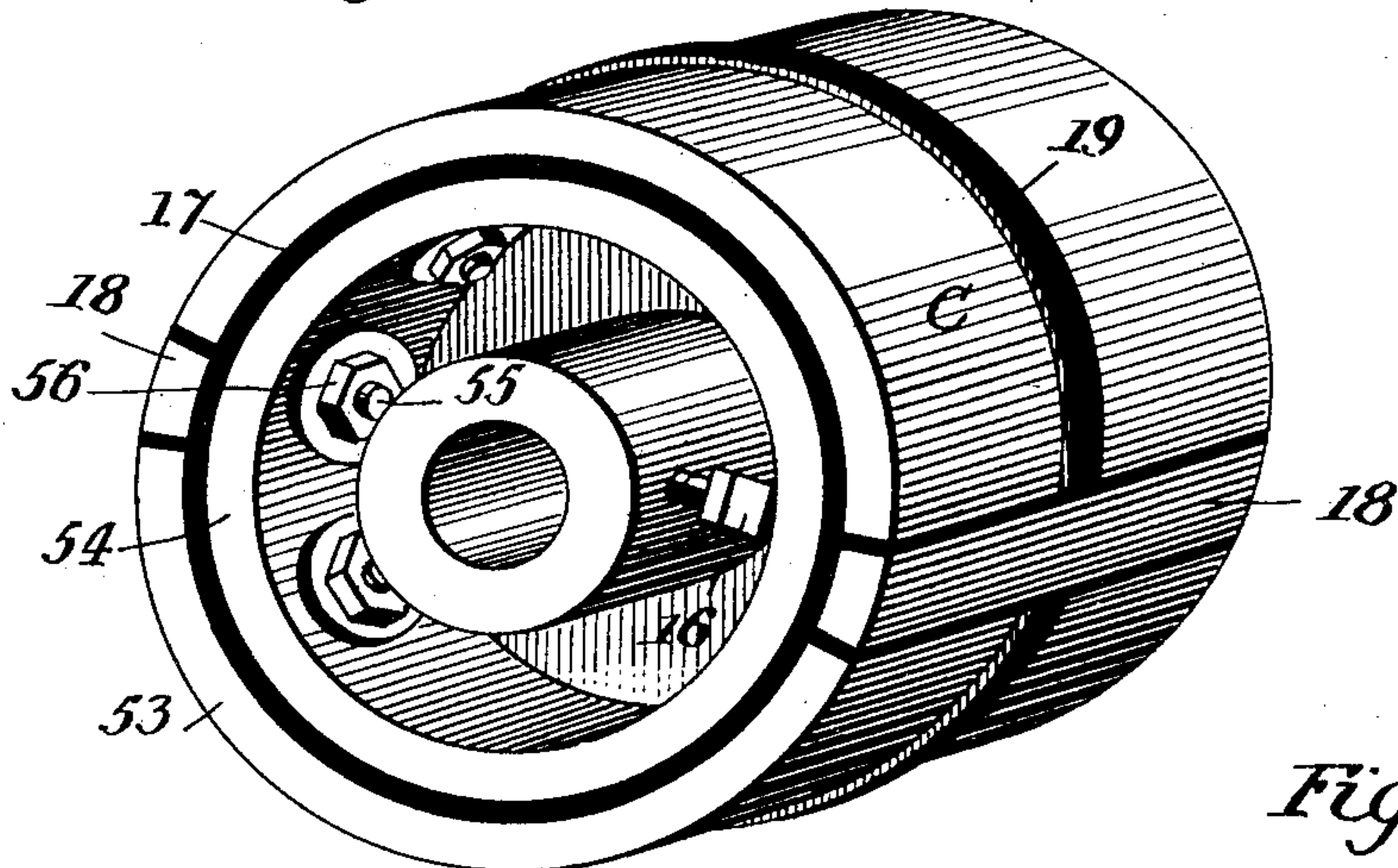


Fig. 8.

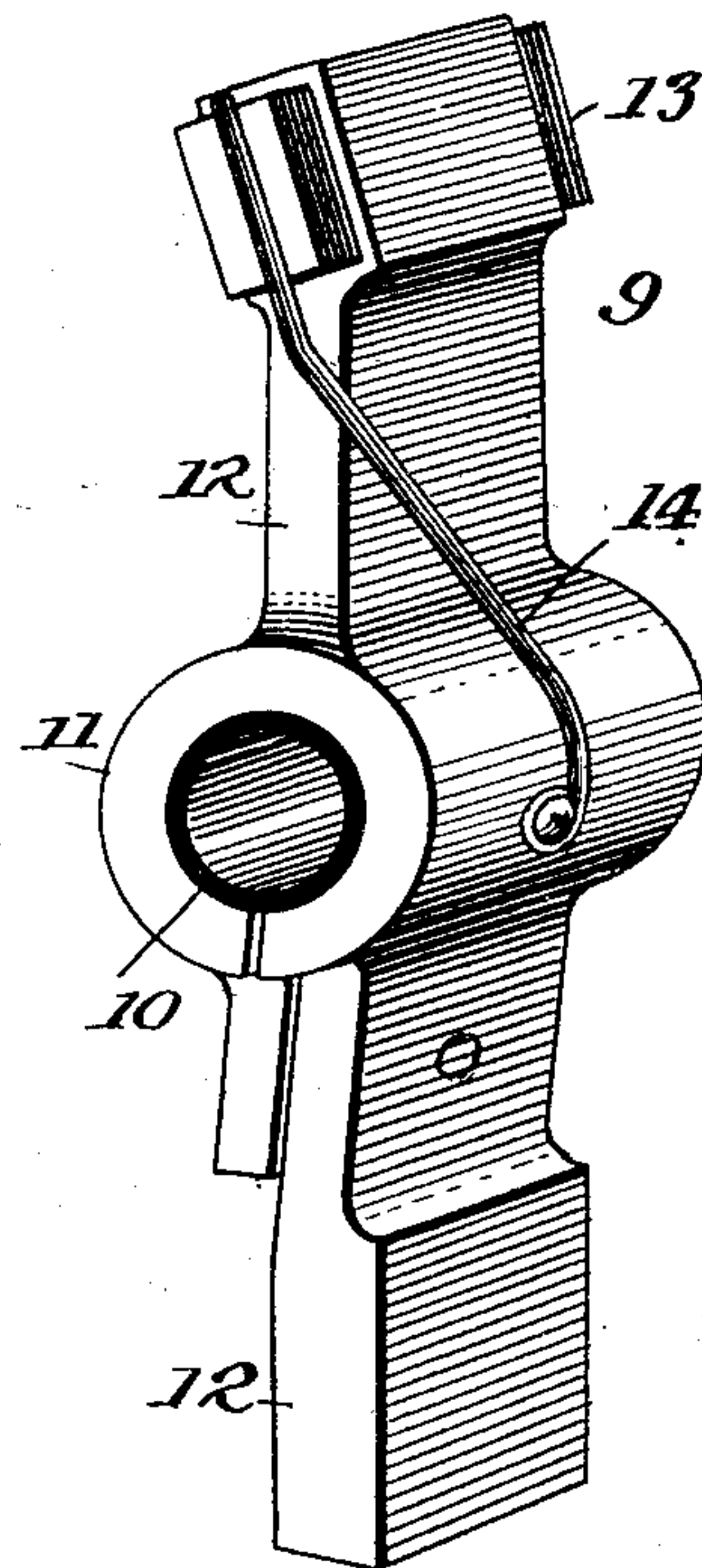
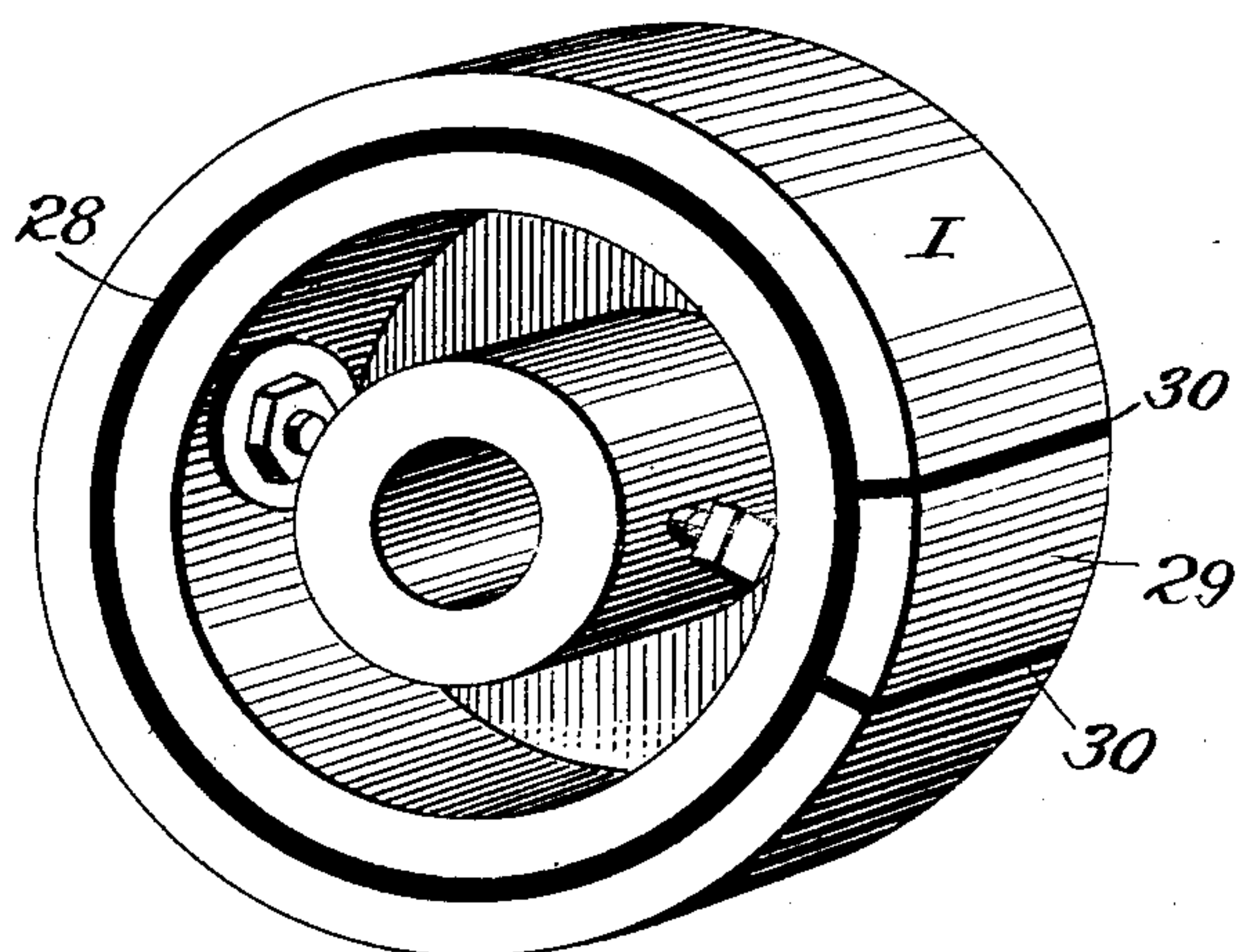


Fig. 6.



Witnesses

*J. G. Hinkel*  
*Sam. Guilman, Jr.*

Inventor

*James Philip Erie*

By

*John E. Freeman*

Attorneys



J. P. ERIE.  
CURRENT REGULATOR.

APPLICATION FILED DEC. 9, 1901. RENEWED DEC. 26, 1902.

NO MODEL.

5 SHEETS—SHEET 5.

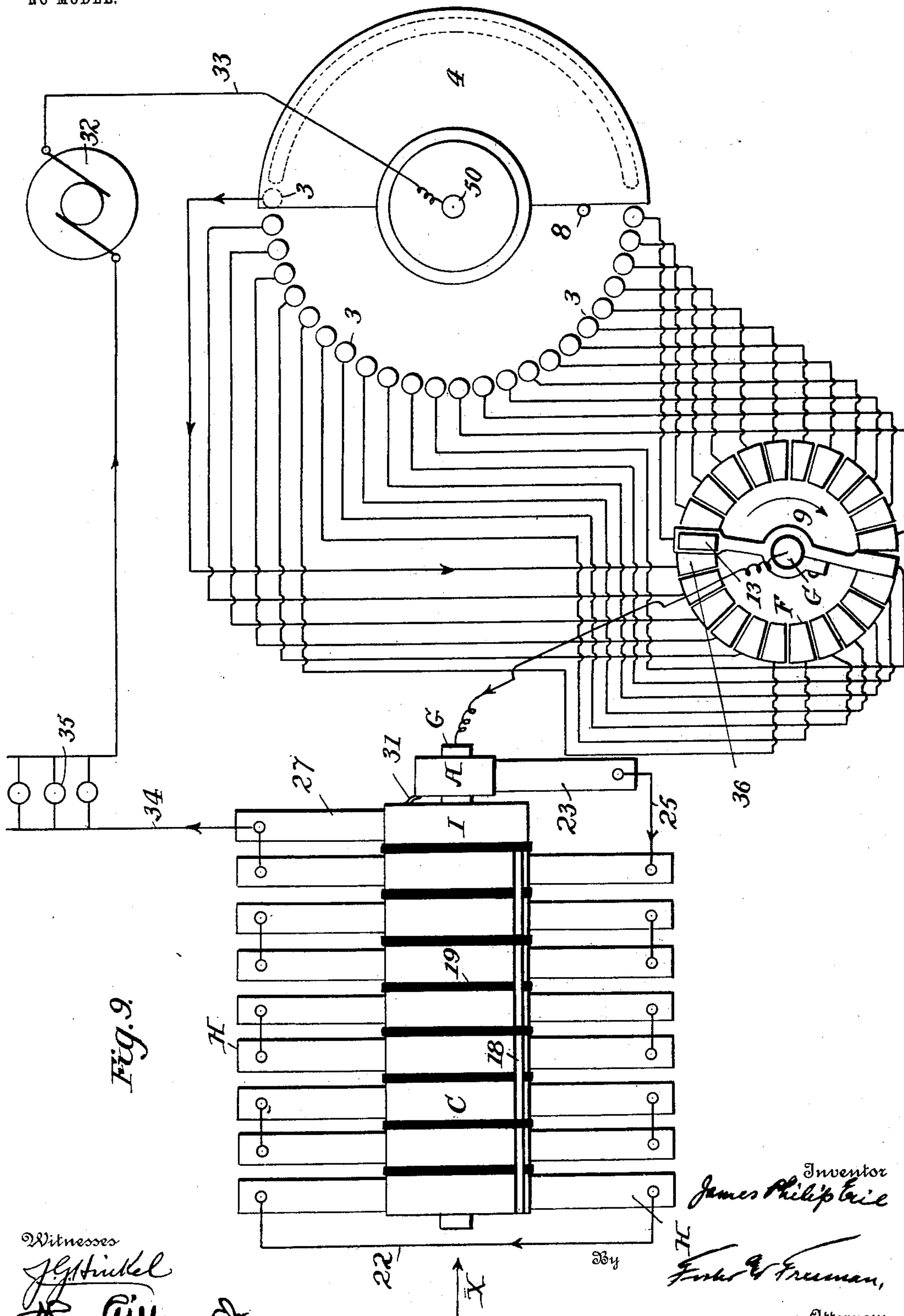


Fig. 9.

Witnesses

*J. H. Hinkel*  
*Sam. Gillman Jr.*

Inventor

*James Philip Erie*

*Frederic W. Freeman,*  
Attorneys



# UNITED STATES PATENT OFFICE.

JAMES PHILIP ERIE, OF NEW YORK, N. Y., ASSIGNOR TO ERIE EXPLORATION COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

## CURRENT-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 733,951, dated July 21, 1903.

Application filed December 9, 1901. Renewed December 26, 1902. Serial No. 136,733. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES PHILIP ERIE, a citizen of the United States, residing at New York city, in the county and State of New York, have invented certain new and useful Improvements in Current-Regulators, of which the following is a specification.

My invention relates to electrical apparatus wherein a circuit is broken between contacts; and its object is to reduce or entirely prevent the sparking at the contacts between which circuit is broken.

My invention consists, primarily, in means for breaking the circuit simultaneously at a plurality of points in series in the circuit with those contacts at which sparking is to be reduced, thereby distributing the sparking over a number of points and reducing or entirely preventing the sparking at the particular contacts desired.

To this end my invention consists of the means hereinafter fully described and shown in the accompanying specification and drawings, in which—

Figure 1 is a perspective view of an apparatus embodying my invention. Fig. 2 is a plan view with the top plate removed. Fig. 3 is a transverse sectional view on the line  $xx$ , Fig. 2, looking in the direction of the arrow 3. Fig. 4 is a transverse sectional view on the line  $xx$  of Fig. 2 looking in the direction of the arrow 4. Fig. 5 is a transverse sectional view on the line  $yy$ , Fig. 2, looking in the direction of the arrow 5. Fig. 6 is a perspective view of the disk A. Fig. 7 is a perspective view of two of the disks C. Fig. 8 is a perspective view of the brush or contact for the segments, and Fig. 9 is a diagram of the circuits in the apparatus.

While my invention is applicable to many classes of electrical apparatus, it is shown and described in connection with a current-regulator and that of the class fully described in the patents granted to me May 7, 1901, Nos. 673,391 and 673,428, wherein current is allowed to flow to translating devices during short intervals of time only, the circuit being rapidly made and broken to accomplish this end. When an electric circuit is rapidly made and broken, as in this class of apparatus, excessive sparking will occur between the con-

tacts at break, and this I prevent by means of my apparatus.

Referring to the drawings, B represents a suitable base-plate, which may or may not be of insulating material, and D a suitable top plate carried on supports E, and, as shown in this instance, between these plates a current-regulator of the class described is arranged and provided with my improved means for reducing sparking.

F represents a series of separately-insulated segments of conducting material arranged on an insulating-support 1, which may be of slate. There may be any suitable number of segments, I having shown twenty-four as a convenient number. Each segment is provided with means for connecting thereto a circuit-wire, these connections being shown as binding-posts 2. Means are provided for including a greater or less number of these segments in the circuit to be regulated, and in this instance I accomplish this purpose by providing a series of contacts corresponding in number to the segments and electrically connected thereto, and by means of a suitable movable contact arm or plate through which the circuit is led I am enabled to place in circuit more or less of the contacts, and consequently more or less of the segments.

The contacts referred to are represented by 3 and may be arranged on any convenient part of the apparatus, being shown on the top plate and connected by wires 5 to the binding-posts 2, several of these connections only being shown in Fig. 3. The contacts 3 in the top plate are shown arranged in a semicircle, while a semicircular plate 4 is arranged to be swept over these contacts. The plate 4 may be slit around its curved periphery in order to increase its elasticity and insure good contact.

Connection is made from the post 6 by a wire 7 to the central spindle 50 of the plate 4, and thus by turning the plate more or less of the segments F may be included in the circuit to be regulated. As shown in Fig. 9, a suitable stop 8 prevents the movement of the plate 4 beyond a certain distance in one direction, so that when the plate is against the stop a portion of it still remains upon a contact 3, and one segment at least, there-



fore, will remain in circuit when the plate 4 is moved against the stop. As the plate 4 is turned to the left it will be seen that it makes contact with an increasing number of the contacts 3, thereby including an increasing number of the segments in circuit.

A suitable brush or contact 9 is arranged to make contact with the segments F, and means are provided for moving the brush and the segments relatively to each other, as shown, means being provided for rotating the brush 9 with relation to the segments, although it is to be understood, of course, that the brush might remain stationary and the segments be rotated, although other connections would have to be arranged for this purpose.

Any suitable brush or contact may be provided, but that illustrated in Fig. 8 is a simple and efficient one and, as shown, consists of an insulating-sleeve 10 inside of a split hub 11, which is provided with arms 12, one of which is recessed at its end for the reception of a contact-piece 13, which may be of copper, said contact-piece preferably being held within its recess and pressed against the segments by any suitable means, as a spring 14. This brush or contact may be suitably secured to a spindle or shaft G, as by a set-screw 15, and held to rotate with the shaft.

The shaft G is carried in suitable bearings 51 and 52 upon the base-plate B, and, as shown, this shaft carries a plurality of disks C, two of which are shown in detail in Fig. 7. These disks are secured to the shaft by suitable means, as set-screws 16, and the outer rims 53 of the disks are insulated from the inner portions by suitable rings 17. The rims 53 and rings 17 are secured to the flanges 54 of the disks, as shown, by screws 55 and nuts 56. The disks are insulated from each other by means of suitable insulation 19, Fig. 2, and the adjacent disks of consecutive pairs of disks are provided with oppositely-located insulated conducting-pieces 18 on their peripheries, so that these adjacent disks are electrically connected to each other across said insulation 19. Insulation between the lateral sides of all of the disks may or may not be provided, as desired.

Series of brushes are suitably supported upon the base B and insulated therefrom and arranged in any convenient manner to bear upon the disks C, as shown, there being sixteen brushes H, arranged eight on each side of the disks C. The brushes H are insulated from each other in pairs by suitable insulation 20, the connection between the brushes which are uninsulated from each other being made through brush-holders 21, and the insulation of the brushes is so arranged that when the conducting-pieces 18, connecting pairs of the disks C, are made to bridge across or make contact between the adjacent brushes of consecutive pairs a complete electrical circuit may be made through the brushes and through the conducting-pieces 18 on the

disks; but when the relative position of the disks and the brushes is such that the conducting-pieces 18 do not bridge or make contact with the brushes circuit cannot be completed through the brushes and disks.

In order that a circuit may be completed through the brushes and disks, electrical connection is made in any suitable manner, as by a wire 22 between the two end brushes H, and two other insulated disks A and I are provided upon the shaft G, the disk A having a continuously-conducting periphery insulated from the shaft, this periphery being electrically connected with the hub 11 of the brush 9, as shown, by conductor 58, and a brush 23, insulated from the brushes on the same side by suitable insulation 24, is arranged to bear upon the disk A, electrical connection being made between this brush 23 and the series of brushes by a suitable wire 25, connecting the brush-holders. Electrical connection is also made between the disk I and disk A, as by connection 31.

Assuming that the positive lead from a source of supply of direct current is connected to the central spindle 50 of the plate 4, the negative lead should be connected to the brush-holder 26, and a brush 27 in electrical connection therewith is arranged to bear upon the disk I. This disk I is shown in detail in Fig. 6 and has a rim insulated from the inner portion of the disk by suitable insulation 28, while a part of the periphery 29 is suitably insulated from the remainder by insulation 30, and this part 30 is wider than the conducting-pieces 18 on the disks, it being approximately twice as wide, for a purpose to hereinafter appear, and suitable electrical connection is made, as by the wire 31, between the two disks A and I.

J represents a suitable motor, which may be an electric motor energized in any suitable manner, for rotating the shaft G, and assuming the motor to rotate said shaft in a clockwise direction when looking in the direction of the arrow X, Fig. 9, it will be seen that when the parts of the apparatus are in the positions shown in Fig. 2 or Fig. 9, with the plate 4 in the position shown in the diagram of Fig. 9, current may enter the apparatus from the source of supply 32 and pass by a wire 33 to the spindle 50 and plate 4, from thence to the contact 3, covered by the plate 4, and to the particular segment 36 of the segments F, connected to this contact, then to the brush 9 when the brush is in contact with this segment, as shown, from thence to the disk A by the connection 58, to the disk I, to brush 27, and by wire 34, connected in any suitable manner to the holder of brush 27, through suitable translating devices, shown as lamps 35, back to the source of supply 32.

No current may pass from the disk A through brush 23, wire 25, and the series of brushes H, since contact is not made between the adjacent brushes of consecutive pairs until the conducting-pieces 18 bridge these



brushes. In the position of the parts shown in Figs. 2 and 9, with the rotation of the shaft G clockwise looking in the direction assumed, it will be seen that the brush 9 is about to break contact with the segment 36, and the parts are so arranged and adjusted that just prior to its leaving the segment 36 the conducting-pieces 18 will have made contact with the brushes H opposite them, and at the same time the insulated part 29 of the disk I, as shown in Fig. 4, will come into contact with brush 27. As soon as the part 29 comes into contact with brush 27 circuit will be broken at brush 27, but will be simultaneously made at the brushes H, as described, and circuit will now be completed from the segment 36 through brush 9, disk A, brush 23, wire 25, brushes H, conducting-pieces 18, and wire 22, and out by wire 34 back to the source of supply. It will thus be seen that the brushes H are thrown into series in the circuit at the same time that they are electrically connected, and the parts are also so arranged that just as the brush 9 breaks circuit with the segment 36 the conducting-pieces 18 break circuit simultaneously at all of the brushes H, thereby distributing the sparking in series in such manner that sparking between the brush 9 and segment 36 may be entirely prevented and in any event will be greatly reduced.

The cycle of operations described will be rapidly repeated as the shaft G continues to rotate, the breaking of the circuit at the segments taking place always on segment 36 of the series.

The insulated part 29 of the disk I is made wider than the conducting-pieces 18, being preferably about twice as wide, and this is for the reason that after the circuit has been broken at all of the brushes H it may not at once be completed between the brush 27 and the disk I, for the brush 27 must remain for a short time longer on the insulated part 29, thus insuring an absolute break of the circuit at all the brushes H.

Assume now that the plate 4 has been turned in a direction to include more of the segments F in circuit. Then the more segments included in circuit the longer will be the interval of time during which the current is allowed to flow through my regulator; but no matter how many segments may be included the break will always take place as the brush 9 leaves the particular segment 36, so that the means for preventing sparking at this break will come into operation with any time interval between the make or break or, on the other hand, between the breaks of the circuit at the segments.

It will thus be seen that the segments and brush described constitute contacts for making and breaking an electric circuit to be regulated, while the conducting-pieces 18 and the particular brushes H, between which they complete circuit just prior to its being broken at the segments, constitute switches or cir-

cuit-breakers included in series in the circuit.

Since the circuit is broken at all of these brushes and their contact-pieces in series in the circuit simultaneously with the breaking of the circuit at the segments, it will be seen that the sparking at the segments will be greatly reduced or entirely prevented.

The segments and their brush operate automatically to make and break the circuit to be regulated, and the brushes and contacts, which are included in series in the circuit, operate automatically to reduce sparking at the segments whatever the time interval between make and break at the segments may be.

As hereinbefore described, the circuit, including the segments, is opened between brush 27 and disk I by the insulated part 29 coming opposite brush 27, and simultaneously therewith circuit is closed through all of the brushes H, so that disk I and brush 27 may be said to constitute contacts which are opened at the same time that the normally open switches formed by the brushes H and conducting-pieces 18 are included in series in the circuit of the segments. It will also be seen that the circuit-breakers or switches referred to are not only normally open but they are normally out of the circuit of the segments, and they are included in series in said circuit just prior to each break and are broken simultaneously with the breaking of the circuit at the segments.

The plurality of circuit-breakers may also be said to be in a normally open circuit, and they are intermittently included in the circuit of the segments, and this is done by simultaneously opening the circuit of the segments and closing the circuit-breakers, thereby including them in series in the circuit.

Without limiting myself to the precise construction and arrangement of parts shown, I claim as my invention—

1. In an apparatus for making and breaking an electric circuit, means for alternately making the circuit at a single point and breaking it at a plurality of points, substantially as described.

2. In an apparatus for making and breaking an electric circuit, means for alternately making the circuit at a single point and breaking it at a plurality of points in series in said circuit, substantially as described.

3. In an apparatus for making and breaking an electric circuit, means for varying the time interval between make and break, and means for alternately making the circuit at a single point and breaking it at a plurality of points, substantially as described.

4. The combination with contacts for interrupting an electric circuit, of a plurality of circuit-breakers in said circuit, and means for breaking the circuit at the circuit-breakers simultaneously with the interruption of the circuit at said contacts, thereby distributing the sparking over a number of points



and reducing the sparking at said contacts, substantially as described.

5. The combination with contacts for interrupting an electric circuit, of a plurality of circuit-breakers in series in said circuit, and means for breaking the circuit at the circuit-breakers simultaneously with the interruption of the circuit at said contacts, thereby distributing the sparking over a number of points and reducing the sparking at said contacts, substantially as described.

6. The combination with a plurality of switches, of an electric circuit containing contacts, means for simultaneously opening said contacts and including the switches in series in the circuit, and means for simultaneously operating said switches to break the circuit, substantially as described.

7. The combination with a plurality of normally open switches, of an electric circuit containing contacts, and means for simultaneously opening said contacts, closing said switches and including them in series in said circuit, substantially as described.

8. The combination with a plurality of normally open switches, of an electric circuit containing contacts, means for simultaneously opening said contacts, closing said switches and including them in series in said circuit, and means for breaking said circuit at each of the switches simultaneously, substantially as described.

9. In an apparatus for regulating an electric circuit, the combination with means for rapidly making and breaking the circuit, of a plurality of circuit-breakers normally out of the circuit, means for including them in series in said circuit prior to each break, and means for breaking the circuit simultaneously at each circuit-breaker, substantially as described.

10. The combination with an electric circuit, and means for completing the same, of a plurality of switches normally out of the circuit, means for intermittently including said switches in series in said circuit, and means for simultaneously operating said switches to rapidly make and break said circuit, substantially as described.

11. The combination with an electric circuit, and means for completing the same, of a plurality of switches normally out of the circuit, means for intermittently including said switches in series in said circuit prior to breaking the same, and means for breaking the circuit at each switch simultaneously, substantially as described.

12. The combination with an electric circuit containing contacts, of a plurality of switches, means for including said switches in series in said circuit prior to breaking the same, and means for simultaneously opening the contacts in said circuit and closing the switches, substantially as described.

13. The combination with an electric circuit containing contacts, of a plurality of switches, means for including said switches

in series in said circuit prior to breaking the same, means for simultaneously opening the contacts in said circuit and closing the switches, and means for simultaneously opening said switches to break the circuit, substantially as described.

14. The combination with an apparatus for intermittently interrupting an electric circuit, of means for reducing the sparking at each interruption consisting of a plurality of circuit-breakers in series with each other in said circuit, and means for operating said circuit-breakers simultaneously with the interrupting apparatus to rapidly make and break the circuit, substantially as described.

15. In an apparatus for regulating an electric circuit, the combination with a series of separately-insulated segments, of a contact, means for moving the contact and segments relatively to each other to rapidly make and break the circuit, a plurality of circuit-breakers, means for including them in series in said circuit prior to breaking the same, and means for simultaneously operating said circuit-breakers to break the circuit, substantially as described.

16. In an apparatus for regulating an electric circuit, the combination with a series of separately-insulated segments, and means for including more or less of the segments in the circuit, of a contact, means for moving the contact and segments relatively to each other, a plurality of circuit-breakers, means for including them in series in said circuit prior to breaking the same, and means for simultaneously operating said circuit-breakers to break the circuit, substantially as described.

17. In an apparatus for regulating an electric circuit, the combination with a series of separately-insulated segments, and means for including more or less of the segments in the circuit, of a contact, means for moving the contact and segments relatively to each other, a plurality of normally open circuit-breakers, means for closing said circuit-breakers and including them in series in said circuit prior to breaking the same, and means for breaking the circuit at said circuit-breakers simultaneously.

18. In an apparatus for regulating an electric circuit, the combination with a plurality of segments, of a contact, means for moving said contact and the segments relatively to each other to rapidly make and break the circuit, a plurality of circuit-breakers, means for including them in series in the circuit to be regulated prior to breaking the same, and means for breaking the circuit at each circuit-breaker simultaneously, substantially as described.

19. In an apparatus for regulating an electric circuit, the combination with a plurality of segments, of a contact, means for moving said contact and the segments relatively to each other to rapidly make and break the circuit, a plurality of normally open circuit-breakers, means for simultaneously closing



said circuit-breakers and including them in series in the circuit to be regulated prior to breaking said circuit, and means for simultaneously operating said circuit-breakers to break the circuit, substantially as described.

20. In an apparatus for regulating an electric circuit, the combination with a plurality of segments, and means for including more or less of them in circuit, of a contact, means for moving said contact and the segments relatively to each other, a plurality of normally open circuit-breakers, means for simultaneously closing said circuit-breakers and including them in series in the circuit to be regulated prior to breaking said circuit, and means for simultaneously operating said circuit-breakers to break the circuit, substantially as described.

21. In an apparatus for regulating an electric circuit, the combination with a plurality of conducting-segments, of a contact, means for moving said contact and the segments relatively to each other to rapidly make and break the circuit, a plurality of circuit-breakers normally out of the circuit to be regulated, means for including them in series in said circuit prior to breaking the same, and means for breaking the circuit at the circuit-breakers simultaneously with the breaking of the circuit at the segments, substantially as described.

22. In an apparatus for regulating an electric circuit, the combination with a plurality of conducting-segments, and means for including more or less of them in circuit, of a contact, means for moving said contact and the segments relatively to each other to rapidly make and break the circuit, a plurality of circuit-breakers normally out of the circuit to be regulated, means for including them in series in said circuit prior to breaking the same, and means for breaking the circuit at the circuit-breakers simultaneously with the breaking of the circuit at the segments, substantially as described.

23. In an apparatus for regulating an electric circuit, the combination with a plurality of conducting-segments, of a contact, means for moving said contact and the segments relatively to each other to rapidly make and break the circuit, a plurality of normally open circuit-breakers normally out of the circuit to be regulated, means for simultaneously closing said circuit-breakers and including them in series in said circuit prior to breaking the same, and means for breaking the circuit at the circuit-breakers simultaneously with the breaking of the circuit at the segments, substantially as described.

24. In an apparatus for regulating an electric circuit, the combination with a plurality of conducting-segments, and means for including more or less of them in circuit, of a contact, means for moving said contact and the segments relatively to each other to rapidly make and break the circuit, a plurality of normally open circuit-breakers normally

out of the circuit to be regulated, means for simultaneously closing said circuit-breakers and including them in series in said circuit prior to breaking the same, and means for breaking the circuit at the circuit-breakers simultaneously with the breaking of the circuit at the segments, substantially as described.

25. In an apparatus for regulating an electric circuit, the combination with a plurality of segments, of a contact, means for moving said contact and the segments relatively to each other, a plurality of circuit-breakers normally out of circuit, means for including them in said circuit prior to breaking the same, and means for simultaneously operating said circuit-breakers with the breaking of the circuit at the segments, substantially as described.

26. In an apparatus for regulating an electric circuit, the combination with a plurality of separately-insulated conducting-segments, of a shaft carrying a series of insulated disks, conducting-pieces oppositely located on the peripheries of pairs of the disks and insulated therefrom, series of brushes electrically connected in pairs bearing on said disks, two separate insulated disks carried by the shaft one provided with an insulated piece in its conducting periphery of greater width than the said oppositely-located conducting-pieces, said disk being also adapted to be connected by a brush in the circuit to be regulated, and the other of said two disks being electrically connected to the series of brushes through another brush, a brush for making contact with the series of insulated segments, electrical connection between said brush and said two separate insulated disks, means for moving the insulated segments and their brush relatively to each other, and means for moving the disks and their brushes relatively to each other simultaneously with the relative movement of the segments and their brush.

27. In an apparatus for regulating an electric circuit, the combination with a plurality of conducting-segments, of a shaft carrying a plurality of insulated disks, conductors oppositely located on the peripheries of pairs of the disks, series of brushes electrically connected in pairs bearing on said disks, two other insulated disks carried by the shaft one provided with an insulated piece in its conducting periphery and adapted to be connected in the circuit to be regulated by a brush, the said two disks being electrically connected to the series of brushes through a brush, a brush for making contact with the plurality of segments, an electrical connection between said brush and said two other insulated disks, means for rotating the segments and their brush relatively to each other, and means for simultaneously rotating the disks and their brushes relatively to each other in unison with the relative movements of the segments and their brush.



28. In an apparatus for regulating an electric circuit, the combination of conducting-segments, a contact, means for moving the contact and segments relatively to each other  
5 to rapidly make and break the circuit, a series of brushes electrically connected in pairs, means for including said brushes in series in the circuit prior to breaking the circuit at the segments, and means for breaking the  
10 circuit between the adjacent brushes of consecutive pairs simultaneously with the breaking of the circuit at the segments, substantially as described.

29. In an apparatus for regulating an electric circuit, the combination of conducting-segments, a contact, means for moving the contact and segments relatively to each other  
15 to rapidly make and break the circuit, a series of brushes electrically connected in pairs, means for making contact between adjacent brushes of consecutive pairs and including the brushes in series in the circuit prior to  
20 breaking the same, and means for breaking the circuit between the pairs of brushes simultaneously with the breaking of the circuit at the segments, substantially as described.

taneously with the breaking of the circuit at the segments, substantially as described. 25

30. In an apparatus for regulating an electric circuit, the combination with a plurality of conducting-segments, and means for including more or less of them in circuit, of a  
30 contact, means for moving the segments and contact relatively to each other to rapidly make and break the circuit, a series of brushes electrically connected in pairs, means for making contact between adjacent brushes of  
35 consecutive pairs and including the brushes in series in the circuit prior to breaking the same, and means for breaking contact between the pairs of brushes simultaneously with the breaking of the circuit at the segments, substantially as described. 40

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JAMES PHILIP ERIE.

Witnesses:

H. G. OGDEN, Jr.,  
W. CLARENCE DUVALL.