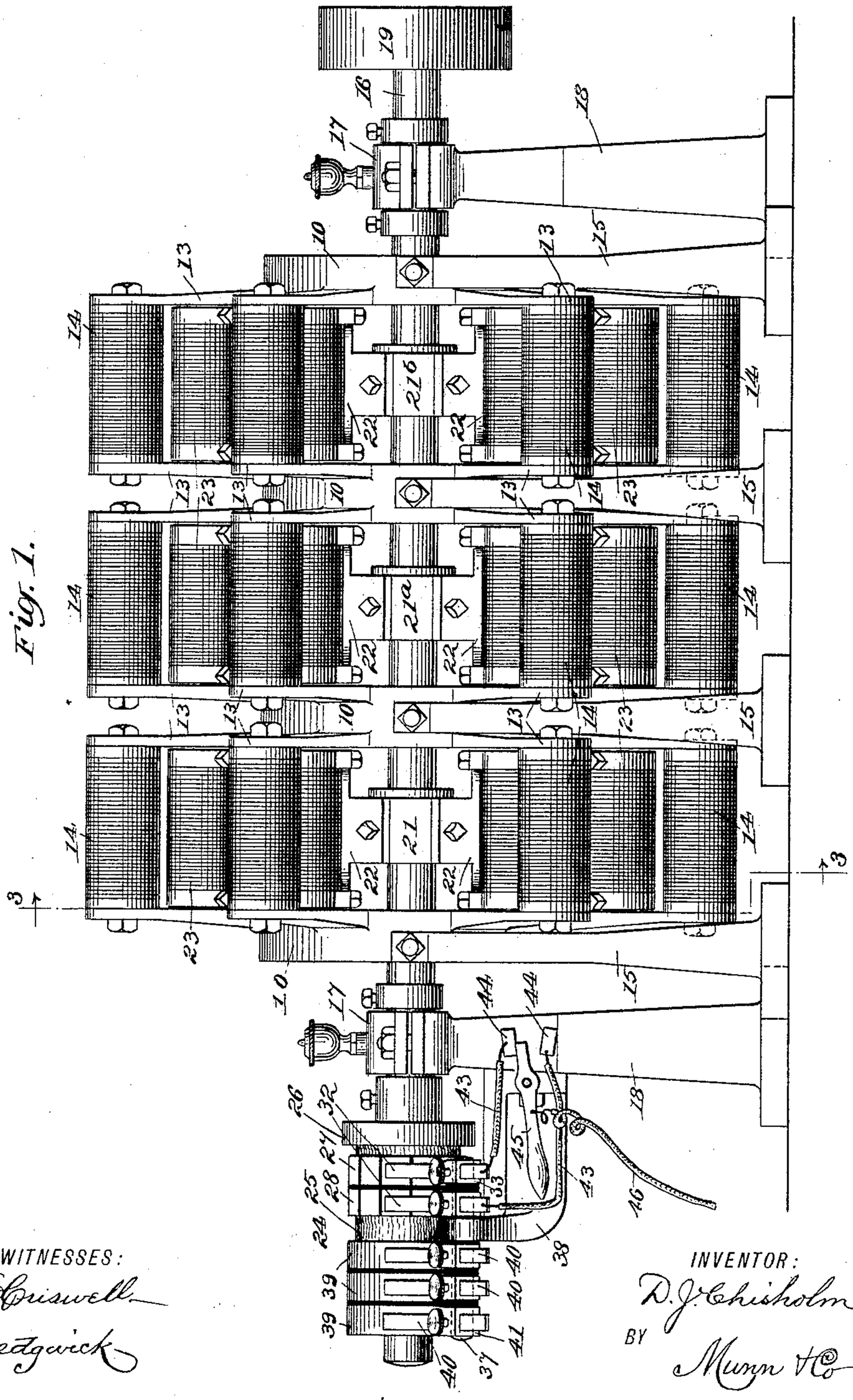
(No Model.) 5 Sheets—Sheet 1.

D. J. CHISHOLM.

ELECTRIC MOTOR.

No. 452,214. Patented May 12, 1891.

Fig. 1.



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D. J. CHISHOLM.

ELECTRIC MOTOR.

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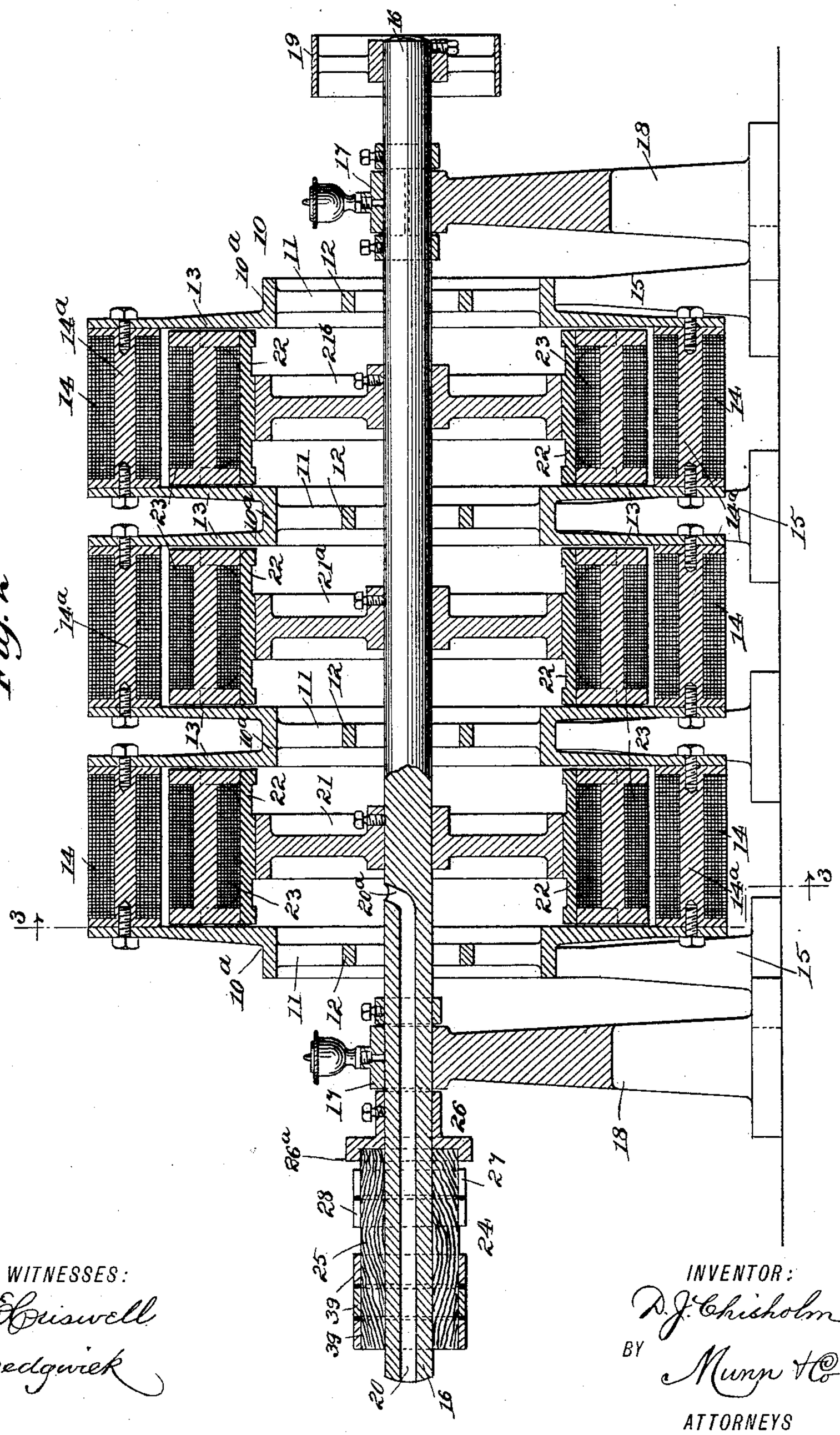
Fig. 2.



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ELECTRIC MOTOR.

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Fig. 3.

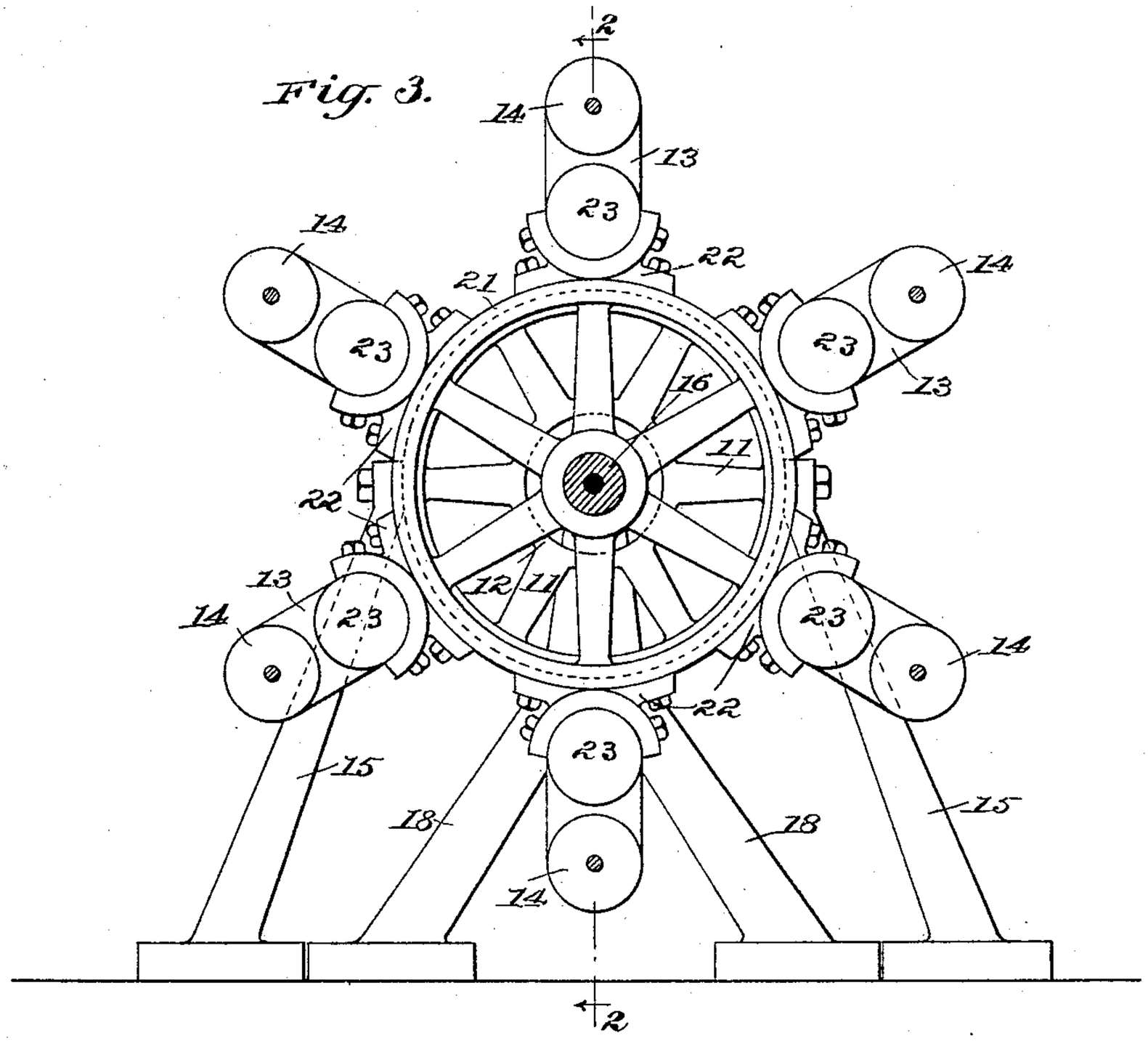
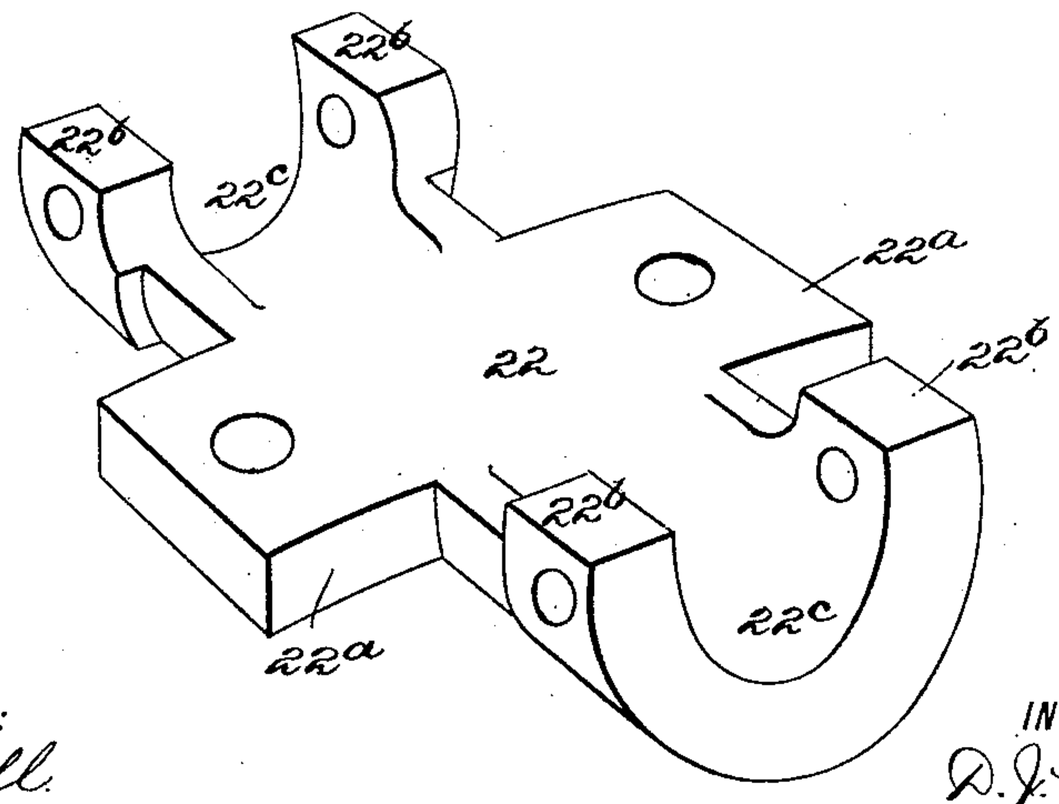


Fig. 4.



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ELECTRIC MOTOR.

No. 452,214. Patented May 12, 1891.

Fig. 5.

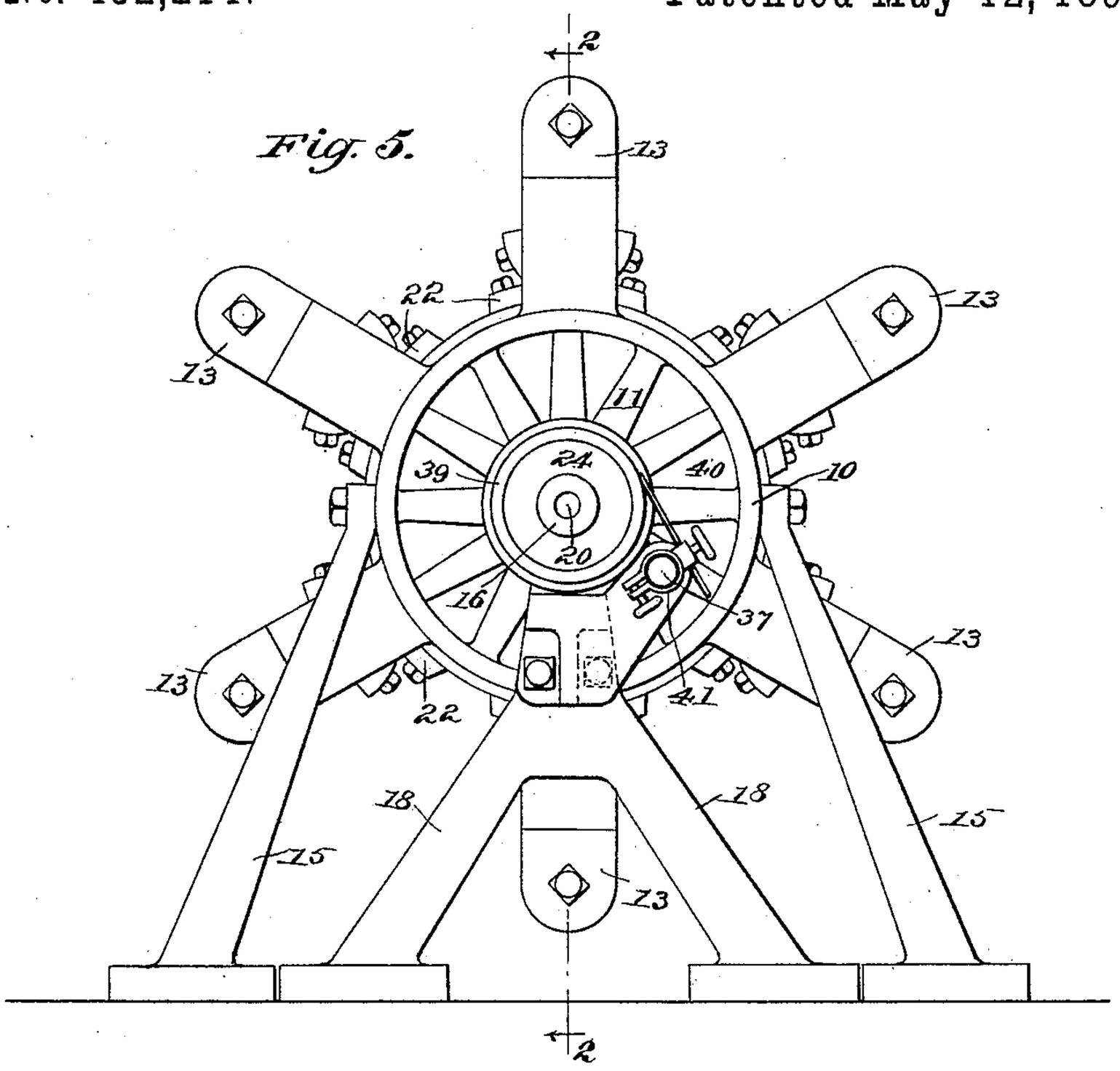
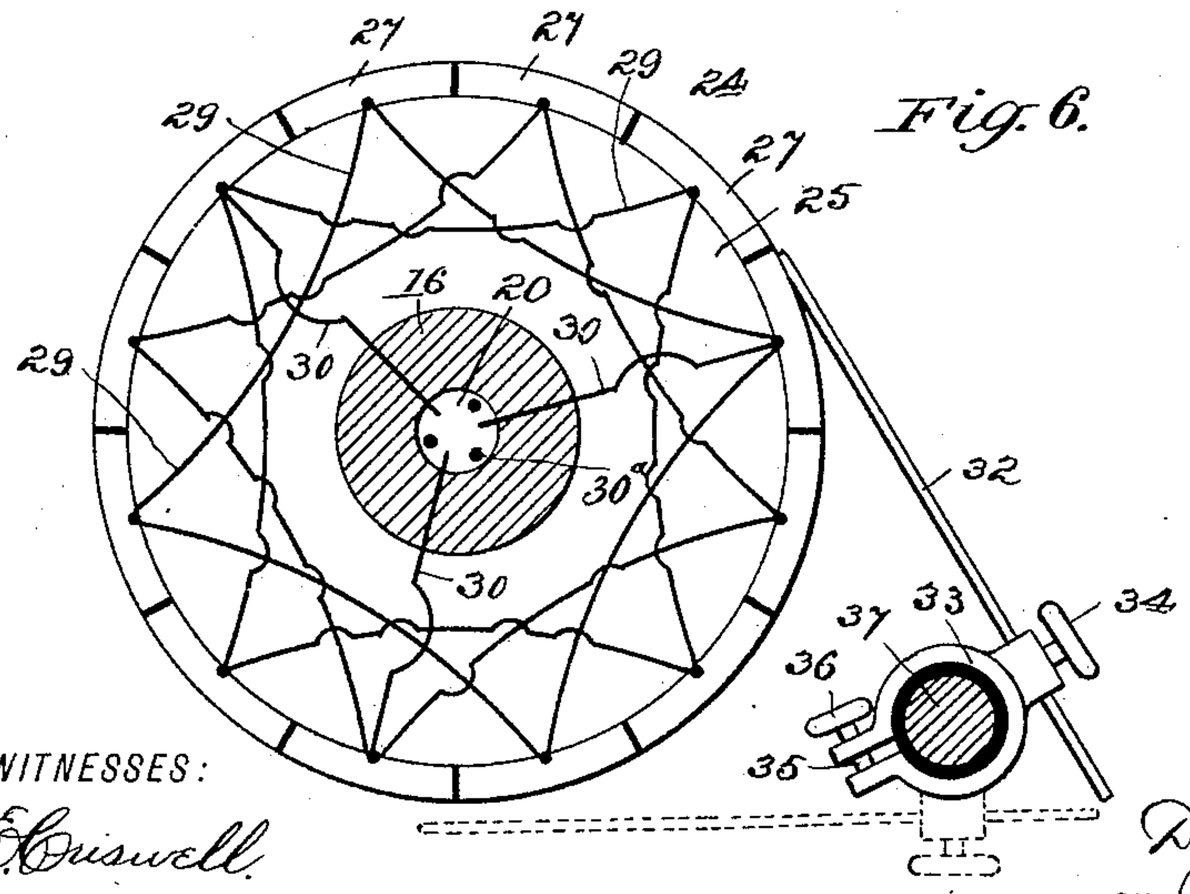


Fig. 6.



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(No Model.) 5 Sheets—Sheet 5.

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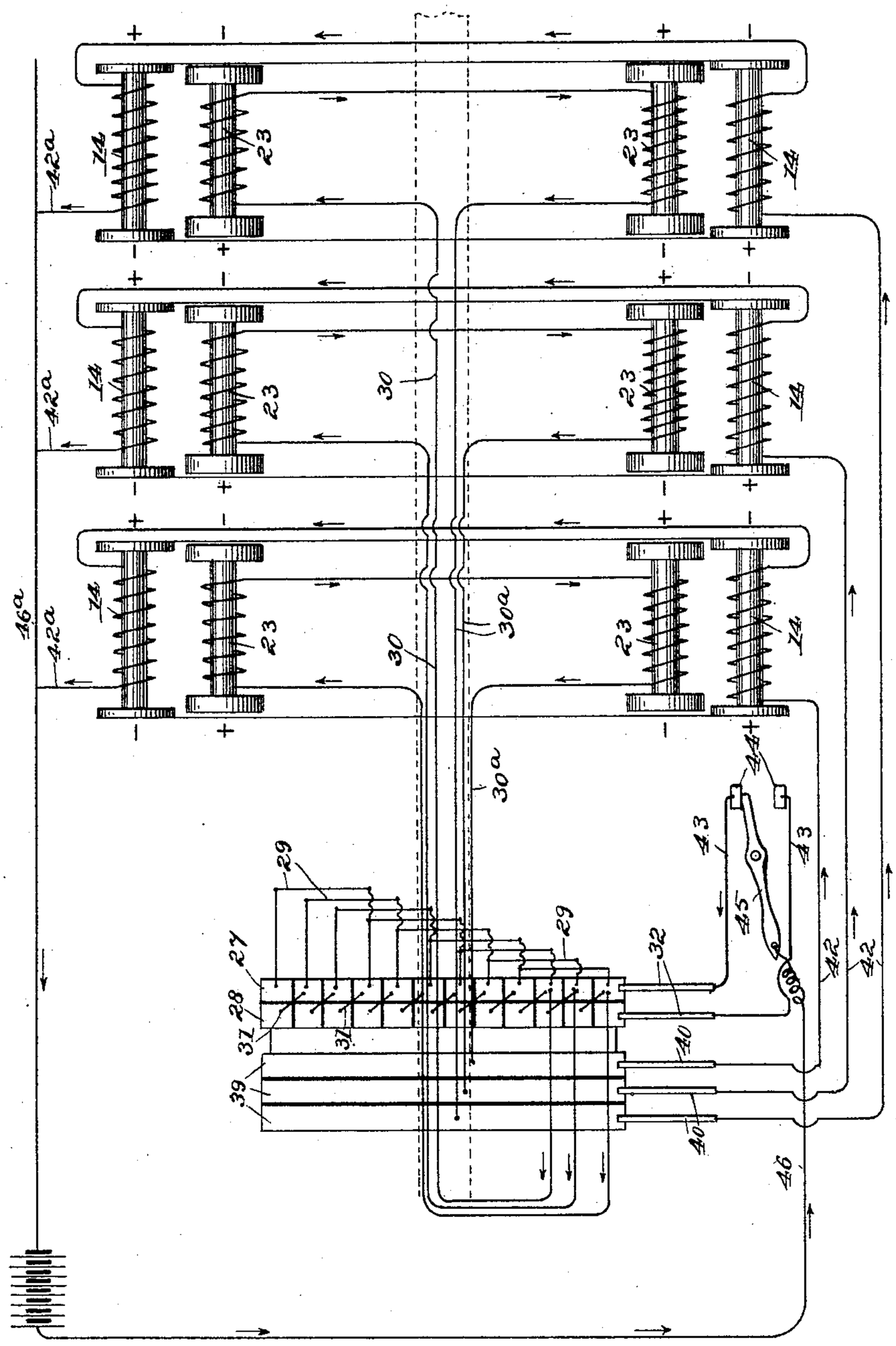
ELECTRIC MOTOR.

No. 452,214. Patented May 12, 1891.

Fig. 1.



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UNITED STATES PATENT OFFICE.

DANIEL J. CHISHOLM, OF NEW YORK, N. Y.

ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 452,214, dated May 12, 1891.

Application filed September 27, 1890. Serial No. 366,350. (No model.)

To all whom it may concern:

Be it known that I, DANIEL J. CHISHOLM, of the city, county, and State of New York, have invented a new and Improved Electric Motor, of which the following is a full, clear, and exact description.

My invention relates to improvements in that class of electric motors in which armatures are made to revolve in magnetic fields; and the object of my invention is to produce a motor having great power in proportion to the current supplied; and a further object of my invention is to produce a commutator having to a certain extent the function of a cut-out, whereby the current may be alternately passed through the different series of coils on the armature and field-magnets, and by means of which the motor may be easily reversed, thus making the motor especially adapted for use upon street-railway cars.

To this end my invention consists in certain features of construction and combinations of parts, which will be hereinafter fully described, and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar figures of reference indicate corresponding parts in all the views.

Figure 1 is a side elevation of the motor embodying my invention. Fig. 2 is a vertical longitudinal section of the same on the line 2 2 of Fig. 3, the motor-shaft being broken away to show the means of connecting the armature with the cut-out. Fig. 3 is a vertical transverse section on the line 3 3 of Fig. 1. Fig. 4 is an enlarged detail perspective of one of the holders of the armature-coils. Fig. 5 is an end view of the motor. Fig. 6 is a transverse section through that portion of the commutator having the segmental plates thereon, showing the connection between the plates and between the plates and the armature-coils, and showing also the contact-brush connecting with the plates; and Fig. 7 is a diagrammatic view showing the connections between the commutator and the armature and field-magnet coils.

The hollow cylindrical frame 10, carrying the field-magnets, consists of a series of spaced rings 10^a, held upon opposite supports 15 and connected together as described. From the rings 10^a extend inwardly spokes 11, which terminate in circular bands 12, the bands forming openings for the armature-shaft 16. The rings 10^a are provided with series of radially-extending arms or pole-pieces 13, the inner rings having a series on each edge and the outer rings on the inner edge only. The ends of the arms of the adjacent rings are united by cores 14^a, carrying coils 14, the arms and coils thus forming the field-magnets. The frame 10 is held in position by the supports 15, and the openings through the circular bands 12 enable it to be accurately centered upon the armature-shaft 16, this being done by inserting circular bushings between the bands and the shaft, the bushings being removed when the supports 15 are properly adjusted and secured.

The shaft 16 is mounted in suitable boxes 17 on the supports 18, and the shaft has at one end a pulley 19, from which power is taken, and has at the other end a central longitudinal bore 20, which opens laterally through the shaft at the bend 20^a, as shown in Fig. 2, and the bore thus affords means for connection between the commutator and the armature-coils, the wires being passed through the bore for the purpose. I have shown the shaft provided with a bore 20, as it affords a convenient means for connecting the commutator and armature-coils; but I do not claim it as a feature of my invention, and the said parts may be connected in any other convenient manner.

A series of pulleys 21, 21^a, and 21^b are fixed to the shaft 16, each pulley being placed between the spokes 11 of two adjacent rings 10^a of the frame 10, so that the pulleys align with the coils 14 of the field-magnets. The pulleys 21 have brass holders 22, fixed to their periphery, the said holders carrying coils 23, which align with the field-magnet coils 14, and the length of which is such that they may pass between the opposite arms or pole-pieces 13 of the frame 10. Each holder 22 has a curved base 22^a, which fits nicely upon the armature-pulleys, and which is perforated to enable it to be easily bolted thereto, and has upwardly-curved arms 22^b at the ends, which thus form sockets 22^c to receive a coil 23, the arms 22^b being perforated, as shown in Fig. 4, to afford means of fastening the coils in place.

On the hollow end of the shaft 16 is a commutator 24, the body portion of which consists of a bushing 25, which is preferably made of seasoned hard wood, but which may be made of any suitable non-conducting material, and the bushing is held in place by a collar 26, which is fixed to the shaft and which has an annular flange 26ª, which overlaps one end of the bushing. Near the inner end of the bushing 26 are two series of segmental plates 27 and 28, the series being insulated from each other and the segments composing each series being also insulated from each other. These segmental plates afford means of connecting alternately with the series of armature-coils attached, respectively, to the pulleys 21, 21ª, and 21ᵇ, and the number of segmental plates in a series must therefore be a multiple of the number of series of armature-coils, and as there are three series of armature-coils shown there are twelve of these segmental plates in each series of the commutator. Every fourth plate 27 is connected by a wire 29, so that, as shown in the drawings, there are three series of connected segmental plates 27, and one plate of each series is connected with the armature-coils on the pulley 21, 21ª, or 21ᵇ by a wire 30, the said wires 30 being passed through the bore 20 in the shaft 16 and thence out through the opening 20ª to connect with the armature-coils 23, as best shown in Fig. 7. It will thus be seen that when contact is made with one of the connected series of plates 27 the circuit will be through the series of coils on the armature-pulley 21, and also through field-coils in line with same armature. When the contact is made with another of the segments, it will be through the armature-coils on the pulley 21ª and the corresponding field-magnets, and when contact is made with one of the other series of segments the circuit will be through the coils of the armature-pulley 21ᵇ, and when the contact is made with the next segment it will be returned to the coils first mentioned on the pulley 21, so that the current will be automatically switched and its full force applied alternately to the different series of coils.

The segmental plates 28 are insulated from each other, as described, and each plate is connected by a wire 31 with a plate 27 in advance of it, the wires 31 extending diagonally, as best shown in Fig. 7, so that when contact is made with the plates 28 the circuit is through one of the plates 28, thence back through one of the wires 31 to a plate 27, and thence through a wire 30 to the armature-coils 23, and it will thus be seen that when contact is made with the plates 28 the current passes back over one of the diagonal wires 31 to the plate 27, which is in connection with the armature, thus magnetizing the armature and corresponding field-magnets for twice the period that they are magnetized when the current passes directly through the plates 27, and the resistance of the magnet thus causes the armature to be stopped, and when it stops it immediately starts in the opposite direction.

Contact is made with the plates 27 and 28 by means of the brushes 32, which are held in the brush-holders 33, the brushes being held in a desired position by the thumb-screws 34, which extend through the brush-holders and impinge upon the brushes, the brush-holders 33 being split on one side, as shown at 35, and the two adjacent parts being connected by a thumb-screw 36, so that by tightening the thumb-screw the brush-holder may be tightened upon the shaft 37, upon which it is mounted.

If desired, the brush-holder 33 may be provided with a brush on the under side, as indicated by dotted lines in Fig. 6, so that when the motor is reversed the lower brush may connect with the segmental plates 28, and there will be no danger of injuring the brush. The shaft 37 is held in an arm 38, which extends laterally from one of the supports 18, as shown in Fig. 1.

On the outer end of the bushing 25 are a series of rings 39, which are insulated from each other, and there are as many rings as there are series of coils in the field-magnet, and therefore in the present case there are three. Contact is made with these rings by means of the brushes 40, which are held in brush-holders 41, said brush-holders being mounted on the shaft 37 and being similar to the brush-holders 33 already described. The rings 39 are connected with the return-wires 30ª of the armature-coils, which also extend through the hollow shaft 16, and the brushes 40 are connected by wires 42 with the field-magnet coils 14, thus completing the circuit. The brushes 32 are connected by wires 43 to contact-blocks 44, which are insulated on one of the supports 18, and pivoted on an arm of the support adjacent to the blocks is a switch 45, adapted to be connected with either of said blocks, said switch connecting with one of the main wires 46. The field-magnet coils 14 are connected by wires 42ª with the main return-wire 46ª.

The operation of the machine is as follows: When the machine is to be started, the switch 45 is turned to connect with one of the contact-blocks 44, so that the current will pass through one of the wires 43 and brushes 32 to the segmental plates 27, and the current passes through one series of said plates by means of one of the wires 30 to the coils 23, which are arranged on the first armature-pulley 21, the current passing from said coils through the return-wire 30ª to one of the rings 39, and from thence through one of the brushes 40 and wires 42 to the field-magnet coils 14, and from thence through one of the wires 42ª to the return-wire 46ª. When the circuit is closed through one of the series of segmental plates 27 and through the first series of armature and field-magnet coils, as shown, the motor is started, and when the brush 32 passes from one of the segmental

plates 27 to the next the circuit is thereby closed through the armature-coil on the pulley 21^a and through the corresponding field-magnet coil, and when it passes to the next segmental plate the circuit is closed through the armature-coils on the pulley 21^b and through the corresponding field-magnet coils, and contact with the next segmental plate closes the circuit again through the first-mentioned coils, and it will thus be seen that the circuit is alternately closed through each series of armature and field-magnet coils, so that the whole force of the current is constantly utilized to run the motor.

It will be readily seen from the foregoing description that the armature may be provided with any desired number of pulleys and with corresponding series of coils and that the field-magnet may be increased in the same ratio, so that a motor of any size may be produced, and it will also be seen that by having the armature-coils carried on the circumference of the pulleys, as shown, they are thus placed at a comparatively long distance from the armature-shaft, thereby greatly increasing its power.

The motor may be provided, as described, with any number of series of armature and field-magnet coils, and in carrying out this idea the segmental plates 27 and 28 should always be a multiple of the number of series of coils, and the rings 39 on the cut-out must correspond in number to the number of series of field-magnet coils.

When the motor is to be used for ordinary purposes, it is only necessary to provide the commutator with one series of segmental plates, the series of plates 27 being used, as it is necessary to run the motor in but one direction; but when the motor is to be used for railway purposes, or where it is necessary to reverse it, the commutator is provided with the segmental plates 28 in order that it may be quickly reversed.

In adjusting the machine the commutator should be placed upon the armature-shaft in such a manner in relation to the armature and field-magnets that when a contact-brush first touches one of the contact-plates the armature-coils will be a distance of about their own diameter from the field-magnet coils, and the machine will thus be prevented from stopping on a dead-center.

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

1. An electric motor comprising a hollow frame having a series of radially-extending arms or pole-pieces arranged in pairs and carrying coils, an armature consisting of a common shaft carrying independent pulleys to move between the pole-pieces, said pulleys having coils held in sockets on their faces, and means for closing the circuit successively through the several series of armature and field-magnet coils, substantially as described.

2. In an electric motor, the armature comprising a common shaft, a series of independent pulleys fixed to the shaft, and coils held in sockets secured to the faces of the pulleys, substantially as described.

3. The combination, with the hollow frame having series of radially-extending arms or pole-pieces carrying coils and the armature-pulleys having coils upon their circumference to move between the pole-pieces, of the commutator comprising an insulating-bushing mounted on the armature-shaft, a double series of contact-plates thereon, the plates of one series being adapted to connect with the armature-coils and being diagonally connected with the plates of the other series, and a series of rings on the bushing adapted to connect with the armature and field-magnet coils, substantially as described.

4. In an electric motor, the combination, with the armature-pulleys, of the coil-holders having curved bases to fit the pulleys and having upwardly-curved arms at each end to form sockets for the coils, substantially as described.

5. In an electric motor, the commutator comprising an insulating-bushing, a series of segmental contact-plates adapted to connect with the armature-coils, the plates adapted to connect with a series of coils being connected together, as shown, a series of insulated segmental contact-plates connected diagonally with the first-mentioned plates, and a series of rings insulated from each other and adapted to connect with the armature and field-magnet coils, substantially as shown and described.

6. The combination, with the field-magnets and armature having the coils arranged in series, of the commutator comprising an insulating-bushing, a series of segmental contact-plates connected with the armature-coils, the plates connecting with each series being also connected together, a series of segmental contact-plates arranged parallel with the first-mentioned plates, each of the latter plates being connected with one of the former plates in advance of it, and a series of rings connected with the armature and field-magnet coils, substantially as described.

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