(No Model.)

7 Sheets—Sheet 1.

T. DUNCAN.

ELECTRIC METER.

No. 604,465. Patented May 24, 1898.

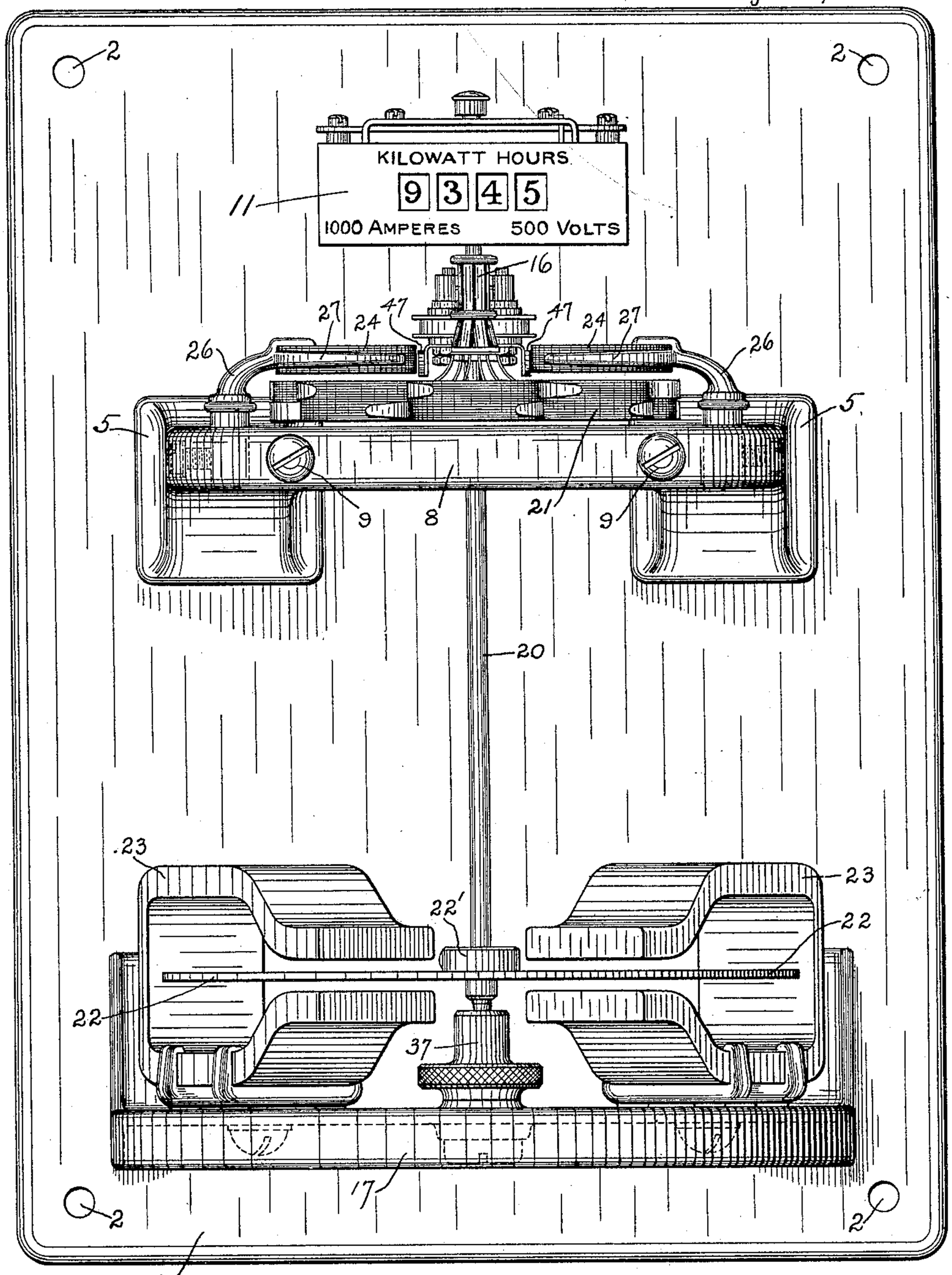

Fig. 1.

Witnesses
Samuel A. Bachtel
William Murray

Thomas Duncan Inventor
By his Attorneys Chapin & Denny

(No Model.) 7 Sheets—Sheet 2.

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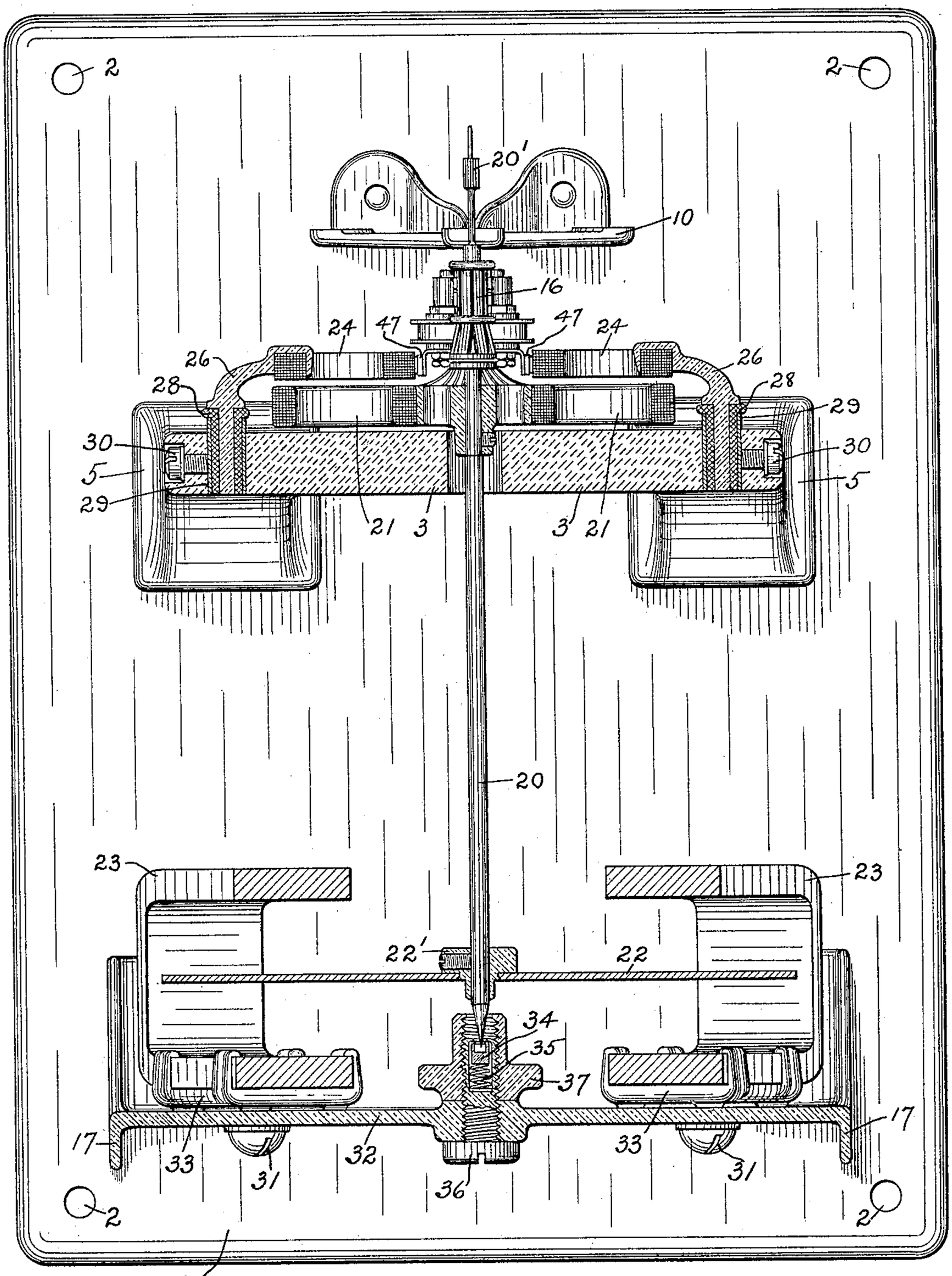

Fig. 2.

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Fig. 3.

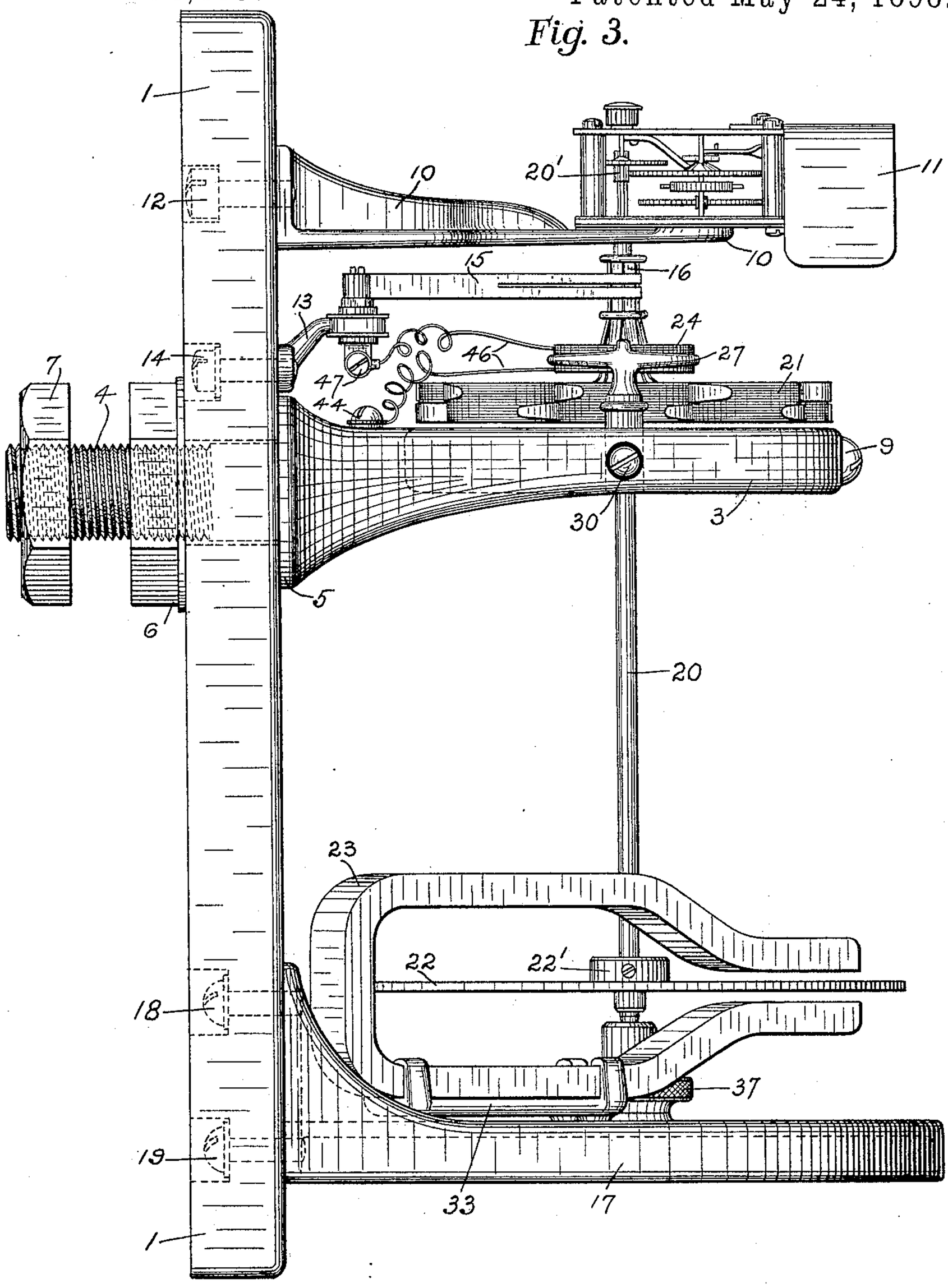

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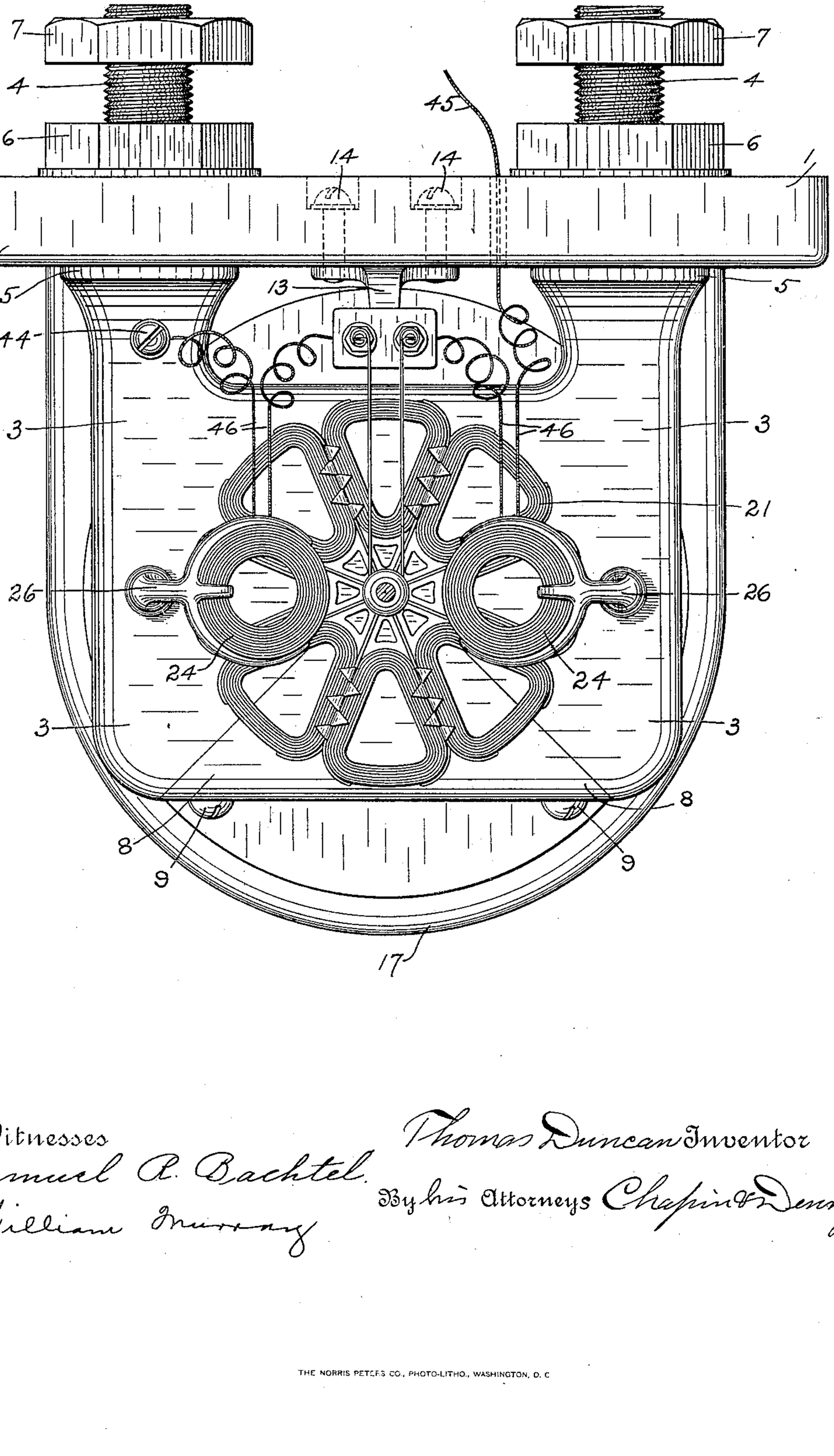
Fig. 4.



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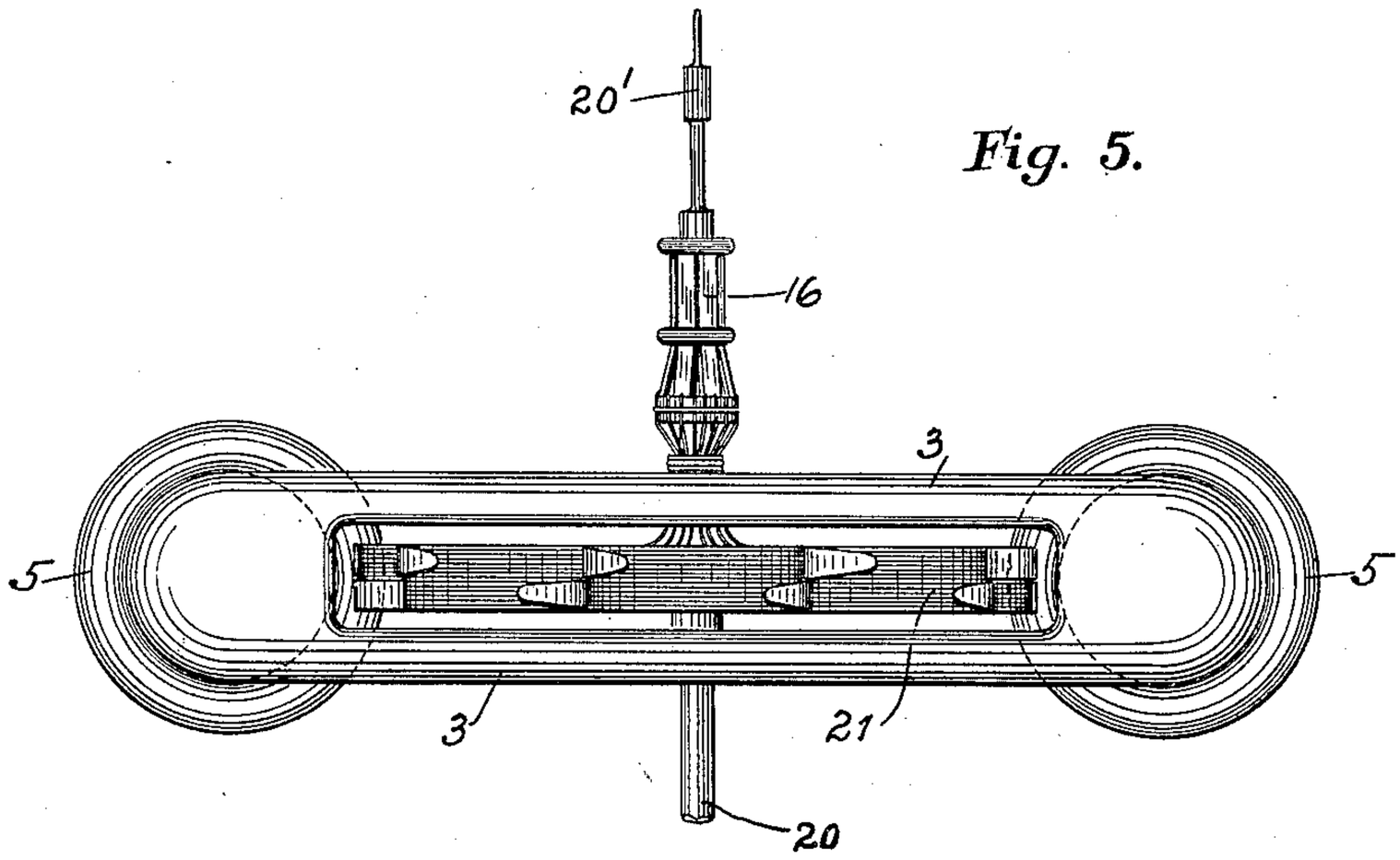

Fig. 5.

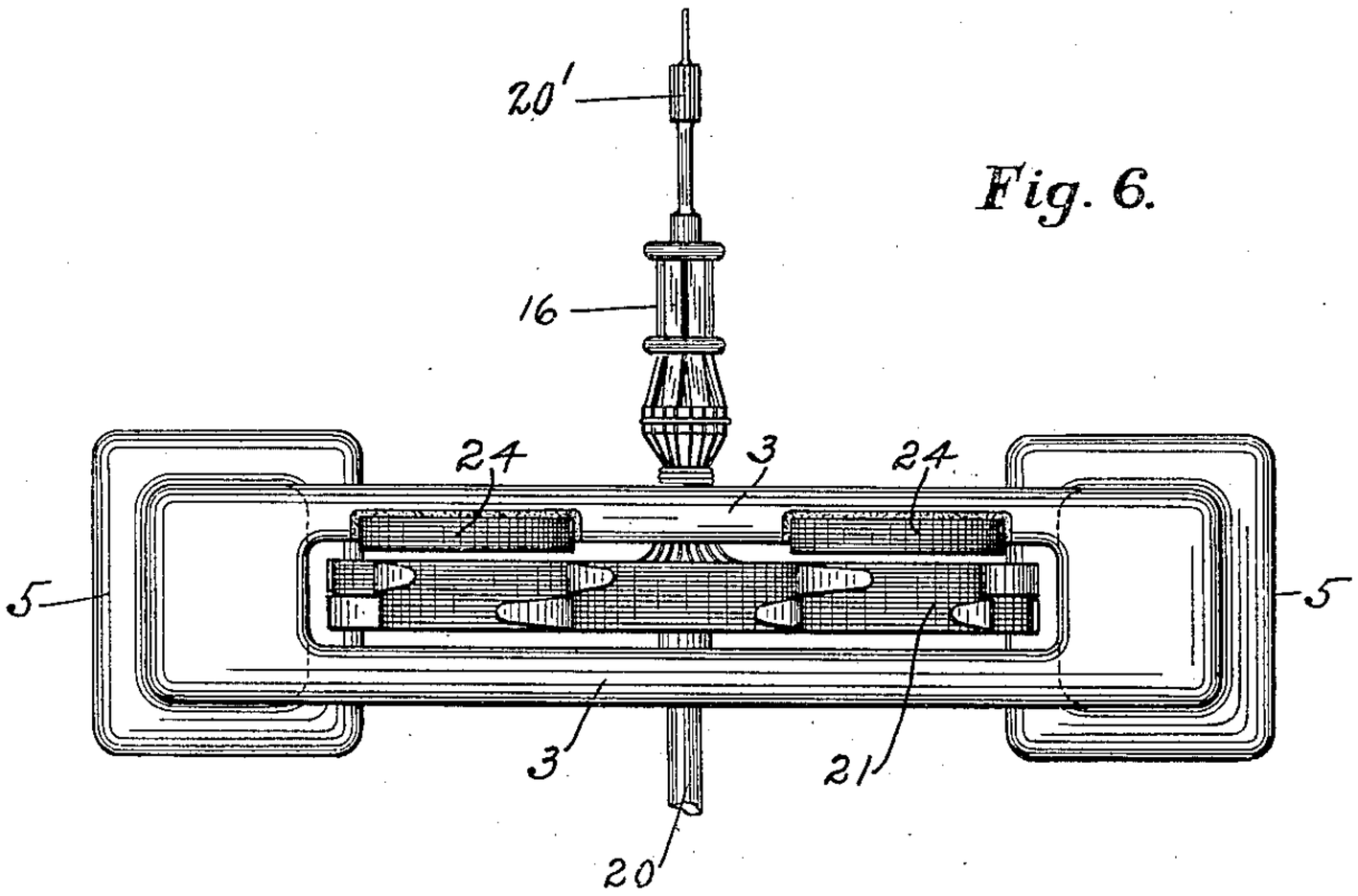

Fig. 6.

Witnesses
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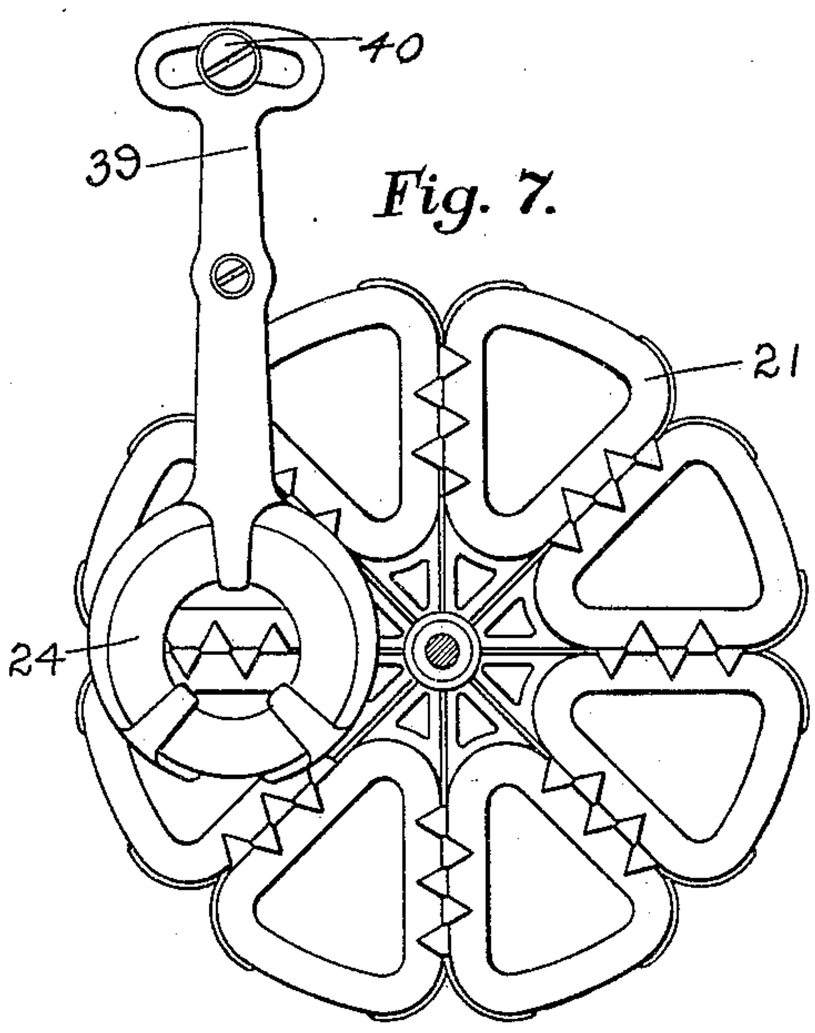


Fig. 7.

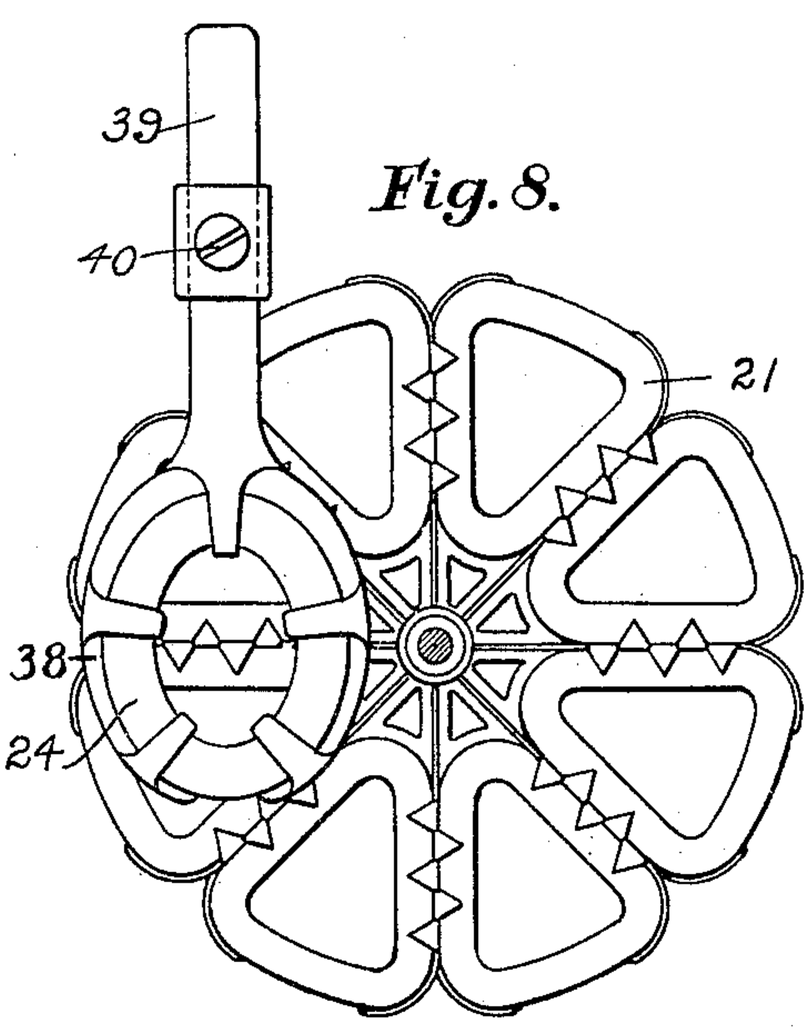
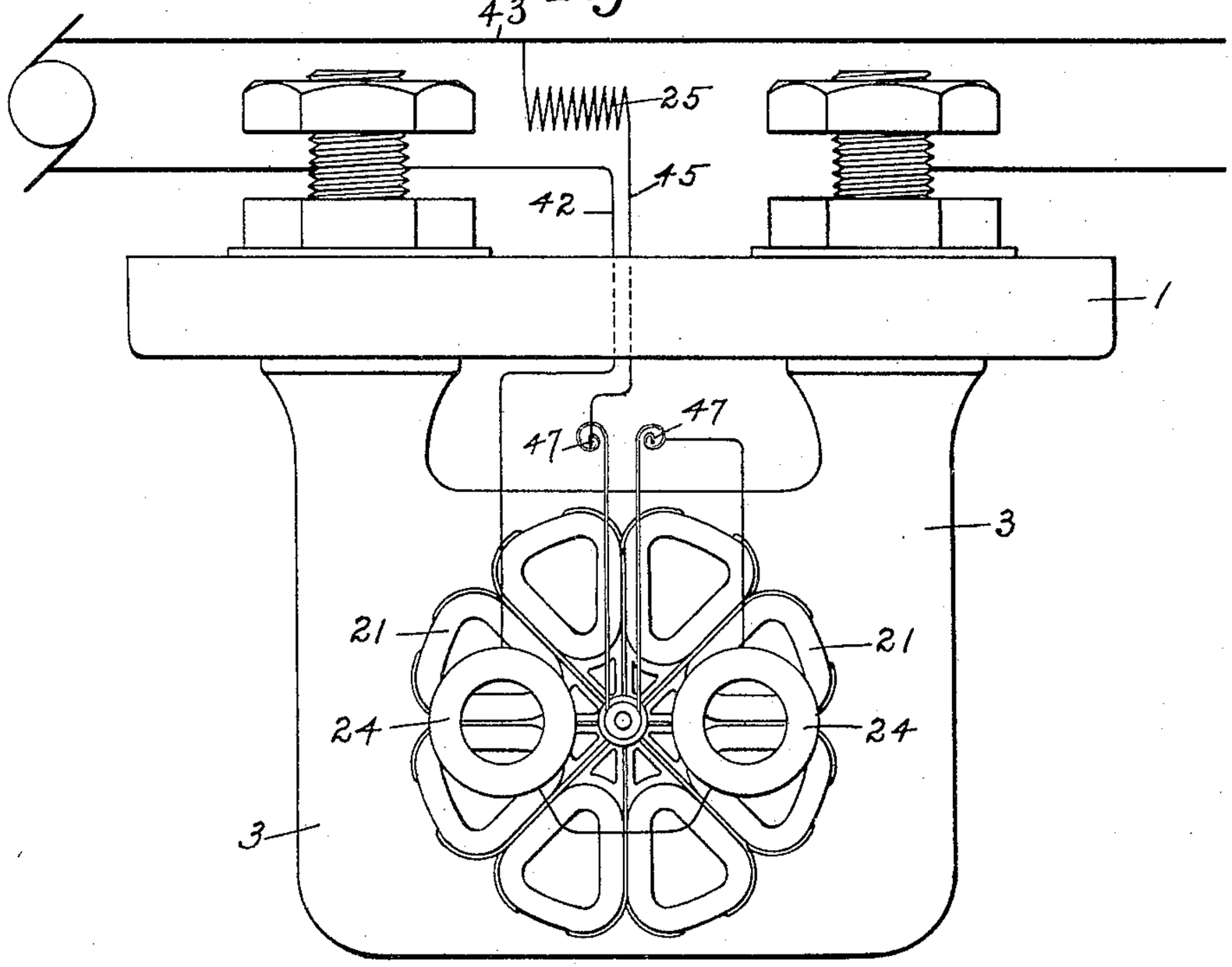


Fig. 8.

Fig. 9.



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ELECTRIC METER.

No. 604,465. Patented May 24, 1898.

Fig. 10.

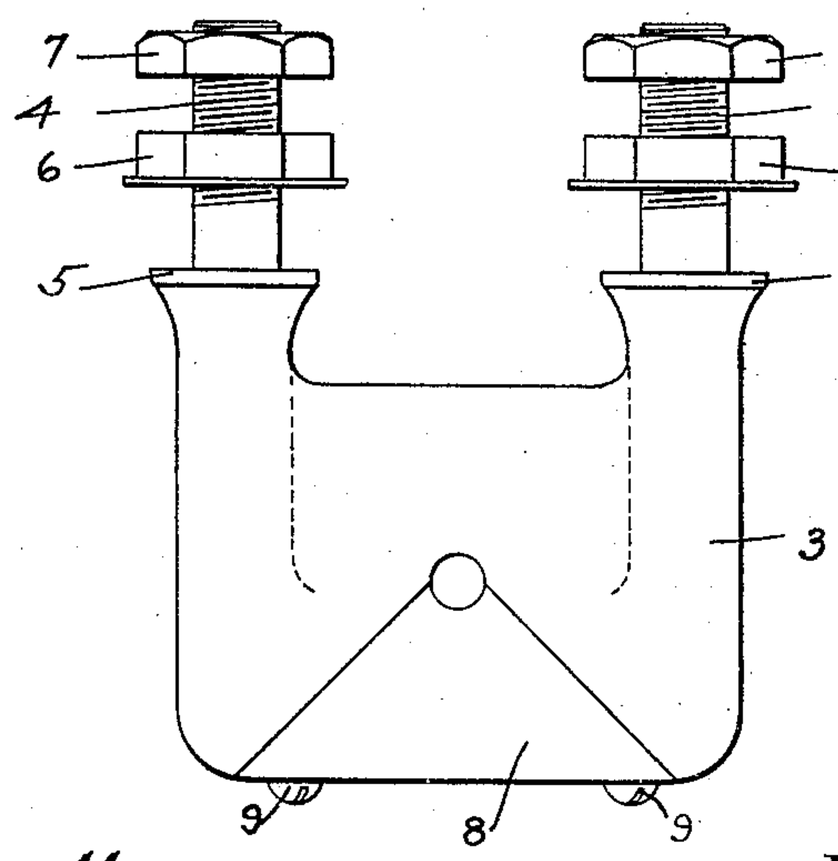


Fig. 11

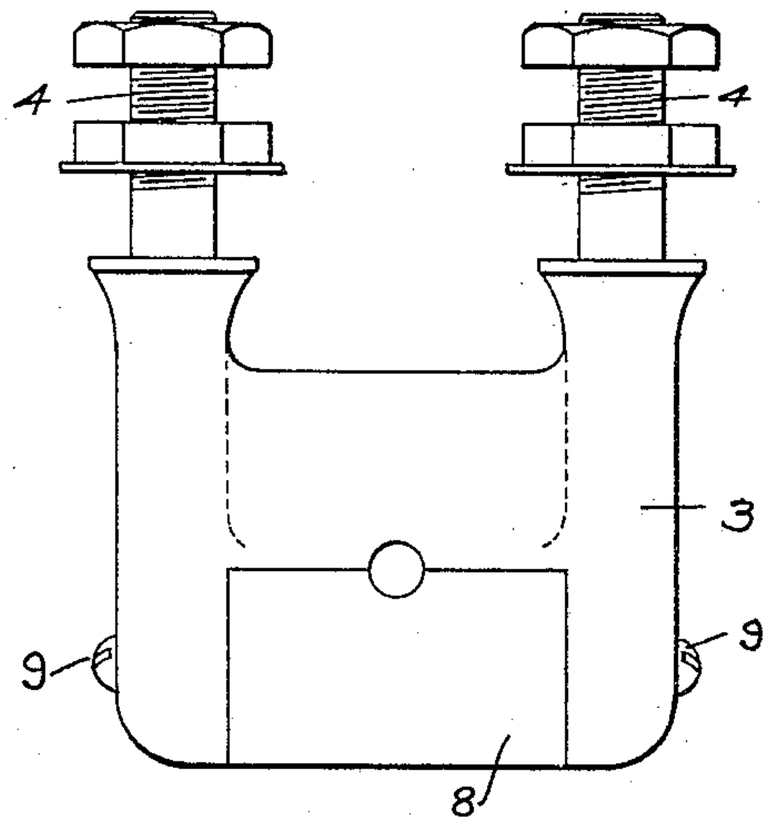


Fig. 12.

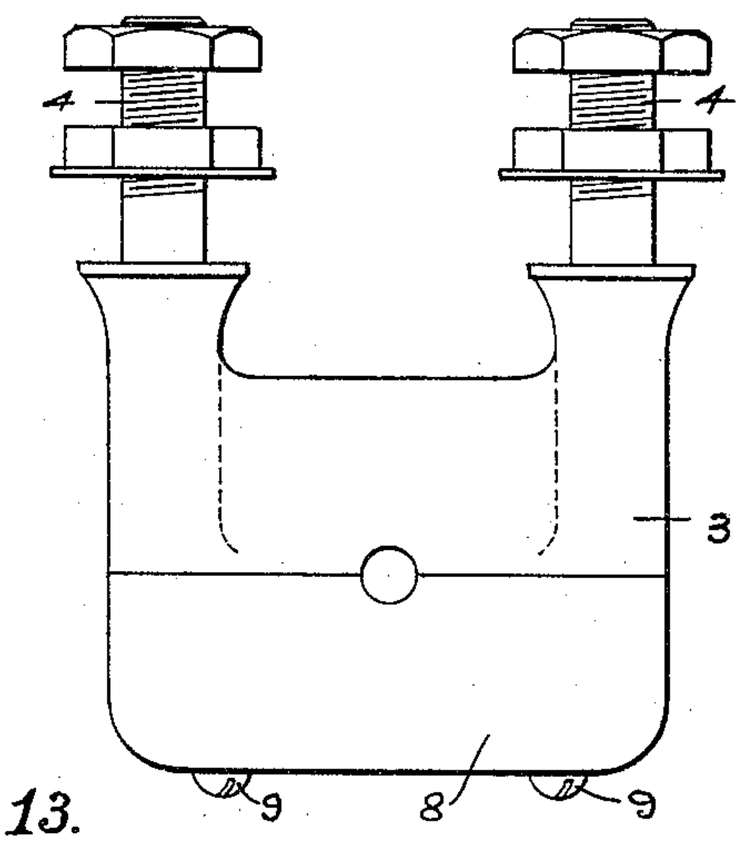
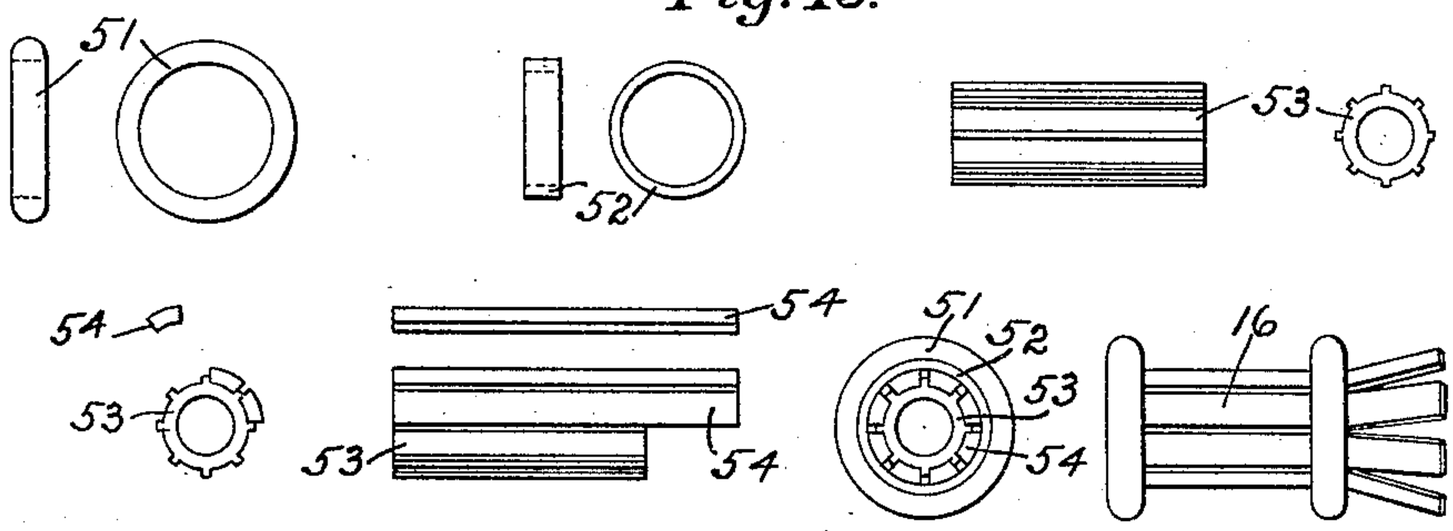


Fig. 13.



Witnesses
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William Murray

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UNITED STATES PATENT OFFICE.

THOMAS DUNCAN, OF FORT WAYNE, INDIANA.

ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 604,465, dated May 24, 1898.

Application filed September 24, 1897. Serial No. 652,848. (No model.)

To all whom it may concern:

Be it known that I, THOMAS DUNCAN, a citizen of the United States, residing at Fort Wayne, in the county of Allen, in the State of Indiana, have invented certain new and useful Improvements in Electric Meters; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to improvements in electric meters, particularly that class known as "integrating wattmeters" of the motor type.

The objects of the present invention are, first, to provide an electric meter of simple and economical construction and reliable in operation specially adapted for measuring large currents, such as those from central-station and street-railway generators; second, to provide a meter which while specially adapted for large currents is adapted to operate on and measure with equal accuracy very small amounts of energy; third, to provide a simple and efficient means of compensating for the increasing friction caused by the wear and continued use of the working parts of the meter.

Similar reference-numerals indicate like parts throughout the drawings, in which—

Figure 1 is a front elevation of my improved meter, showing the relative arrangement of the operative parts. Fig. 2 is a vertical section of the same. Fig. 3 is a side elevation thereof. Fig. 4 is a plan view of the same with the registering-train removed, showing the motive part of the meter and also showing the manner of connecting the circuit to the field of the meter. Figs. 5 and 6 are modified forms of the field-casting. Figs. 7 and 8 illustrate different methods of employing the variable compensating coil for overcoming the friction and inertia of the meter. Fig. 9 illustrates diagrammatically the manner of applying my improvement to a street-railway or other system of supply. Figs. 10, 11, and 12 are modified forms of the casting employed in the field which carries the main current. Fig. 13 exhibits in detail the component parts of the commutator.

The vertical supporting-bracket 1 on which my improvement is mounted is made of marble, slate, or other suitable insulating material and is preferably provided at each corner thereof with holes 2, by which it can be secured to the switchboard or other desired position.

To the front face of the bracket 1 is fixed the horizontal field-casting 3, adapted to carry the main current from the generator. This casting is provided upon its rear edge with a pair of rearwardly-projecting screw-threaded lugs 4, adapted to snugly fit suitable adjacent openings in said bracket. These lugs have an annular flange 5 upon their inner end and the nuts 6 and 7 upon their outer end, the former adapted to rigidly secure said casting in position and the latter to secure the leads or the mains of the switchboard in a well-understood manner. If desired, the said field-casting may be made in two parts, as shown in Figs. 11 and 12, the line of division being diametric to the opening therein for the armature-spindle. By this construction the armature and spindle can readily be removed or replaced when desired by disconnecting the detachable section 8 of said casting, which is secured in position by proper holding-screws 9. At a proper distance above the said field-casting and pro-midway the sides thereof is a forwardly-projecting horizontal bracket 10, rigidly secured in position on the bracket 1 by means of proper holding-screws, (shown in dotted outline at 12, Fig. 3.) On the forward end of said bracket 10 is properly secured the registering-train 11, of the usual or other proper construction.

To the bracket 1 and directly above the field-casting is fixed an oblique forwardly-projecting arm 13, Fig. 3, by means of proper holding-screws 14. On the outer end of this arm are adjustably mounted the commutator-brushes 15, in operative relation with a proper commutator 16, rigidly fixed upon the upper part of the armature-spindle, hereinafter described.

To the front face and lower end of the

bracket 1 is fixed by means of proper holding-screws 18 and 19 the horizontal bracket 17, which forms a supporting-base for the permanent magnets and armature-spindle. On the outer basal bracket 17 are arranged the permanent magnets 23, which are mounted in the clamps 33. The clamps are firmly secured in the said basal bracket by the screws 31, Fig. 2. In a central screw-threaded opening in said bracket 17 is mounted the screw 36, having its upper end centrally apertured for the conical lower end of the armature-spindle 20 and having a proper jewel-bearing 34 arranged in a horizontal central slot therein and supported upon a suitable spiral spring 35, adapted to take the jar off of the said jewel, as in shipment. In this jewel-bearing the lower conical end of the armature-spindle is mounted. On the upper portion of said screw 36 is arranged the thumb-nut 37, centrally apertured at its upper end to admit the lower end of said spindle.

Upon the armature-spindle 20, near the lower end thereof, is fixed by means of a proper set-screw the retarding-disk 22. This aluminium disk is adapted to rotate between the poles of the said permanent magnets to make the speed of the meter proportional to the energy passing through the same in a manner well understood. This disk has a central hub 22, having a pendent annular lug concentric with said spindle. By elevating the thumb-nut 37 to contact with the pendent portion of said hub and then rotating the same the spindle 20 wil be elevated out of contact with said jewel-bearing, as is desired in case of shipment. The armature-spindle 20 passes upward through a central opening in the said field-casting 3 and is provided near its upper reduced end with a rigid pinion 20′ or other proper means for forming an actuating engagement with said registering-train.

The armature 9 is a wound armature whose peculiar construction is fully shown and described in a prior patent issued to me upon the 15th day of December, 1896, and numbered 573,080, and need not be more particularly described here. This armature may be arranged directly above the field-casting, as shown in Fig. 2, and secured to the armature-spindle by a proper set-screw in a pendent annular lug on said armature. The armature may be arranged either above or below said field-casting or it may be located in a hollow center thereof, as shown in Figs. 5 and 6. This I have found to be a very efficient arrangement.

My improved means for compensating for the increased friction of the meter resulting from use consists of two compensating coils 24, located, as shown in Figs. 1, 2, and 3, immediately over the armature. These coils are firmly held in position out of contact with the armature by means of the clamps 26, whose arms 27 firmly embrace said coils. The lower ends of said clamps 26 are inclosed by a rubber brushing 28, which in turn is inclosed by a proper brass tubing 29. Thus inclosed the said ends are inserted in suitable vertical openings in said field-casting and insulated therefrom, and are rigidly secured in position by means of the set-screws 30. These compensating coils may of course be variously arranged. As shown in Fig. 6, they may be located in a central opening in the field-casting, also adapted to contain the armature. As these compensating coils may be variously adjusted toward or away from the armature and can be employed in meters having field-coils of different forms, I do not hereby limit myself to any of the specific forms or relative arrangements herein shown.

In Fig. 8 the compensating coil is adjustably mounted in the horizontal support 38 and can readily be adjusted as desired by the arm 39, after which the said arm is secured by the set-screw 40. In Fig. 7 the adjusting-arm is pivoted and has its outer end slotted to receive the screw 40. While I have shown two compensating coils in the drawings, obviously one coil may be used instead of two.

In Fig. 13 I have shown in detail the various parts of the small commutator employed in my meter, comprising a fiber cylinder 53, the insulating-rings 52, the brass rings 51, a side view of a complete commutator 16, an end view of the same with its various parts assembled, and a series of peripheral segments 54, adapted to fit between peripheral teeth or radial lugs of a height much less than the thickness of said segments, whereby a series of peripheral air-spaces is provided and all danger of contact of said teeth with the brushes is avoided. The segments 54 are rigidly secured in position by the insulating-rings 52 and the brass rings 51, inclosing said rings 52.

The operation of my improved meter is briefly stated as follows: The current traversing the field-casting 3 sets up a magnetic field whose strength varies with the amount of current, while the current flowing through the armature will vary as the electromotive force, since its terminals are in multiple upon the circuit. Therefore the torque set up between these two conductors represents the energy passing through the meter. The said disk 22, rotating between permanent magnets, is adapted to keep the speed of the meter proportional to the energy passing through the same in a well-understood manner.

One of the principal features of my invention is the means I employ to make the meter reliably operative on small currents or small amounts of energy and to compensate for the increase of friction incident to continued service. For example, when a meter is first calibrated it possesses a certain amount of friction, which has in some meters been temporarily compensated for by supplementing the series field with a shunt-coil, thereby producing an auxiliary starting-field, which, however, is not variable in character. The result

is that after the meter has been in use for some months the friction of the moving parts in most cases will have so increased that from five to ten times as much energy is required to start it as when first calibrated.

Another objection to the employment of a stationary shunt-coil in the present meters is the fact that any changes made in it, such as adding more turns to it, simply adds resistance into the armature-circuit, which results in possibly compensating for friction, but lowers the registry or characteristic on all the other loads. Placing the said supplemental shunt-coil inside of the series coil is also objectionable, as it thus becomes a secondary to the series coil on alternating currents, thereby setting up a counter electromotive force in opposition to that of the mains. This counter effect increases as the current through the series coils increases, whereby its tendency to overcome friction decreases as the energy of the current through the meter increases instead of remaining constant.

My improved means for overcoming the above objections is by employing one or more, preferably two, compensating coils 24, located immediately above the armature. These compensating coils are connected in series with the armature and a suitable resistance 25. In calibrating the meter these compensating coils are simply moved laterally or vertically by means of the screw 30 until the friction is overcome, whereupon a small amount of energy through the meter will operate it. The armature and the said compensating coils are supplied with current by the wire 42, which is connected to the left-hand lug 4, the current then passing through the compensating coils, the brushes, and armature and then through the resistance 25 to the other side of the circuit 43, Fig. 9, all of which connections are well understood.

While the terminals of the armature and compensating coils are shown as connected upon the outside of the meter or back of the switchboard, the connections may also be made as shown in Figs. 3 and 4, in which one of the shunt-terminals receives its current from the inside of the meter by being screwed to the field-casting 3 by the set-screw 44 and after passing through the armature and shunt-coils terminates in the wire 45 at the back of the meter. In Fig. 3 these connections are shown to start from the screw 44 on the field-casting, the current then passing through one wire 46, through the compensating coils, through the other wire 46 and the screw 47 to the brushes, and then through the armature. I do not hereby limit myself to the application of the said adjustable compensating coils to the series field herein shown, as they can readily be applied to various other forms of series fields.

Having thus described my invention, what I desire to secure by Letters Patent is—

1. In a meter for measuring large electric currents a stationary field-conductor having a detachable section for the purpose specified; a disk-like armature comprising a series of sector-like coils assembled as shown, and arranged in inductive relation to said conductor; and a commutator arranged as shown and provided with proper contact-brushes.

2. In a meter for measuring large electric currents a stationary field-conductor having a detachable section for the purpose specified; a disk-like armature comprising a series of sector-like coils assembled as shown, and arranged in inductive relation to said conductor; a commutator arranged as shown and provided with proper contact-brushes, and one or more adjustable compensating coils arranged as shown in operative relation to said armature.

3. The hereinbefore-described method of securing a variable compensation for the increased friction incident to use in an electric meter, consisting in accelerating the rotation of the armature by the influence of one or more adjustable compensating coils arranged in coöperative relation therewith.

4. The combination of a stationary field-casting traversed by the main current, provided with a horizontal central opening adapted to contain the rotary armature as shown; a rotary disk-like armature mounted in said opening of the field-casting as shown, in inductive relation therewith; a commutator and contacting brushes; a retarding device and a proper totalizing mechanism.

5. The combination of the two-part stationary field-casting traversed by the main current; a rotary disk-like armature arranged in inductive relation to said field-casting; an adjustable compensating coil or coils in coöperative relation to said armature; a disk 13; and permanent magnets embracing said disk as shown.

6. In an electric meter adjustable compensating coils 24 mounted as shown in inductive relation to the rotary armature and adapted to compensate for the increased friction incident to use, substantially as described.

7. In a motor-meter the combination of a series field carrying the main current; a revoluble armature in inductive relation to said field; and an adjustable compensating coil or coils in coöperative relation to said armature for the purpose specified.

Signed by me, at Fort Wayne, Indiana, this 22d day of September, A. D. 1897.

THOMAS DUNCAN.

Witnesses:
ADELAIDE KEARNS,
WATTS P. DENNY.