Sept. 4, 1928.

C. FAYER ET AL

1,682,748

RECTIFYING TRANSFORMER

Filed July 27, 1922

FIGURE 1

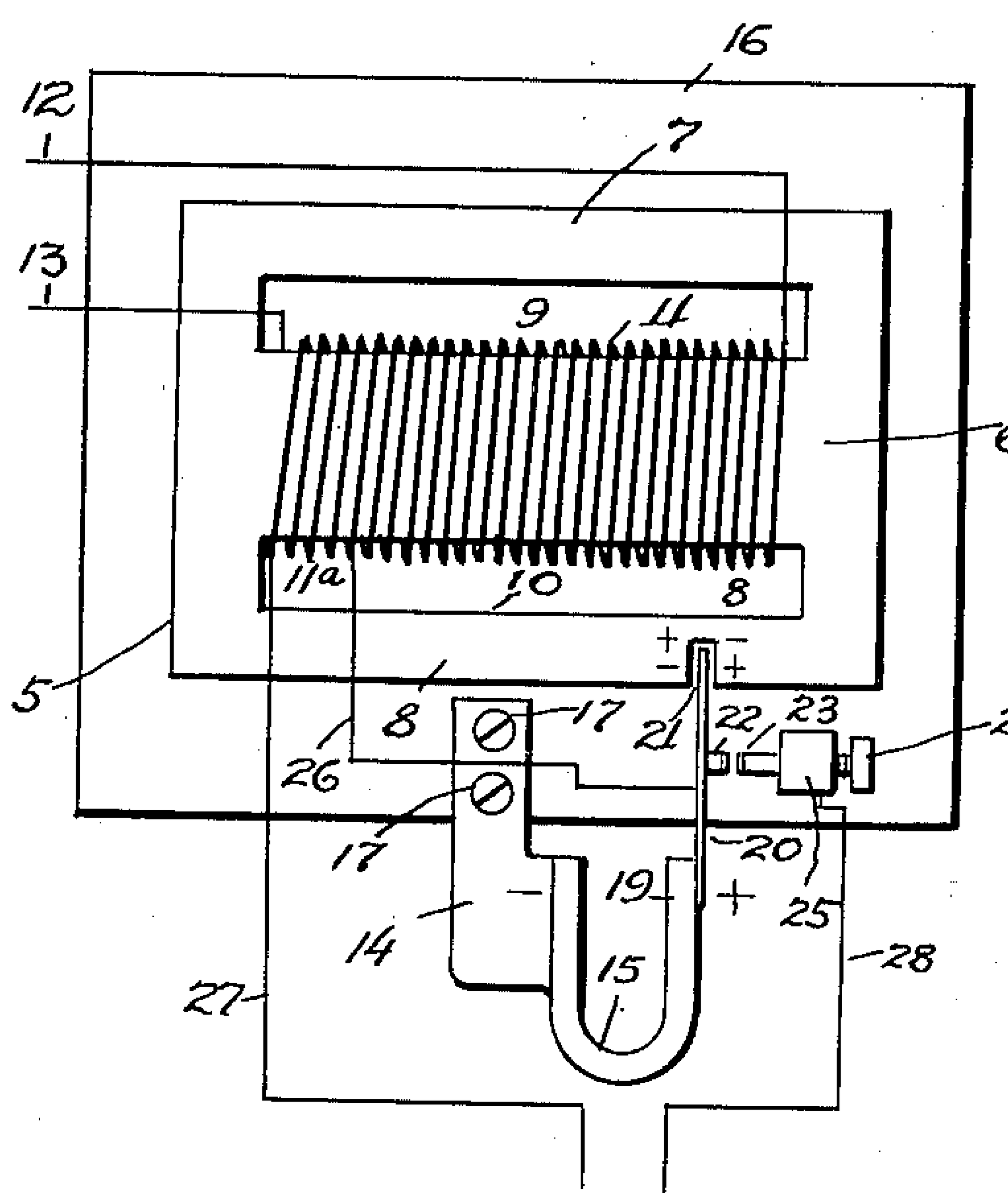


FIGURE 2

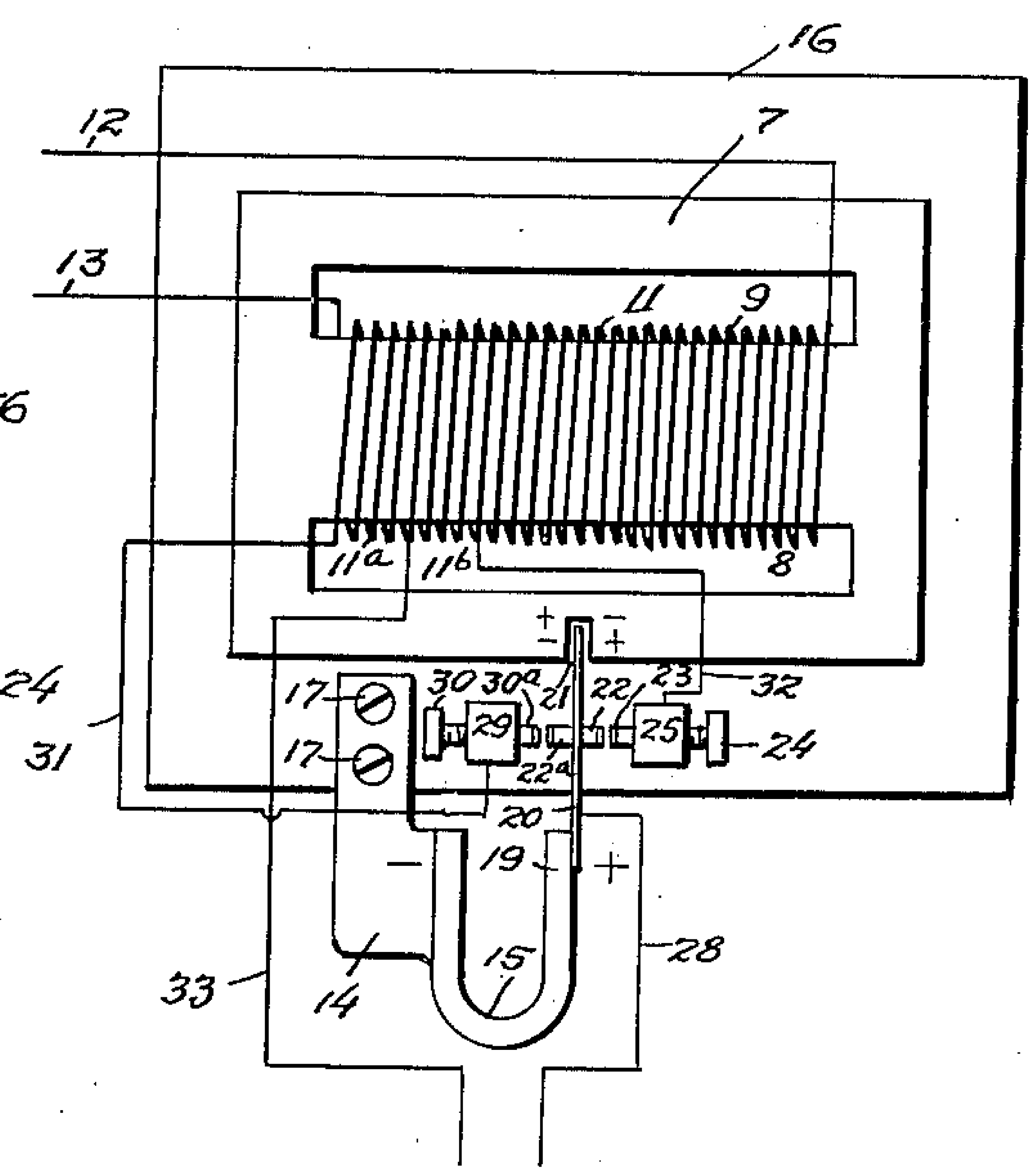


FIGURE 3

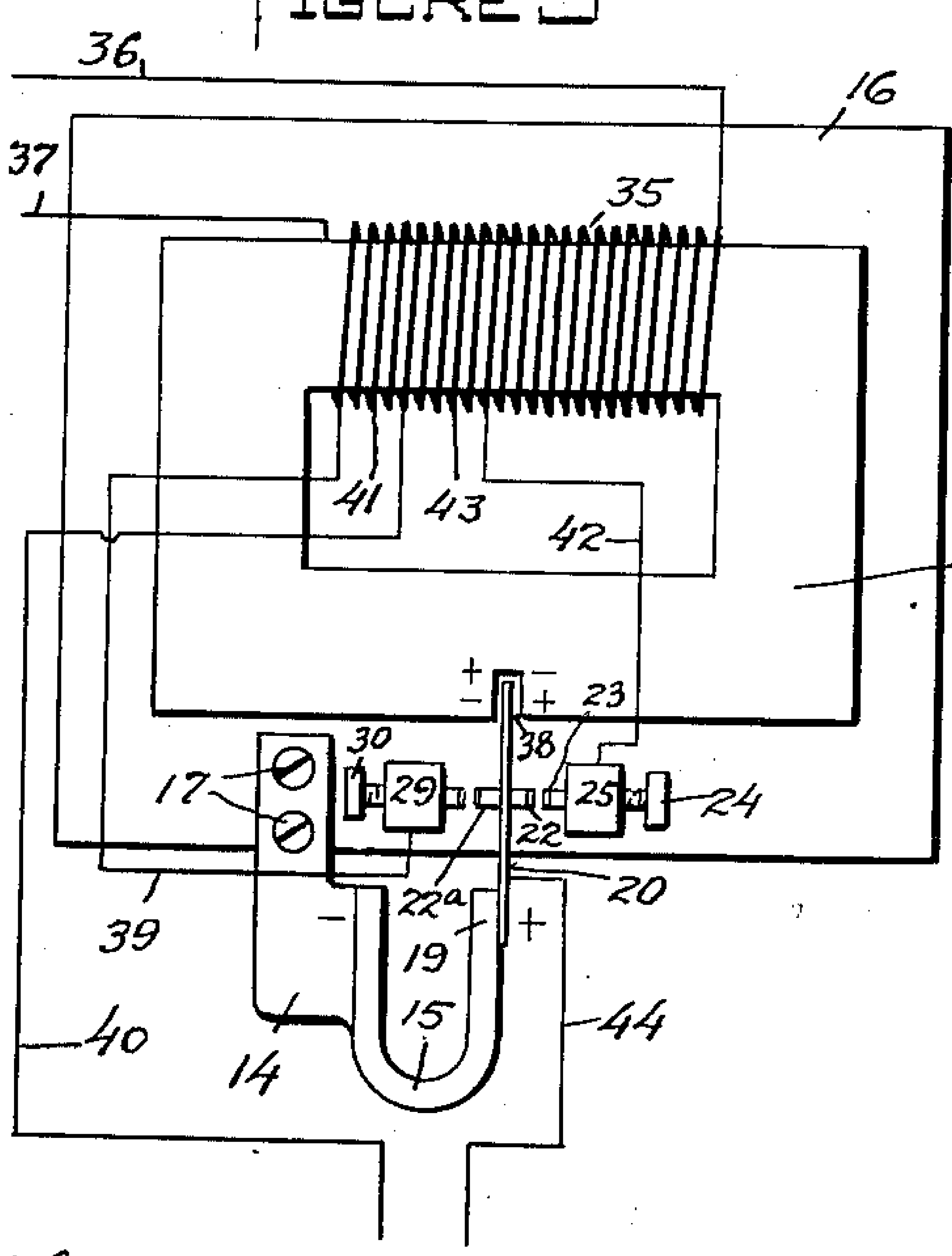
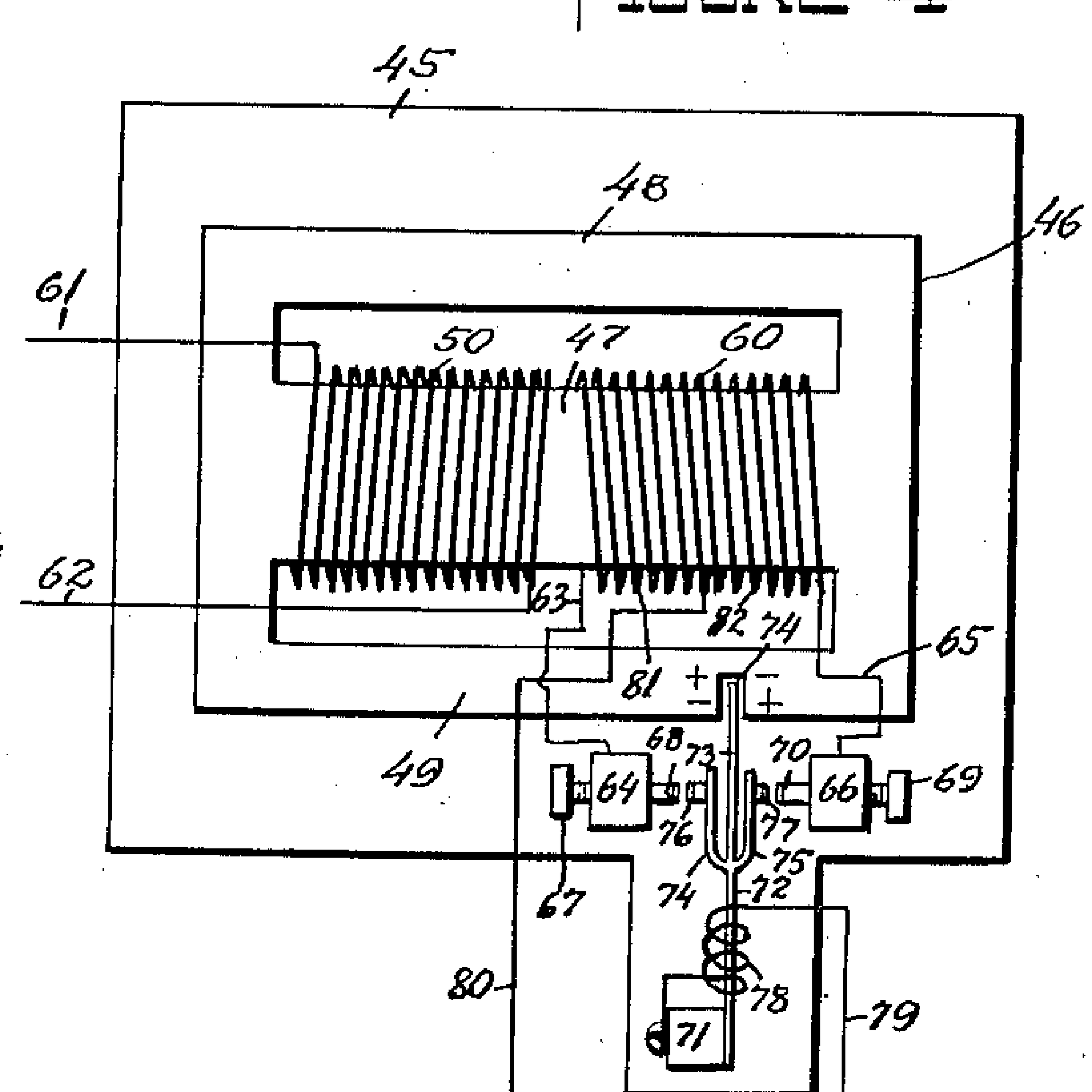


FIGURE 4



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Patented Sept. 4, 1928. **1,682,748**

UNITED STATES PATENT OFFICE.

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RECTIFYING TRANSFORMER.

Application filed July 27, 1922. Serial No. 578,017.

Our invention relates to rectifying transformers of the type in which a magnetically-operated contact member, controllable by an alternating current and operated in synchronism therewith, is caused to periodically open and close a circuit shunted from the alternating current circuit and energized thereby, so as to produce currents of unitary direction.

More particularly stated we seek to produce a device of this character having a very simple construction and made up of a relatively small number of parts, so formed and arranged as to confer upon the device as a whole a number of substantial advantages, among which are the following:

I. To dispense with an electro-magnet ordinarily required as a means for actuating the contact mechanism used for rectifying the current.

II. To provide means for adjusting the contact mechanism, for the purpose of bringing it into synchronism with one or both of the alternations of the alternating current.

III. To so arrange the contact mechanism that by its adjustment the operator can cause the alternating circuit to be broken at the precise moment when no current is flowing in either direction, and thus to prevent sparking.

IV. To employ the core of the transformer as the motor magnet for actuating the contact mechanism.

V. To tap off from the transformer winding a subdivision consisting of a few turns of wire, and using these turns only in rectifying the currents, in order that the voltage of the currents rectified be reduced as compared with the total voltage used in energizing the transformer.

VI. To tap off from the transformer winding a plurality of sub-divisions each containing a small number of convolutions of wire, and to so connect the contact mechanism with the sub-divisions that the sub-divisions are each in succession brought into the circuit used for developing the rectified or direct circuits.

VII. To improve generally the efficiency of the rectifying transformer and parts immediately associated therewith.

Reference is made to the accompanying drawing forming a part of this specification and in which like reference characters indicate like parts throughout the several figures.

Figure 1 is partly in plan and partly diagrammatic, showing one form of our rectifying transformer, in which only one direction of flow of an alternating current is used in making the rectified current.

Figure 2 is a view somewhat like Figure 1, but showing a form of our transformer in which two directions of flow of the alternating current are employed in making the rectified current.

Figure 3 is a view partly in plan and partly diagrammatic, showing a third form of our device, the transformer core having a form different from that appearing in Figure 2 but the construction and action being otherwise the same as in this last-mentioned figure.

Figure 4 is a view similar to Figure 2, but showing a form of our device in which the primary and secondary windings are entirely separate, and in which the armature is polarized by a winding instead of by a permanent magnet.

In the form shown in Figure 1 a shell-type transformer appears at 5 and is provided with a core 6 having branches 7 and 8, and openings 9 and 10, the core 6 being provided with a single winding 11, this winding being connected with leads 12 and 13 whereby it is energized by means of alternating current.

A magnet arm 14 carries a permanent magnet 15 and is mounted upon a base 16, made of slate or other insulating material, and secured in position by screws 17.

The magnet 15 is provided with a pole 19, and mounted upon this pole is a spring armature 20 which extends into a slot 21, with which the portion 8 of the transformer core is provided. The spring armature 21 carries a contact member 22, made preferably of tungsten or platinum. Another contact member 23 is carried by a screw 24, the latter extending through a post 25. This post is mounted upon the base 16.

A wire 26 is connected with the winding 11 in such manner as to form a sub-division 11^a, consisting of a small number of turns at wire of the left of Figure 1, this sub-division being connected by the wire 26 with the spring armature 20. Another wire 27 is connected with the winding 11, at the end thereof to the left according to Figure 1. A wire 28 is connected with the post 25. The wires 27 and 28 constitute the pair of leads through which the rectified current flows.

With each cycle of the alternating currents passing through the leads 12 and 13 and energizing the winding 11, the polarity of every part of the core changes twice. Since the spring armature 20 is always polarized by the pole 19 of the permanent magnet 15, it follows that during each cycle of the alternating current the spring armature 20 is shifted once to the right and once to the left. Such being the case, during each cycle the contact member 22 is once brought into and out of engagement with the contact member 23.

The net result is, that each time the contact is thus made, current flows in a predetermined direction through a circuit which may be traced as follows: Wire 27, convolutions 11^a, wire 26, spring armature 20, contact members 22 and 23, post 25, and wire 28 to the point where the direct current is to be used, and thence back to the wire 27.

When, however, the spring armature 20 swings to the left according to Figure 1, so that the contact member 22 is carried out of engagement with the contact member 23, the current flowing through the convolutions 11^a is not diverted, and thus for the moment there is no flow of current through the wires 27 and 28.

Thus there flows through the wires 27 and 28 a current of unitary direction, but which is intermittent.

In the form of our device appearing in Figure 2, a post 29, similar to the post 25, is added. The post 29 is provided with a screw 30, carrying a contact member 30^a. Mating this contact member is a contact member 22^a, carried by the spring armature 20. A wire 31 extends from one end of the winding 11. In this winding two sub-divisions 11^a and 11^b are tapped off, these two portions each being made up of a few convolutions of wire. A wire 32 extends from the post 25 to the winding 11, the point at which this wire is connected at the winding being the point at which the sub-division 11^b is tapped off. A wire 33 is so connected with the winding 11 as to tap off the sub-division 11^a and thus to mark the dividing line between the sub-divisions 11^a and 11^b, as may be understood from Figure 2. The slot 21 is in this instance located midway between the ends of the core.

Each time the winding 11 is energized by a complete cycle of current passing through the leads 12 and 13, the spring armature 20 moves once to the left and once to the right. Each time it moves to the left a current of unitary direction flows through a circuit which may be traced as follows: wire 33, sub-division 11^a of the winding 11, wire 31, post 29, contact member 30, 22^a, spring armature 20, wire 28 to the point where the current is to be utilized, and thence back to the wire 33.

It will be noted that in both of the circuits above traced the current flows in the same direction through the wires 33 and 28, the net result being a practically constant uni-directional current.

In the form of our device shown in Figure 3 we use an ordinarily closed core 34, carrying a winding 35, and connected with this winding are the leads 36 and 37, for energizing the winding by means of alternating current. The core 34 is provided with a slot 38, which in this instance is located midway between the ends of the core, as is the case with the slot 21 shown in Figure 2.

A wire 39 is connected with one end of the winding 36, and extends therefrom to the post 29. A wire 40 is connected with the winding 35 in such manner as to form a sub-division 41 of the winding, as shown at the left of Figure 3. Another wire 42 is connected with the post 25, and extends therefrom to the winding 36, being so connected therewith as to form a sub-division 43 of the winding. A wire 44 is connected with the spring armature 20. The wires 40 and 44 constitute the leads for utilizing the rectified current.

Except as above stated, the structure and action of the mechanism shown in Figure 3 is like that shown in Figure 2.

We find that by adjusting the screws 24 and 30, two rather remarkable results are obtained. First, the timing of the contact mechanism can be so controlled as to bring the contact mechanism into exact synchronism with the current phase. Second, it is an easy matter to effect such an adjustment and bring about such synchronism that at the precise instant when the contact mechanism breaks the circuit controlled by it, no current whatever is flowing through the circuit and consequently through the contact mechanism. It follows as a corollary that the device can be so adjusted as to prevent sparking by the contact mechanism.

The form of our device shown in Figure 4 is like that appearing in Figure 2, but with certain parts added and other parts arranged differently. Mounted upon a base 45 is a shell-type transformer 46, provided with a middle core 47 and branches 48 and 49. Mounted upon the middle core 47 is a primary winding 50 and a secondary winding 60. A pair of leads 61, 62 are connected with the ends of the primary winding 50. A wire 63 leads from one end of the secondary winding 60 to a post 64, and a wire 65 leads from the other end of the winding 60 to a post 66.

The post 64 carries a screw 67, provided with a contact member 68, and the post 66 carries a screw 69 provided with a contact member 70.

A post 71 supports a spring armature 72, this armature having a portion 73 which extends into a slot 74 with which the portion 49 of the transformer core is provided. The spring armature 72 carries a pair of spring arms 74, 75, these arms carrying contact members 76, 77.

A winding 78 encircles the spring armature 72, and renders the same magnetic. A wire 79 is connected with this winding, and another wire 80 is connected with the middle portion of the secondary winding 60. Thus the winding 60 is made up of two sub-divisions 81 and 82.

The wires 80 and 79 are the leads through which the rectified currents flow.

The operation of the mechanism shown in Figure 4 may be readily understood from the foregoing description.

The primary winding 50 is energized by alternating currents flowing through the leads 61 and 62.

The secondary winding 60 is energized by alternating current induced by the transformer 4.

Each time the spring armature moves to the left according to Figure 4, so that the contact member 76 engages the contact member 68, a circuit is completed as follows:

Wire 80, sub-division 81 of secondary winding 60, wire 63, post 64, contact members 68 and 76, spring arm 74 and a portion of spring armature 70, post 71, winding 78 and wire 79 to the point where the rectified current is to be used, and thence back to wire 80.

Each time the spring armature 72 swings to the right according to Figure 4, so that the contact member 77 engages the contact member 70, a circuit is completed as follows: wire 80, sub-division 82 of secondary winding 60, wire 65, post 66, contact members 70 and 77, spring arm 75 and a portion of spring armature 72, post 71, winding 78, wire 79 to point where the rectified current is to be used, thence back to wire 80.

Thus it will be noted that the winding 78 is energized first by current from the sub-division 81, and then by current from the sub-division 82, of the winding 60. In either case however the current flows in the same direction through the wires 79 and 80, and also through the wire winding 78. Therefore the polarity conferred upon the spring armature 72 by the winding 78 is always the same, no matter what may be the direction of current through the secondary winding or through the primary winding.

Except as above stated the structure and action of the device shown in Figure 4 is identical with that shown in Figure 2.

We find that the rectifying apparatus above described is very reliable in its action, and that when once adjusted it can remain so for long periods of time.

We also find that in practice when the adjustment is properly made there is no sparking whatever by the contact mechanism.

It will be noted that there is no material waste of energy inherent in the use of this apparatus. If the contact mechanism is virtually idle while the alternating current is flowing in one direction, as indicated in Figure 1, this does not mean that the current in the opposite direction is wasted. Such current simply remains in the line for general use and is actually or constructively available at some other point.

In our device the number of movable parts employed is reduced to minimum.

Since the magnetic field used for actuating the armature is very powerful as well as very uniform there can hardly be any chance for the armature to be moved otherwise than in the proper direction and to the proper extent.

We find in practice that there is little or no chance for the armature to stick to the core. In fact it seems to have acquired some property whereby it is prevented from sticking.

We do not limit ourselves to the precise mechanism shown, as variations may be made therein without departing from our invention, the scope of which is commensurate with our claims.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is as follows:

1. A device of the character described comprising a closed core made of magnetic material and provided with a slot, a winding mounted upon said core for energizing the same periodically, a spring armature extending into said slot and therein movable by magnetic action of said core, contact mechanism connected with said spring armature and controllable by movements thereof, connections from said winding to said contact mechanism, and means for energizing said winding and said contact mechanism.

2. A device of the character described comprising a closed core made of magnetic material and provided with a slot, across which passes a portion of the magnetic flux, a winding mounted upon said core for the purpose of energizing the core, a vibratory armature made of magnetic material and extending into said slot, said armature being free to move by magnetic action of said core, and free to vibrate crosswise of the slot, contact mechanism connected with said armature and movable by vibratory movements thereof due to said magnetic action of said core, means for energizing said winding, and connections to said contact mechanism for enabling said contact mechanism to open and close an electric circuit.

3. A device of the character described,

comprising a closed core made of magnetic material and provided with a slot across which passes magnetic flux, a winding mounted upon the core for the purpose of energizing the core, a spring armature made of magnetic material and extending into said slot, so as to be vibrated by the direct action of magnetic flux crossing said slot, contact mechanism connected with said spring armature and actuated by movements thereof, leads connected with said winding for the purpose of supplying alternating current to the winding and thus magnetizing said core, connections from said winding to said contact mechanism for the purpose of supplying alternating currents to the contact mechanism, said contact mechanism being synchronized to reversals in the alternating currents, so as to be opened when the current flows in one direction and to be closed when the current flows in the opposite direction, thus rectifying the alternating currents, and means for conducting from said contact mechanism the currents thus rectified.

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