No. 792,120. PATENTED JUNE 13, 1905.

F. CONRAD.

CONSTANT CURRENT REGULATOR.

APPLICATION FILED JAN. 20, 1904.

2 SHEETS—SHEET 1.

Fig. 1.

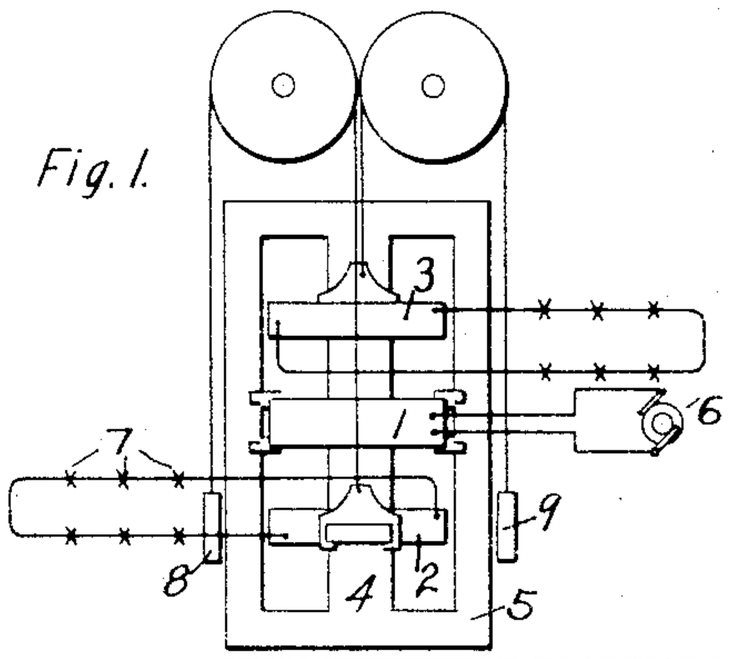


Fig. 2.

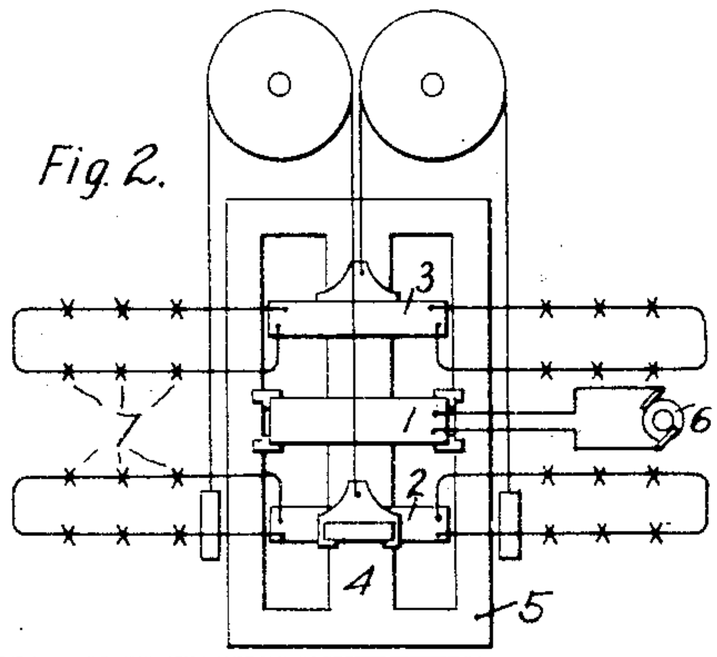
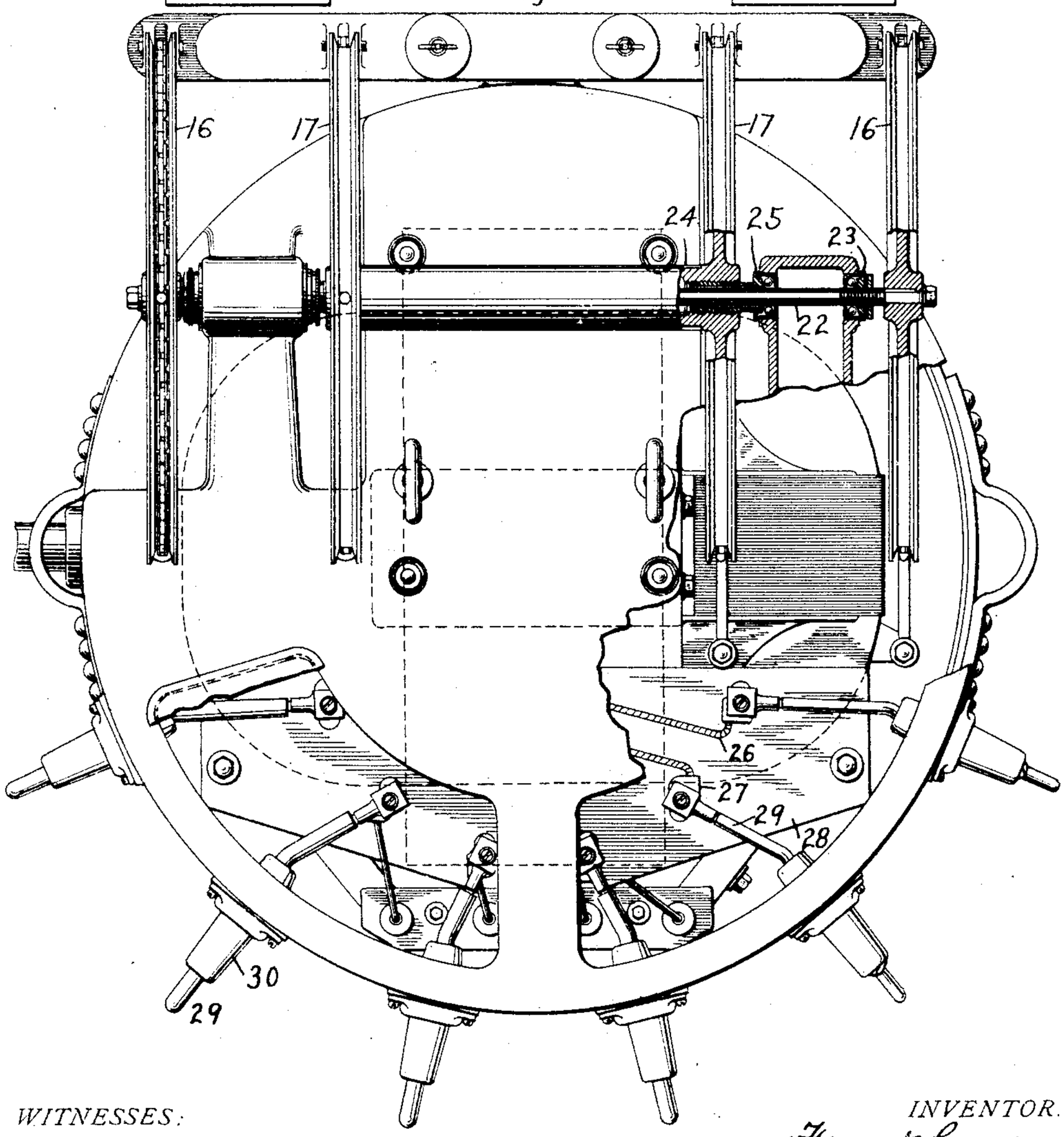


Fig. 3.



WITNESSES:

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Fred. H. Miller.

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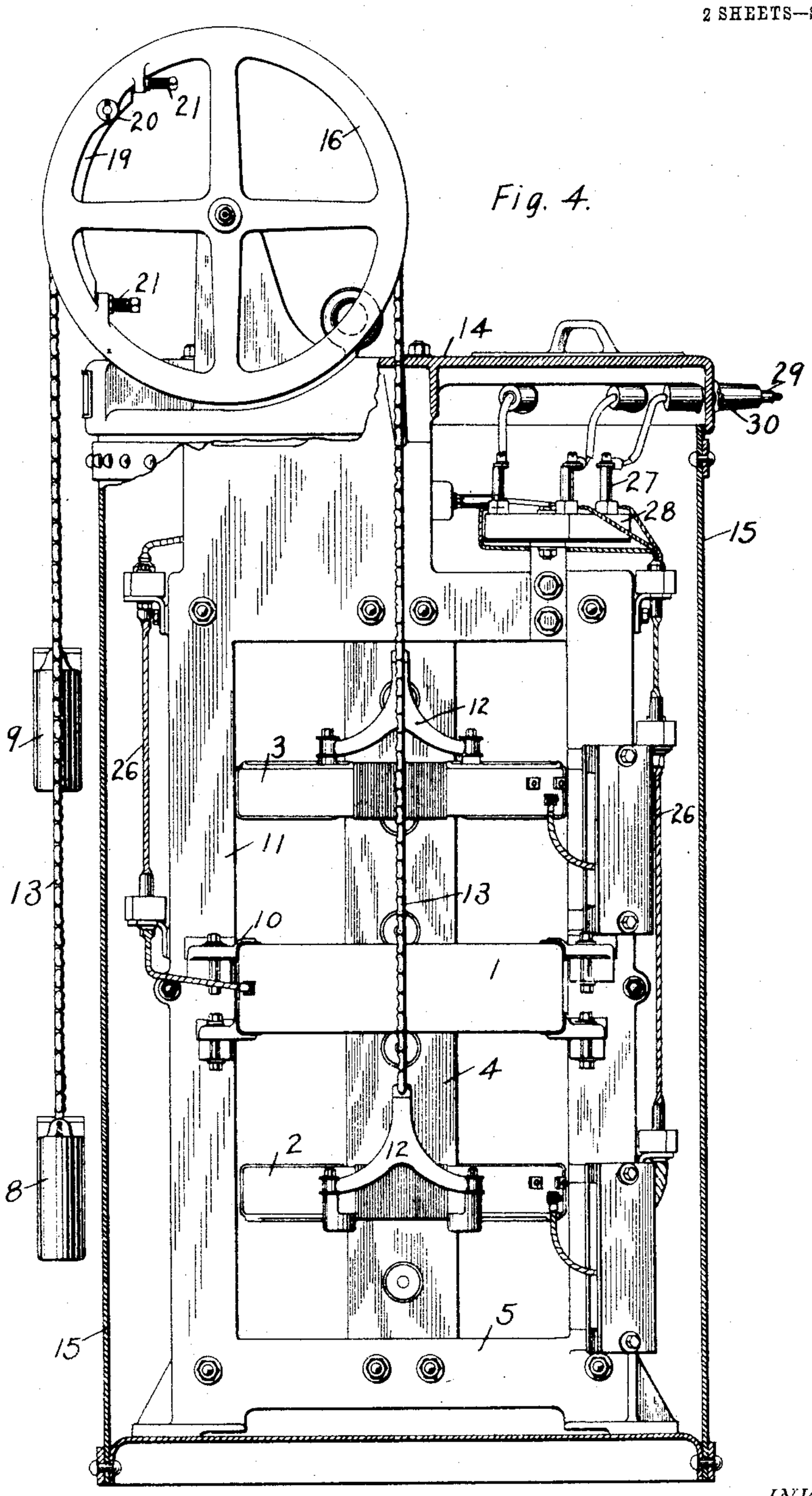
2 SHEETS—SHEET 2.

Fig. 4.



WITNESSES:

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No. 792,120. Patented June 13, 1905.

UNITED STATES PATENT OFFICE.

FRANK CONRAD, OF EDGEWOOD PARK, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

CONSTANT-CURRENT REGULATOR.

SPECIFICATION forming part of Letters Patent No. 792,120, dated June 13, 1905.

Application filed January 20, 1904. Serial No. 189,910.

To all whom it may concern:

Be it known that I, FRANK CONRAD, a citizen of the United States, and a resident of Edgewood Park, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Constant-Current Regulators, of which the following is a specification.

My invention relates to constant-current regulators for alternating-current circuits, and particularly to such as are used in connection with systems supplying energy to series arc-lamps; and it has for its object to provide an automatic regulator of large capacity and having at least two independent circuits, such that fluctuations in one circuit have substantially no effect upon the other and in which the dangers due to high voltages are reduced to a minimum.

A common form of regulator comprises a transformer having a pair of primary coils and a pair of secondary coils, the coils of one pair being movable on the core between the coils of the other and the weights of the movable coils being partially or wholly counterbalanced. The secondary coils have ordinarily been movable in opposite directions between the stationary primary coils. In order to minimize the element of danger, the voltages of systems of distribution are limited to such values that for ordinary connections of the transformer-coils the capacity of the regulator is unduly limited. If the two secondary coils are connected in series and translating devices are included in the circuits between the coils, however, the capacity of the regulator may be doubled without increasing the voltage on the distributing-line. The latter arrangement is dangerous and unsatisfactory, because if a distributing-conductor be broken at any place the full secondary potential of the regulator will exist between the terminals at the break and both circuits will be interrupted. This arrangement is more objectionable, however, by reason of the fact that one circuit is affected by fluctuations in the other, because both secondary coils surround approximately the same quantity of magnetic flux.

My invention provides a regulator of large capacity, such that in no case can the voltage of the distributing-line rise above that which exists between the terminals of a secondary coil and neither circuit of lamps is affected appreciably by fluctuations in the other. I place a single stationary primary coil on the iron core between two movable and properly-counterbalanced secondary coils the circuits of which are independent and severally capable of supplying circuits of lamps or other devices. The secondary coils may thus surround different amounts of flux, and either circuit may even be operated alone. The capacity of my regulator may also be doubled by dividing each of the secondary coils into two portions and by connecting the portions, as has been common in the old form of regulator, thus making four circuits, each containing translating devices. However, each pair of circuits is open to the same objections as the old form, the only advantage gained being in the increased capacity.

In the accompanying drawings, Figure 1 is a diagrammatic view of the circuits and connections of a regulator constructed in accordance with my invention. Fig. 2 is a similar diagrammatic view of a regulator having double the capacity of that shown in Fig. 1, but with the same voltage on the system. Fig. 3 is a plan view of a regulator comprising my invention, portions of some of its parts being broken away; and Fig. 4 is a view in side elevation of the regulator shown in Fig. 3.

A stationary primary coil 1 and two movable secondary coils 2 and 3, located, respectively, on opposite sides thereof, surround the middle portion 4 of an iron core 5, alternating-current energy being supplied to the primary winding 1 from any suitable source, such as a generator 6, and each of the secondary coils 2 and 3 supplying independent circuits containing arc-lamps 7 or other translating devices in series relation. The secondary coil 3 is only partially counterbalanced

by a weight 8, while the coil 2 is somewhat overbalanced by its corresponding weight 9, with the result that when the coil 1 is not energized the two coils 2 and 3 are by gravity caused to approach each other and the coil 1. However, when the primary coil 1 is energized the coils 2 and 3 are repelled therefrom in opposite directions such a distance that the currents in the circuits supplied thereby are maintained approximately constant. Since the coils 2 and 3 are separate and independently movable, fluctuations in one circuit will not affect the other circuit, and the maximum possible difference of potential between any two points of the secondary circuit is only that which exists between the terminals of a secondary transformer-winding.

In Fig. 2 each of the coils 2 and 3 is divided into two portions, lamps or other translating devices being included in each of the circuits connecting the two portions of each coil, substantially as shown. If the circuit is broken at any point, full secondary potential difference will exist between the terminals at the break, the greatest difference of potential between any two points under normal conditions, however, being only half that amount.

As shown in Figs. 3 and 4, the primary coil 1 is secured at the middle of the portion 4 of the iron core 5 by means of clamps 10, suitably attached to the framework 11, which supports the iron core 5. The ends of the coil 2 are provided with brackets 12, which are attached to the ends of chains 13, that pass through the top 14 of the case 15 and over pulleys 16, adjustable weights 8, that are heavier than the coil 2, being attached to the other ends thereof, so that when the regulator is not in operation the weights 8 serve to retain the coil 2 in its uppermost position. In a similar manner the coil 3 is partially counterbalanced by means of adjustable weights 9; but when the regulator is not in operation the coil 3, being heavier than the weights 9, assumes its lowermost position. Means are provided for adjusting the lengths of the lever-arms of the pulleys 16 and 17, comprising curved segments 19, pivoted at 20 and adapted to occupy recesses provided therefor in the troughs of the pulleys, the positions thereof being adjustable by means of set-screws 21. The pulleys 16 and 17 are mounted so that they are independently movable, the pulleys 16 being secured to opposite ends of a shaft 22, having suitable bearings 23, and the pulleys 17 being mounted on a sleeve 24, having suitable bearings 25 at its ends. The leads 26 from the several coils are brought to the top of the regulator and connected with suitable terminals 27, which are secured to an insulating-block 28, the leads 29, surrounded by bushings 30, being brought through the case 15 for connections to the proper circuits. The case 15 may be filled with a suitable insulating-oil, which serves to aid the ventilation and cooling of the regulator.

The structural details of the mechanism shown and described may be varied within considerable limits without departing from my invention.

I claim as my invention—

1. The combination with an iron core, a primary winding and movable secondary windings, one on each side thereof, of means for overbalancing the weight of one secondary winding and means for partially counterbalancing the weight of the other.

2. The combination with a stationary winding, of two movable windings in inductive relation thereto, one of which is overbalanced and the other of which is only partially counterbalanced.

3. The combination with a stationary winding, of two movable windings, one on each side thereof and in inductive relation thereto, one of which is overbalanced and the other of which is only partially counterbalanced.

4. The combination with a stationary primary winding, of a movable secondary winding located above said primary winding and in inductive relation thereto, a counterweight therefor which exerts a pull that is less than that of gravity, a movable secondary winding below the primary winding and a counterweight therefor which exerts a pull that is greater than that of gravity.

5. The combination with a primary winding, of subdivided secondary windings, one on each side thereof and in inductive relation thereto, and circuits containing translating devices connecting the subdivisions.

6. The combination with a primary winding, of subdivided secondary windings, one on each side thereof and in inductive relation thereto, and movable in opposite directions, and circuits for translating devices connecting the subdivisions.

7. A constant-current regulator for alternating-current circuits, comprising a transformer having a stationary primary coil and two movable secondary coils at opposite sides thereof, the secondary coils being connected to separate circuits.

8. In a constant-current regulator, the combination with a transformer comprising a core, a stationary primary winding and two movable secondary windings respectively located above and below said primary winding, of counterweights for the upper secondary winding that are lighter than said winding and counterweights for the lower secondary winding that are heavier than said winding.

9. In a constant-current regulator, the combination with a core and a stationary primary winding, of two movable secondary windings located respectively above and below the primary winding, counterweights and cords or chains for said secondary windings and pul-

leys for said cords or chains having means for adjusting the leverage exerted by said counterweights.

10. In a constant-current regulator, the combination with a transformer comprising a core, a stationary primary winding and two movable secondary windings located respectively above and below said primary winding, of cords or chains and counterweights for said movable coils, pulleys for said cords or chains having movable segments and means for adjusting said segments to vary the leverage exerted by said counterweights.

In testimony whereof I have hereunto subscribed my name this 11th day of January, 1904.

FRANK CONRAD.

Witnesses:
JOS. W. ALEXANDER,
BIRNEY HINES.