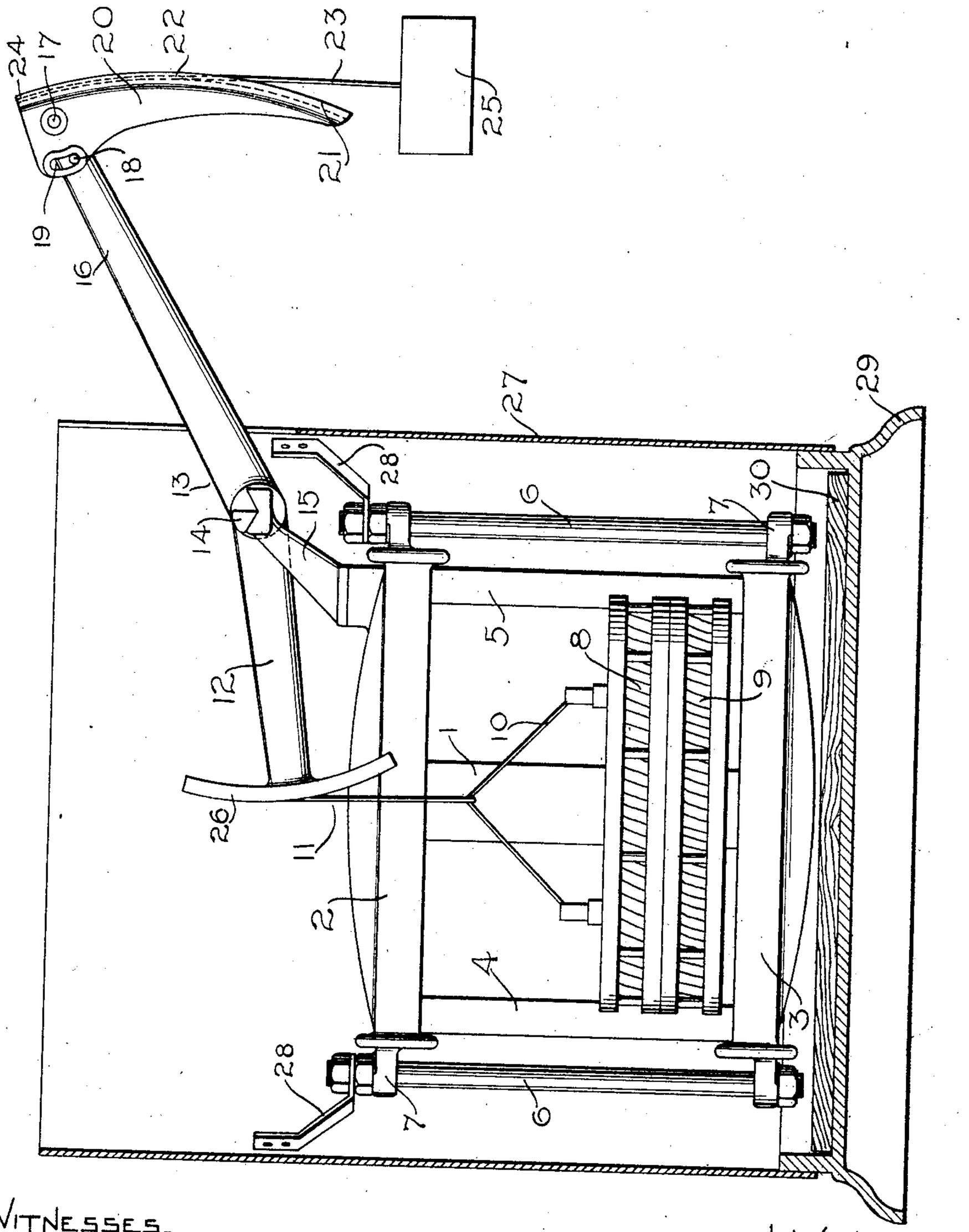
No. 710,050. Patented Sept. 30, 1902.

A. R. EVEREST.

CONSTANT CURRENT TRANSFORMER.

(Application filed Mar. 4, 1899.)

(No Model.)



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UNITED STATES PATENT OFFICE.

AUGUSTINE R. EVEREST, OF LYNN, MASSACHUSETTS, ASSIGNOR TO THE GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

CONSTANT-CURRENT TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 710,050, dated September 30, 1902.

Application filed March 4, 1899. Serial No. 707,721. (No model.)

To all whom it may concern:

Be it known that I, AUGUSTINE R. EVEREST, a subject of the Queen of Great Britain, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Constant-Current Transformers, (Case No. 1,021,) of which the following is a specification.

My invention relates to alternating-current transformers for changing currents of constant potential to currents of constant volume or the reverse, and has reference more especially to that type of transformer in which relatively movable coils are employed. In some of its broader aspects, however, my invention is not limited to use in connection with transformers, but may be applied to a variety of electromagnetic devices having relatively movable coils, motion between which is caused by the action upon each other of currents flowing in the coils.

My invention is chiefly valuable, however, in connection with transformers of the type above mentioned, and I use it in this relation for the purpose of obtaining better regulation. I have observed that in constant-current transformers such as already referred to the secondary current at small loads, when the coils of the transformer are separated from each other, is larger than at full load, when the coils of the transformer are close together. In these transformers, as is well understood, the force of repulsion between the currents in the primary and secondary coils is opposed by a suitably-applied force the value of which serves to determine the current at which the coils will separate or move apart from each other. With every decrease of load in the secondary circuit there is a tendency toward increase of current and a consequent increase in the force of repulsion between the primary and secondary coils. The coils therefore move away from each other and more leakage flux is created between the coils than when in the original position. The secondary electromotive force is thus decreased, thus tending to decrease the current to its proper value. As above noted, however, I have observed that the load curve of the transformer is not a straight line, but shows a larger current at small loads than at full load. In order to compensate for this defect, I provide a device—such, for example, as a variable counterweight—of such a nature as to decrease the force urging the coils together the more the coils are separated. The decreased force of repulsion between the coils when they are widely separated is thus opposed by a correspondingly-decreased force urging the coils together. Under these conditions a given increase in secondary current will produce an increased displacement of the coils and consequent decrease in electromotive force sufficient to cut down the current to its original value.

My invention will be more readily understood by reference to the following description and accompanying drawing, while its scope will be clearly and particularly pointed out in the appended claims.

The drawing illustrates my invention as applied to an alternating-current transformer.

The core of the transformer is here shown as of rectangular form, with a main core or bar 1 connected to end pieces secured within the castings 2 and 3. Bars 4 and 5 are arranged parallel to the bar 1, with their ends likewise secured in the end pieces in the castings 2 3. Clamping-bolts 6 engage lugs 7 on corresponding ends of the end pieces 2 3 and serve to clamp the parts of the transformer together. Primary and secondary coils are illustrated at 8 and 9, and both coils are arranged to embrace the bar 1 of the transformer-core. The coil 9 is preferably stationary and is arranged so as to rest on the lower cross-piece of the transformer-core. The coil 8 is movable relatively to the coil 9 and is suspended from one end 12 of an oscillating lever by means of the looped cord 10 and suspending-cord 11. So far as the principle of the invention is concerned it is immaterial which of the coils 8 and 9 is the primary and which the secondary.

The oscillating lever 13 is mounted on knife-edges 14, carried by a fork-shaped bracket 15, secured to the cross-bar or casting 2 of the transformer-frame or otherwise suitably supported. The other end 16 of the oscillating lever carries a device similar in form to a cam, the same being pivoted to the end of the lever at 17. A bolt 18, the head of which is

not shown, passes through the end 16 of the oscillating lever and through a slot 19 in the cam 20, the slot being curved along arcs struck from radii with the bolt 17 as a center. By moving the cam 20 so that the clamping-bolt 18 is secured in different positions in the slot 19 it will be observed that the end 21 of the cam may be moved toward or away from the fulcrum or axis of oscillation of the lever. The horizontal projections of different points in the winding or cam surface 22 of the cam 20 are thus shifted relatively to the axis of oscillation of the lever 13. A cord 23 is connected to the winding-surface 22 at a point indicated approximately at 24, and to the lower end of the cord a weight 25 of suitable value is secured.

The cord 11, which carries the coil 8, engages a winding-surface 26 of cylindrical shape with its axis coincident with the axis of oscillation of the lever 13, to which the winding-surface is fixed. Whatever, therefore, be the position assumed by the lever the lever-arm supporting the weight of the coil 8 remains the same. Such, however, is not the case with respect to the lever-arm formed by the weight 25, dragging downward upon the cord 23, passing over the winding-surface 22. Owing to the eccentricity of this winding-surface the lever-arm or moment about the axis of the lever is greater when the arm 16 is depressed than when it is raised in the position illustrated.

The weight 25 is so chosen as partially, but not wholly, to counterbalance the weight of the coil 8. Owing to the change in the lever-arms above mentioned it will be seen that when the coils are close together the unbalanced weight of the coil 8 is greater than when the coils are separated from each other.

In describing the operation of my invention it is unnecessary to set forth the mode of action of a constant-current transformer of the type illustrated, since the same is well understood in the art. Concerning the application of my improvement to this type of transformer, I may state that the decrease in repulsion of the two coils when they are separated from each other over that which takes place when they are close together is probably due to the fact that the reluctance of the magnetic circuit for the leakage-lines of force which return through each coil without threading through the other is greater when the coils are separated than when they are close together. This increase in magnetic reluctance is, however, small and varies with the particular type of transformer employed. It will of course be obvious from what has been said that the load curve of the transformer instead of being made a straight horizontal line may be given any other form by suitably changing the law of the counterbalance. Whether or not this be the reason for the variation in the force of repulsion between the coils, the fact remains that such variation exists and that a device constructed as described for opposing to the force of repulsion a force which varies with the load serves to bring the current in the secondary circuit to the same value, whatever be the relative positions of the coils, thus establishing the utility of my invention regardless of its theory of operation.

Although unessential features of my invention, I may mention that a transformer of the type shown in the drawing is preferably inclosed in an iron casing, which may be filled with oil or other material for insulating the parts of the transformer. With this arrangement the transformer is generally secured to the casing, such as illustrated at 27, by means of brackets 28. The casing 27 is preferably formed of sheet-iron and is riveted or otherwise secured to the cast base-plate 29. A block of wood 30 rests on the top of the cast base-plate 29, and, if desired, may carry the weight of the transformer itself.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination of relatively fixed and movable coils, one of which is attached by suitable means to one end of an oscillating lever, a device adjustably secured to the opposite end of the lever, and having a curved winding-surface, the centers of curvature of parts of which are non-coincident with the axis of oscillation of the lever.

2. In an alternating-current transformer the combination of primary and secondary coils, means for allowing the force of repulsion between the currents in the coils to cause a relative motion in a straight line between the coils, and means for opposing the force of repulsion by a force which decreases as the load decreases.

3. In an alternating-current transformer the combination of primary and secondary coils, means for allowing the force of repulsion between the current in the coils to cause a relative motion in a straight line between the coils, and means for opposing the force of repulsion by a force which is less at some given load than at a higher load.

4. In an alternating-current transformer the combination of primary and secondary coils movable in a straight line relatively to each other, and means for opposing to the force of repulsion between the currents in the coils, a force which varies in such a manner as to make the current in the secondary coil at full load equal in value to the current in the secondary coil when the load is small.

5. The combination of relatively fixed and movable coils, in mutual inductive relation to each other, an oscillating lever to one end of which one of the coils is suitably attached, and a device with a curved winding-surface pivoted to the other end of the lever.

6. The combination of a core, a relatively movable coil coöperatively related thereto, a pivoted member, means for supporting said coil from said member, a device having an

eccentric winding-surface carried by said member, a weight, and a flexible connection attached to said weight and passing over said winding-surface.

7. The combination of a core, a relatively movable coil coöperatively related thereto, a pivoted member, means for supporting said coil from said member, an adjustable winding-surface carried by said member, and a counterbalancing-weight suspended by a flexible connection passing over said surface.

8. The combination of a lever, a coil suspended from one end of the lever, an eccentric winding-surface carried by the other end of the lever, and a counterbalancing-weight having a flexible connection passing over said winding-surface.

9. The combination of a lever, a coil suspended from one end of the lever, means for applying a force of constant value to the other end of the lever, and means for automatically varying the point of application of said force to said lever.

In witness whereof I have hereunto set my hand this 28th day of February, 1899.

AUGUSTINE R. EVEREST.

Witnesses:
ALEX F. MACDONALD,
DUGALD MCKILLOP.