(No Model.) 2 Sheets—Sheet 1.

J. F. McELROY.

STEAM TURBINE DYNAMO.

No. 525,390. Patented Sept. 4, 1894.

Fig. 1

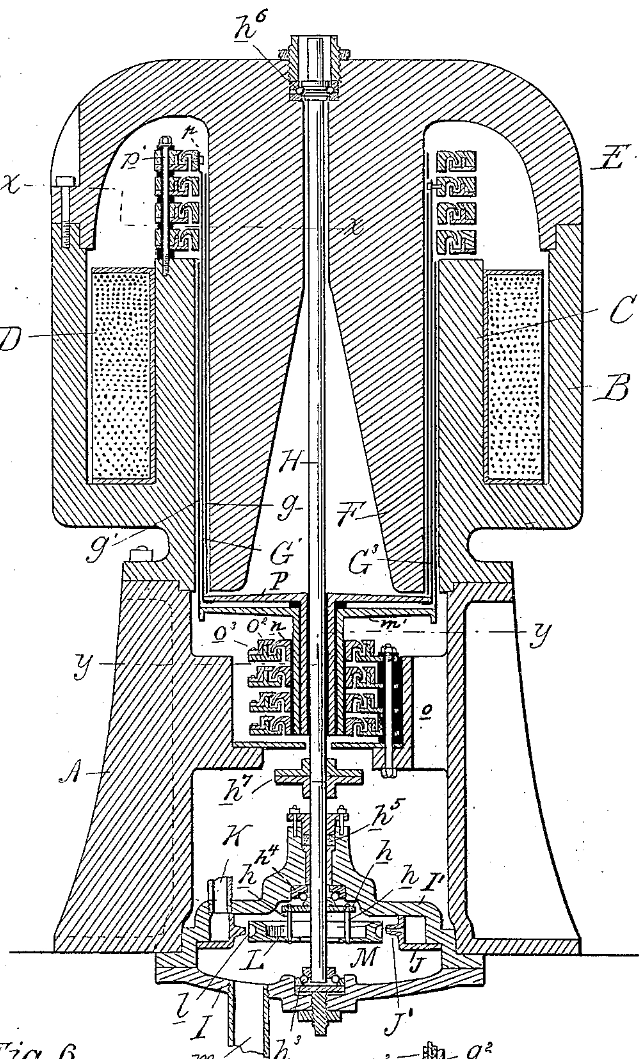
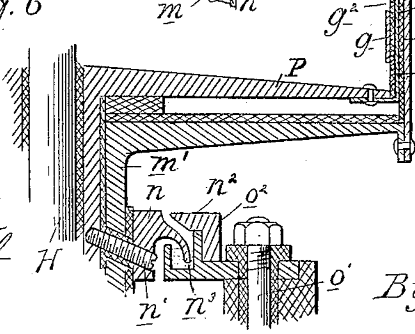


Fig. 6



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(No Model.) 2 Sheets—Sheet 2.

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No. 525,390. Patented Sept. 4, 1894.

Fig. 2

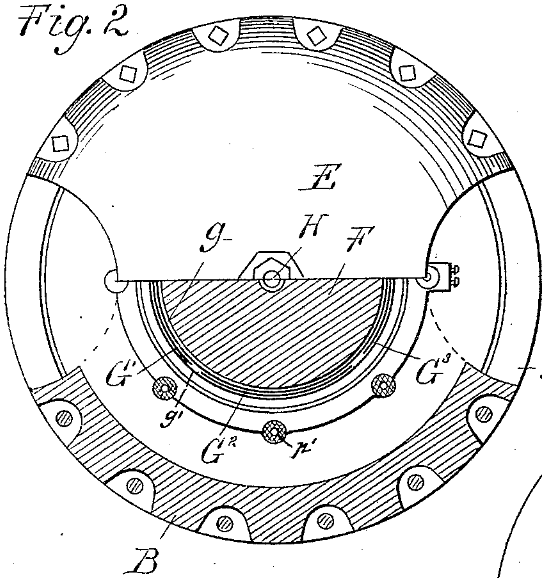


Fig. 3

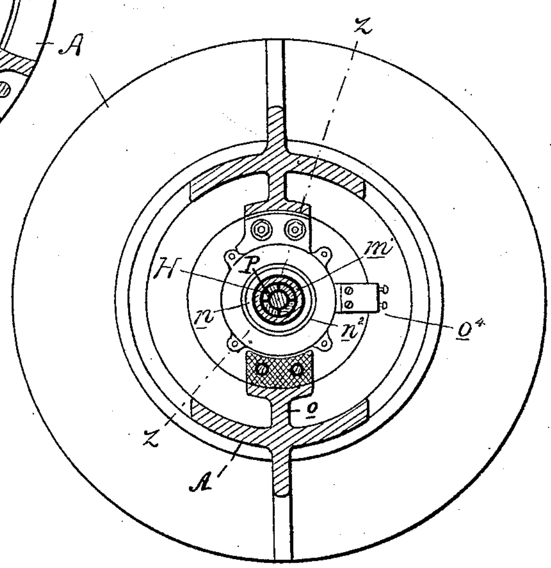


Fig. 4

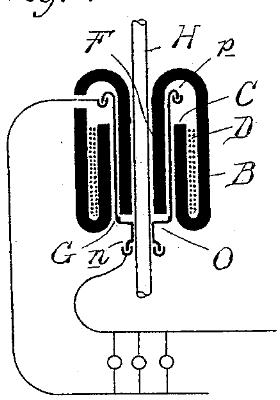
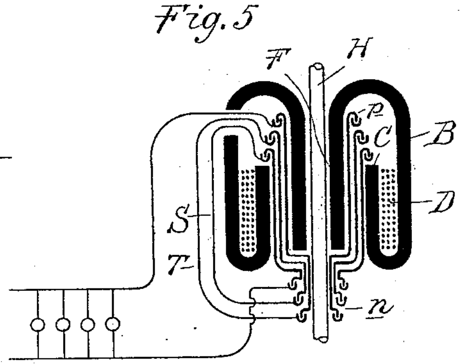


Fig. 5



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UNITED STATES PATENT OFFICE.

JAMES F. McELROY, OF ALBANY, NEW YORK, ASSIGNOR TO THE CONSOLIDATED CAR HEATING COMPANY, OF WHEELING, WEST VIRGINIA.

STEAM-TURBINE DYNAMO.

SPECIFICATION forming part of Letters Patent No. 525,390, dated September 4, 1894.

Application filed December 19, 1893. Serial No. 494,132. (No model.)

To all whom it may concern:

Be it known that I, JAMES F. McELROY, a citizen of the United States, residing at Albany, in the county of Albany and State of New York, have invented certain new and useful Improvements in Steam-Turbine Dynamos, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates more specifically to that type of dynamo, commonly known as unipolar, and the direct object of my invention is to make this type of dynamo available for producing useful currents. I have found that it can be done under conditions of very high speed, much higher than has been applied to dynamos heretofore, and this requires a special construction and combination of dynamo and motor whereby the same are adapted to co-operate to produce the desired object, and to this end my invention consists in a steam turbine dynamo of a construction and arrangement as more fully hereinafter described and shown in the accompanying drawings, in which—

Figure 1 is a sectional elevation of my improved dynamo. Fig. 2 is a half top plan and half horizontal section on line x x in Fig. 1. Fig. 3 is another horizontal section on line y—y in Fig. 1, showing also by dotted line z—z, the plane of section represented in Fig. 1, and Figs. 4 and 5 are diagram sections showing modified forms of construction of the dynamo, specifically referred to hereinafter. Fig. 6. shows a small portion of Fig. 1. on a larger scale.

A is a hollow base forming a pedestal upon which is mounted a heavy cast iron casing B, formed with a hollow cylindrical pole-piece C, and D is a field coil contained in an annular space formed between the casing and pole-piece. Upon the casing is secured a cast iron cap E from which depends centrally the cylindrical pole-piece F which projects within the tubular pole-piece C. The whole constitutes an iron clad electro-magnet having two poles C, F, concentrically placed one within another and forming an annular space between them which is crossed by all lines of force passing through the magnetic circuit formed by the pole-pieces and the casing and cap. In this annular space is placed the revolving armature which in its simplest form shown in Fig. 4 may consist merely of a single metallic tube G secured at one end upon the armature shaft H, or it may consist of several such tubes concentrically secured one within the other and insulated from each other as shown in Fig. 5, or it may be formed of a number of segments or staves G' G^2 G^3 G^4 as shown in Figs. 1, 2 and 3; the staves being held in position between an inner tube g and an outer tube g' with insulating material g^2 placed between the staves and the tubes to insulate the staves from each other, as shown in detail in Fig. 6. It is clear that if such an armature is revolved in the annular space, it will cut the magnetic lines of force, the result being that a difference of potential will be generated between the ends of the tube or tubes.

A steam turbine is housed in the lower part of the base. It has a circular casing, preferably made in two parts I I′, one part fitting into the bottom of the base, and the other forming the under side of the casing. Both parts are firmly bolted to the base and in this way the turbine is supported upon the same foundation on which the dynamo rests and may be accessibly located in a circular well which may be formed in the foundation. Inside of this casing is an inwardly projecting horizontal ledge J which forms the steam ring from which the steam entering the casing through the opening K, is discharged through a number of jet-orifices J′ in the ring against the periphery of the rotating steam wheel L, mounted upon the armature shaft. This rotating steam wheel is provided upon its periphery with a number of cavities l, corresponding with the steam jets into which the steam from the steam ring is discharged by the jets and from which it escapes on both sides of the steam ring into the space M which surrounds the steam wheel and communicates freely into the exhaust pipe m from the casing. The steam wheel which is thus driven at an extraordinary high speed is flexibly secured to the armature shaft H by means of the spring steel wrist pins h which flexibly connect it with a disk h' secured upon the shaft.

The shaft H is perpendicularly supported upon ball bearings h^3 in the lower side of the casing I, and has guide bearings h^4 in the upper side thereof, it extends out through a suitable stuffing box h^5 in the top of the casing and upwardly through a central opening in the pole-piece F into the cap where its end is supported in the ball bearings h^6; for the convenience of mounting and dismounting, however, I prefer to make the shaft H in two parts, as shown in Fig. 1 wherein h^7 shows a coupling joint.

The shaft H is to be flexible, so that the armature, under the centrifugal force can rotate in its exact center of gravity; this is obtained entirely as a result of the construction inasmuch as it gives the shaft considerable length between the bearings with the armature connected to it only at one point and some distance from the bearings, so that if the shaft is made of steel reasonably light it will readily spring without injuring the shaft or bearings and thereby rotate the armature without the least jar at the extraordinary rate of speed conveyed to it.

With a single conductor as shown in Fig. 4, the lower end of the armature may be secured upon the shaft by a suitable spider O secured in the lower end of the tube and secured by its hub upon the shaft and insulated therefrom; the current may be taken off in the usual manner by means of collecting rings or brushes on the opposite ends of the tube, or I would use mercury cups so that the tube would run entirely free.

Where I use several tubes, I would connect them in series to increase the potential. This I do preferably by means of separate collectors for each tube as shown in Fig. 5, wherein the upper end of the outer tube is shown connected to the lower end of the middle tube by means of an outside conductor S connecting the fixed contacts of the collectors on the respective tubes and in a like manner the upper end of the middle tube is connected to the lower end of the inner tube by means of an outside conductor T. In this way I avoid the use of return conductors in the armature, which would generate counter electro-motive force.

In the construction shown in Figs. 1, 2 and 3, I have also shown suitable collectors for connecting the copper conductors in series in a like manner as shown in Fig. 5, using mercury contacts for the purpose. To this end the lower ends of the copper segments G' G^2 G^3 G^4 are connected to a spider P which is divided into a corresponding number of sections insulated from each other and from the shaft to which they are firmly clamped by the hub of a spider m' which is secured to the lower end of the outer tube with insulating material interposed between the two spiders and their hubs. Commutator rings n suitably insulated are then secured upon the hub of the outer spider and connected by suitable means such as set screws n' with the respective segments.

The commutator rings have downwardly turned flanges n^2 which dip into annular mercury cups n^3 which form the fixed contacts. These mercury cups are secured in horizontal planes one above the other, to the inwardly projecting brackets o formed on the inside of the pedestal by means of the bolts o' which are suitably insulated from the cups. The cups are also preferably provided with suitable ring covers o^2 secured by screws o^3 upon the cups, suitable ears being formed on the cups and covers for the screws. The cup to which one terminal of the outer circuit is secured is provided with a suitable binding post o^4. The running contacts for the upper ends of the segmental conductors are constructed in a like manner, the segments being extended a suitable distance above the tube and connected directly to their commutator rings as shown at p. The murcury cups forming the fixed contacts may be secured by bolts p' to the top of the pole piece of the electro-magnet.

It is obvious that other forms of running contacts may be used, such as the usual copper rings and brushes used on alternating dynamos, but the mercury contacts prevent any heating and leave the armature absolutely free to rotate.

The inner and outer tubes which I have employed to hold the segmental copper conductors in place may be made of thin polished iron whereby they are amply strong to resist the centrifugal force; if desired they may also be used as conductors and connected in series with the copper conductor as described in Fig. 5.

As regarding the operation of my machine I am well aware that if the armature would be driven at the ordinary speed with which dynamos are usually driven, the difference of potential created between the two ends of the conductor would be so low that it would not furnish a useful current, but suppose it to be one volt only, it is then obvious that by being driven at a speed of twenty thousand revolutions which is entirely practical and possible with my construction, a difference of potential as high as fifty volts could then be maintained. I obtain such a result, in my machine by reducing the magnetic resistance to a minimum. The space between the two pole pieces is comparatively small and the lines of force have to cross that space but once, while on the other hand the number of magnetic lines crossing the space is very large. It is not necessary in my machine that the armature should not touch the pole pieces, but I prefer to run it freely within the annular space.

As regards the application of such very high speed as I must use, the armature should be so to speak a "spinning top." In my machine the steam wheel together with the armature and shaft form the "spinning top." It is true the shaft runs in bearings, but this does not deprive the armature to rotate freely in its center of gravity. The steam wheel not only creates and maintains the speed, but it steadies the motion by its comparative weight and location at the lower end of the shaft. It is as free as the armature to rotate in its center of gravity, and can have no disturbing influence upon the armature.

The stationary part of my steam turbine is virtually a part of the frame of the dynamo, and has no separate support or connection outside of it and the steam wheel is absolutely balanced under the steam acting upon it.

The practical economy of a steam turbine is in the direction of high speed about one half the velocity of the impelling steam, and as its power is relatively small, my invention applies more directly to such dynamos which require very high speed with comparatively little power. These conditions are most pronounced in that class of dynamos, the armature of which has only an electric conductor but no magnets. The dynamo which I have shown and described belongs that class, and its specific construction is especially devised to offer the very best conditions, but I do not want to be understood as being confined to such application alone.

The term "steam turbine" as used by me should be understood in the broader sense as meaning the type of motor irrespective whether the impelling fluid is steam or any other fluid. It is well known that we can increase the power of a steam turbine considerably if we use a denser medium than steam, for instance, compressed air or steam mixed with a denser fluid or vapor. In the same manner we can vary the speed by increasing or decreasing the velocity of the impelling medium. Thus I consider my invention applicable to other classes of dynamos as well as for the purpose of imparting a high degree of speed to the armature.

What I claim as my invention is—

1. In a steam turbine dynamo, the combination with a frame, of a shaft composed of a flexible portion carrying the armature, and a rigid portion carrying the steam wheel, and bearings supporting said flexible and rigid portions in fixed relation with each other substantially as described.

2. In a steam turbine dynamo, the combination of a supporting frame uniting the dynamo and steam turbine in fixed vertical relation to each other, and to a common vertical axis, substantially as described, a shaft common to both the dynamo and steam turbine, bearings vertically supporting said shaft in the common axis of the dynamo and turbine an armature and a steam wheel both flexibly carried by said shaft in relation to its bearings, whereby each is adapted to adjust itself to its own axis of rotation, substantially as described.

3. In a steam turbine dynamo, the combination of an electro-magnet forming the field of force of a dynamo, a frame supporting the same on its vertical axis, a steam turbine provided with a casing supported on said frame below the magnet and provided with an annular steam ring, a shaft vertically supported in bearings in the top and bottom of the casing in axial line with the magnet, a steam wheel flexibly carried by the shaft, an armature shaft united with the shaft of the steam wheel, a bearing for the upper end of said armature shaft and an armature flexibly carried by said armature shaft, substantially as described.

4. In a steam turbine dynamo, the combination of a hollow base, an electro magnet mounted thereon vertically on its axis and forming a field of force concentric with said axis, an armature, an armature shaft flexibly carrying said armature in its vertical axis of rotation, a bearing for the upper end of said shaft and a steam turbine mounted in the hollow base and having the shaft of its rotating steam wheel united with the armature shaft, substantially as described.

5. In a steam turbine dynamo, the combination of a hollow base, an electro-magnet mounted thereon vertically on its axis and forming a field of force concentric with said axis, an armature, an armature shaft flexibly carrying said armature in its vertical axis of rotation, a bearing for the upper end of said shaft, and a steam turbine comprising a casing mounted in the hollow base, a shaft vertically supported in bearings in the casing and united with the armature shaft and a steam wheel flexibly connected to said shaft, substantially as described.

6. In a steam turbine dynamo, the combination of a hollow base, an electro-magnet mounted thereon vertically on its axis and provided with two pole pieces, concentrically one within the other and forming an annular field of force, a tubular armature a flexible armature shaft to which the lower end of said armature is connected, a bearing for the upper end of the armature shaft and a steam turbine adapted to rotate the armature and comprising a casing supported in the base, a vertical shaft supported in bearings in said case and united with the armature shaft and a steam wheel flexibly mounted upon said shaft and adapted to rotate the armature, substantially as described.

7. In a steam turbine dynamo, the combination of the hollow annular base, the iron clad electro-magnet vertically supported thereon and provided with a hollow cylindrical case, the cap provided with a centrally depending hollow pole piece forming with the case an annular cylindrical field of force within the magnet, the tubular armature

forming a suitable electric conductor, the armature shaft extending upwardly into the depending pole piece and flexibly carrying the armature in its axis of rotation, the ball bearing supporting the upper end of the armature shaft, the steam turbine casing secured in the hollow base, the shaft of the steam wheel supported in ball bearings in the casing and united with the armature shaft, and the steam wheel and its flexible connection with the shaft, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JAMES F. McELROY.

Witnesses:
RALPH W. KIRKHAM,
MARY AGNES BURKE.