# W. WICKERSHAM.

## Electro-Magnetic Engine.

No. 69,880. Patented Oct. 15, 1867.

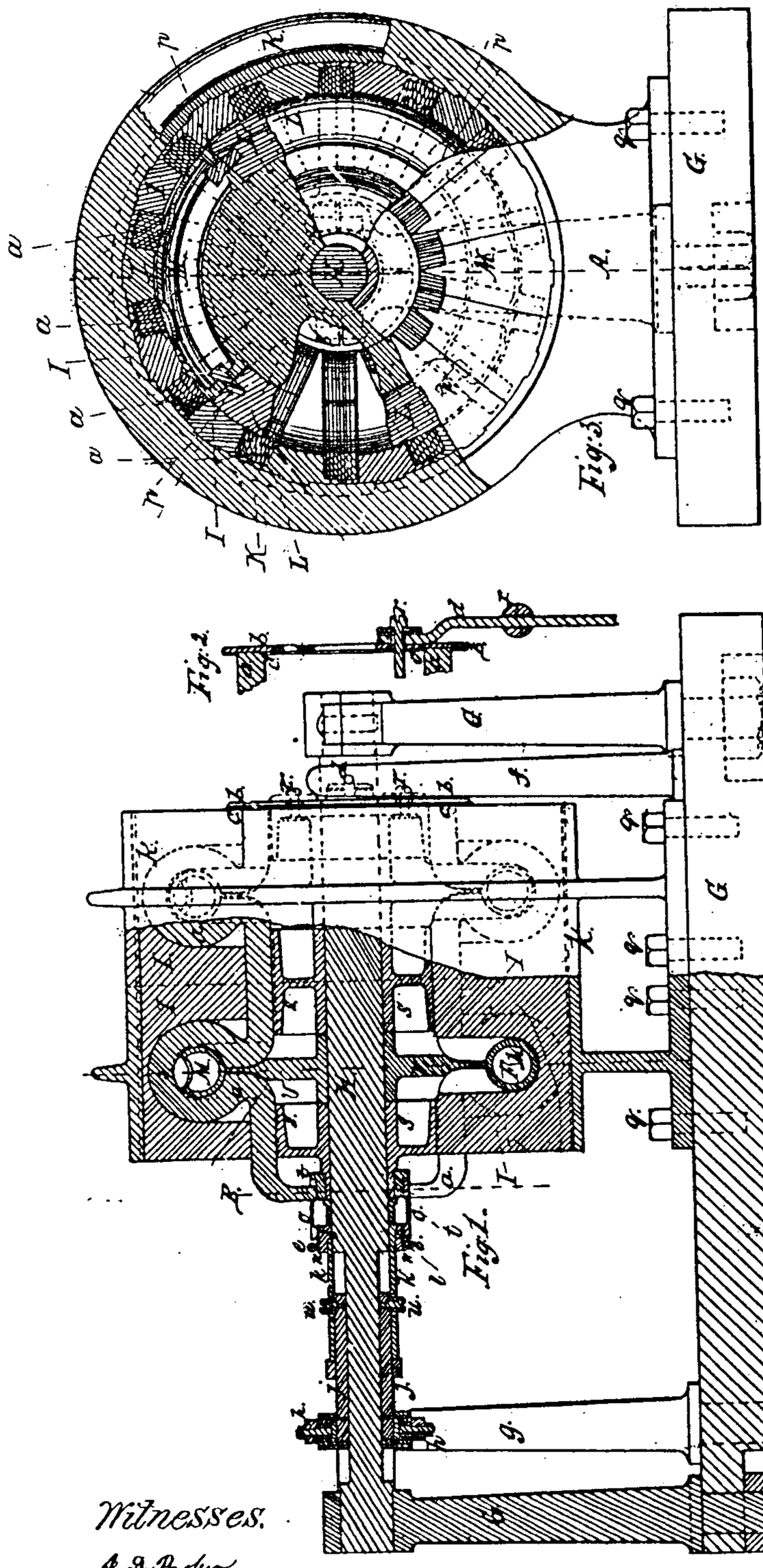

Fig. 1.

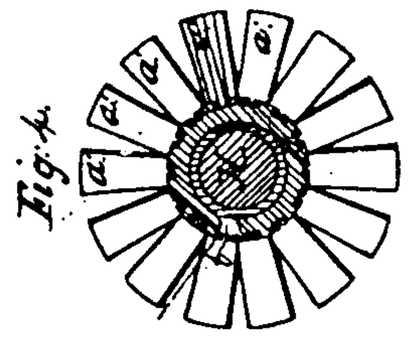

Fig. 4.

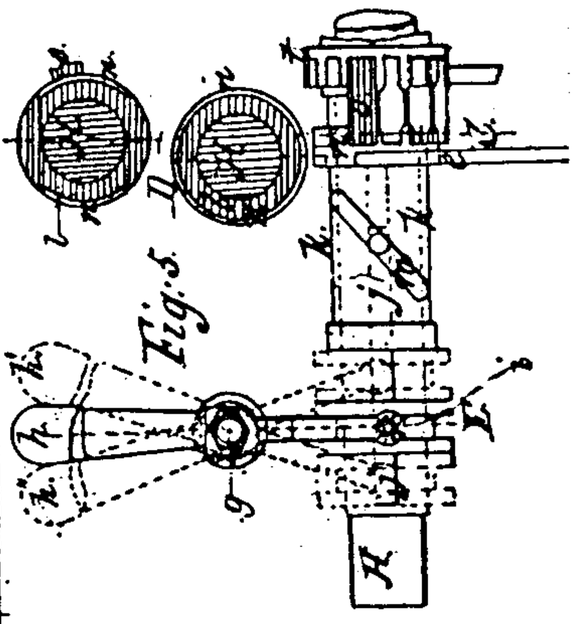

Fig. 5.

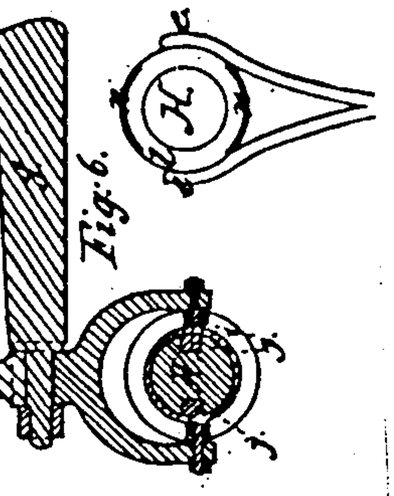

Fig. 6.

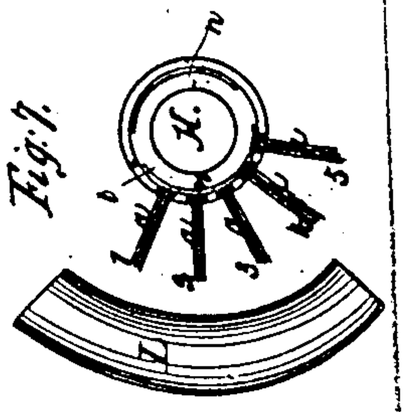

Fig. 7.

Witnesses.

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## IMPROVEMENT IN ELECTRO-MAGNETIC ENGINES.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, WILLIAM WICKERSHAM, of Boston, in the county of Suffolk, and State of Massachusetts, have invented a new and useful Electro-Magnetic Engine; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The first feature of my invention relates to the form of the helices, or a substitute for the helices of other electro-magnetic engines, and consists of bars of copper, or other suitable metal, so formed that they may be attached to or in contact with a metallic plate at one end of the engine, and pass nearly round one or more electro-magnets in their extension towards the other end of said engine, and so constructed, with relation to the said electro-magnet, that when an electric current is caused to pass from one end to the other of said metallic bar, it will impart to or induce in the said electro-magnet a magnetic polarity.

The second feature of my invention relates to the manner of conducting the electricity through the engine, and consists of a metallic plate at one end of said engine, in electric connection with all the said metallic bars, which pass nearly round the electro-magnets, said plate being also in electric connection with one pole of the battery, and so constructed and arranged as to be a common receptacle of the electricity, which is divided into separate currents through said bars of metal, which said currents are cut off or connected with the other pole of the battery, as may be desired at the opposite ends of said bars from said plate.

The third feature of my invention relates to the form and arrangement of the electro-magnets, and consists in making the soft iron electro-magnets of such form that they can become part of the rim of a fly-wheel, and attaching them to the outer edge of a circular disk, through which a shaft passes, all so constructed and arranged that the wrought-iron electro-magnets and similarly-formed parts filling the spaces between them, made of some material not magnetic, shall form the rim of the fly-wheel, and the rim and the said disk shall form the fly-wheel, and this so fitted on to the shaft that, when said fly-wheel is made to revolve, said shaft will rotate also.

The fourth feature of my invention relates to the opening and closing of the electric currents which pass through said bars, and which give polarity to the electro-magnets, and consists in having a cut-off or cut-offs revolve with the shaft, thereby causing the open circuits to continue the same positionary relation to the electro-magnets while they revolve, and the same adjustment is continued.

The fifth feature of my invention relates to the device, or its equivalent, by which the relation of the said open circuit or circuits of electricity to the electro-magnets may be changed while the engine is running; that is, they may be opened to and beyond one end of the electro-magnets, so as to give said magnets the greatest power in that direction, or the said circuits may be opened at equal distance each way from the middle of said magnets, giving said magnets no tendency to revolve one way or the other, or they may be open at the opposite end of said magnets to that first described, giving them the greatest power to revolve in the opposite direction, and these changes made at pleasure, while said engine is running, and consists in having the instrument which opens and closes said circuits on a ring around the shaft, and attached to a tube also around the shaft, and in having in this tube spiral or screw-grooves, and in having slides in grooves in said shaft parallel to its axis, containing pins, which work in said grooves in the tube, and arranged in such a manner that when said slides are moved lengthwise of the shaft said pins will cause said tube to turn round relative to the shaft either way, as may be desired, and carry with it the cut-off instrument, thereby changing the open circuits back or forward relatively to the shaft and the electro-magnets.

The sixth feature of my invention relates to the increase of power by extension, and consists in so arranging and constructing my engine that two or any desirable number of fly-wheels, containing electro-magnets, may be placed on the same shaft, and be operated by the same electric currents, and in this manner increasing the power by increasing the number of fly-wheels.

The seventh feature of my invention relates to the manner of securing the conducting-bars, which conduct electric currents around the electro-magnets, and consists in having these said bars arranged around the shaft in groups, each group being held in its position independently of the others.

The eighth feature of my invention consists in having all the spaces between the said groups of electric

conductors in the engine filled up with blocks of suitable shape, and these supported and kept in their places by a metallic ring or rings.

The ninth feature of my invention relates to the form of the conducting-bars, and consists in giving them a thin and ribbon-like form, and in their arrangement in the engine, with one edge near the electro-magnets and the other edge from said magnets.

*Description.*

Figure 1 shows a side elevation, with one end of the engine in section in the line A, fig. 3, with a view of shaft, fly-wheel, and conducting-bars, which nearly surround the rim of the fly-wheel, with the instrument for opening and closing the circuits, also the apparatus for changing the position of this instrument on the shaft.

Figure 2 shows a horizontal section of the metallic plate, at one end of the engine, which receives the electricity from one pole of the battery, and distributes it through different conducting-bars.

Figure 3 is an end elevation, showing the parts of the fly-wheel between the electro-magnets in section; also showing part of the electro-magnets, conducting-bars, and framework in section, in the line F, fig. 1.

Figure 4 shows a cross-section in the line B, fig. 1, of the shaft, a portion of the frame around the shaft, the ivory ring around this supporting the ends of the conducting-bars; also, it shows one group containing five of the conducting-bars, and the forms which represent all the groups.

Figure 5 shows two sections, in the lines C and D, fig. 5, of the instrument for cutting off and opening the circuits; also shows five of the conducting-keys attached to the ends of the conducting-bars, together with the apparatus for changing the cut-off instrument relative to the shaft.

Figure 6 shows a section of the forked lever, in the line E, fig. 5, and its connection with the apparatus for changing the cut-off; also, it shows the connection of the wire from one pole of the battery, with the cut-off arrangement.

Figure 7 shows the relation of the position of the electro-magnets to that of the conducting-bars through which the circuit is open.

G is a frame on which the engine is hung. H is the shaft. I I I, &c., are pieces placed between the groups of conducting-bars to keep them in their proper places. K K, &c., are rings surrounding and supporting the blocks I I, &c. L L are the electro-magnets. M M are the parts of the fly-wheel between the electro-magnets. *a a a*, &c., are the conducting-bars. *b* is the metallic plate or receptacle, to which the conducting-bars are connected at one end. *c* is an India-rubber insulator. *d* is a wire connecting the receptacle *b* with the positive pole of the battery. *e* is the wire connecting the cut-off arrangement with the negative pole of the battery. *f f* are two posts supporting the wires *d*, &c. *g* is a post supporting the lever *h*. *i* is a groove in a ring around the shaft, and attached to the slides *j j*. *k* is a hollow cylinder around the shaft, and attached to the cut-off ring *l*, and which has the diagonal or screw-grooves *m m* in its sides. *n* is a silver ring, having one half of its length extend entirely round the ivory ring *b*, where it connects with the negative pole through the wire *e*, as shown in the section on the red line D, and the other half of its length extends only part of the way round said ivory ring on two sides, or on the number of sides that there are electro-magnets in the fly-wheel, as shown in section in the red line C. *o o o*, &c., are the conducting-keys, which are attached to the ends of the conducting-bars, having one end of each rest on the part of the ring *n* which is intermittent, or which extends only part of the way round the ivory ring *l*. These conducting-keys are made a little thinner in the middle, and so formed that they will have a little spring force towards the ring to insure their contact. *p p*, &c., are the screws which hold the fly-wheel together. *q q*, &c., are the bolts which hold the rings *k* to the frame. *r r* are the screws holding the plate *b* and the wire *d* in their places. *s s* are rings around the shaft supporting the blocks I I and the conducting-bars on their edges next to the shaft; they also answer as boxes for the shaft to turn in. *t* is an ivory ring holding in position and at the same time insulating the ends of the connecting-keys *o o*, which are attached to the ends of the conducting-bars *a a*. I may remark here that all parts through which the electric current passes are insulated. The wire *d* is wrapped with fine thread, except where it comes on to the plate *b*. The screw *r*, which holds the wire *d* on to the plate *b*, has an insulated washer under its head. The plate *b* has a thin India-rubber sheet, *c*, between it and the end of the engine. Each leaf of the conducting-bars *a* is coated with shellac or India rubber, or wrapped with thread. Also, the conducting-keys are insulated by being fixed in the ivory ring *t*, and by being coated with shellac, varnish, or some insulating substance, to prevent their contact with each other.

Having described the different parts of my electro-magnetic engine, I will proceed to explain its operation.

The conducting-wire *d* is connected with the positive pole of the battery, and also with the disk *b*, which disk is in electric connection with all the conducting-bars *a a a*, &c. Now, as the conducting-wire *e* is in connection with the negative pole of the battery, and also in contact with the silver ring *n*, it follows that the circuit will be open through all the conducting-bars which are in connection with the silver ring *n*, as this makes a continuous metallic connection between the positive and negative poles of the battery. But, as the silver band *n* does not extend all the way round the ivory ring at the end where the conducting-keys *o* rest on it, (part of them resting on the ivory surface, which is a non-conductor,) it follows that the circuit is open only through a part of the conducting-bars; and if these bars through which the circuit is open pass around the electro-magnets, they will be charged with magnetism, and continue so to be while the currents continue; but if these bars *a a a*, &c., are so situated, with relation to the position of the electro-magnets, that there are as many on one side of their middles as on the opposite sides, as shown by the conducting-bars 1, 2, and 3, relative to the electro-magnet L, fig. 7, then the electro-magnet, though charged with magnetism, would have no tendency to revolve one way or the other, but if moved either way around its axis would tend to return to the position shown in the drawings, if the circuit remained open through the same conducting-bars 1, 2, and 3. But suppose

the silver ring or segment *n* were moved round to such position as would open the circuit through the conducting-bars 3, 4, and 5, and close them in those marked 1 and 2, there will be a strong tendency in the electro-magnet to move towards the position of the conducting-bars marked 5. Now, suppose that the electro-magnet L has its position fixed on the revolving shaft H, and suppose, too, that the silver segment *n* has its position fixed on the same shaft, and so arranged that it will always open the circuit in the conducting-bars in advance of the electro-magnet, and always close them as the middle of said electro-magnet approaches them, the tendency will be for the electro-magnet to continue to revolve around its axis, causing the shaft to rotate with it, and this is just what I do with regard to both electro-magnets, as shown in fig. 3. As there is a segment, *n n*, on each side of the ivory ring *l*, as shown at section on the line C, fig. 5, and by turning the silver segments from their middle position, as shown in fig. 7, with the open circuit through 1, 2, and 3, in the opposite direction to that just described, the electro-magnets will be caused to revolve in an opposite direction.

These changes of the positions of the open circuits through my engine, relatively to the positions of the electro-magnets from a coinciding position, causing the electro-magnets to remain in a state of rest to positions either side of this, causing the electro-magnets to revolve either way, are produced at pleasure by the mechanism shown in plan in fig. 5, and in section in fig. 1.

At the plan view at fig. 5 the mechanism is arranged for the middle or coinciding open circuits. In this arrangement it will be seen that the ring containing the groove *i* is fastened by pins to the slides *j j*, as shown in fig. 1, and the tube *k*, with the diagonal grooves *m m*, is attached to the ivory ring *l*, containing the silver band *n*, with its segments at one end, and all arranged in such manner that when the handle *h*, which turns upon the post *g*, is moved to the position *h'*, the pins *u u* move in the grooves *m m*, causing the top of the tube *k* and the silver band *n* and its segments to move in the direction of the handle *h*, causing thereby the open circuits and the electro-magnets to move in that direction, and, by moving said handle to the position *h''*, the open circuits would be changed in the opposite direction, and the electro-magnets would revolve in the opposite direction.

In my drawings I have shown one group of the conducting-bars, as they extend down to the conducting-keys at *a*, fig. 4; and at fig. 5, at *o*, I have shown one group of the conducting-keys; and at *a' a' a'*, &c., fig. 4, I have shown the forms or spaces for the conducting-bars all the way round.

I make the electro-magnets of the purest and softest wrought iron, and the parts M M between them, completing the rim of the fly-wheel, I make of brass, or any other suitable composition which is not magnetic. The shaft should be made of composition of tin and copper, and perhaps the inside parts I I and *s s*, and also the ring or case K, had better be made of the same material. The lower part of the frame G might be made of wood or composition and the posts of composition. The conducting-bars should be made of copper. Silver will do as well, but is too costly. It will be seen that the wedge-shaped blocks I I, &c., fit into small grooves in the rings *s*, and in recesses in the case K at the other end. This is to give them a firm support, in order that the groups of conducting-bars may be held steadily in their places.

In my engine I have only a fraction of the distance for the electric current to travel, after it leaves the positive pole of the battery, until it reaches the negative pole, that exists in any engine that I know of, which I consider a feature of great value, for the power of an electric current diminishes in a rapid ratio as the length of the conducting medium increases.

The ribbon-like form of my conducting-bars is of great value above the wire helices of other engines, as the greater portion of the electric current will pass through the edge of the conducting-bar *a* nearest the electro-magnet, which cannot be the case in an engine using helices, as the whole of the current must go through the outer portion as well as the inner portion in passing through the whole length of wire of which the helix is formed, and this great advantage becomes apparent when we consider that the power of an electro-magnet is in the inverse ratio of the square of the distance of the electric current which produces the magnetic force.

The disk *v*, while it supports the electro-magnets, and connects them with the shaft, occupies but a small portion of the surface of said magnets, at the same time giving the great advantage of making it possible to use the conducting-bars instead of the helices; and making them short instead of great length, and taking all the advantages into account which my improvements give to the electro-magnetic engine, I feel warranted in believing that they will enable it to compete very favorably with the steam engine.

Having thus explained my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. So forming metallic conductors in electro-magnetic engines, that in their extension from one end to the other of said engine, they shall pass nearly round one or more electro-magnets, and so arranging them that when an electric current passes through said conducting-bars, it shall produce magnetic polarity in the said electro-magnets, substantially as described.

2. In combination with said metallic conductors, the arrangement of the receptacle *b*, substantially as and for the purpose described.

3. So forming the electro-magnet in an electro-magnetic engine that it may become a part of the rim of a fly-wheel, and so arranging it on the outer edge of a disk, in connection with the shaft, that when said rim revolves the shaft will revolve also, as described.

4. The cut-off arranged and constructed as described, in combination with the said metallic conductors playing over the interrupted parts of said cut-off, as described.

5. Adjusting in electro-magnetic engines, while they are in motion, the relation of the circuits to the magnets, substantially as described, and for this purpose I claim the spiral slotted tube *k*, arranged and operated substantially as described.

6. In combination with said metallic conductors and magnetic fly-wheel, the arrangement of two or any desirable number of said fly-wheels on the same shaft, all operating together in the manner described.

7. Arranging the conducting-bars in groups around the shaft, and securing each group in its proper position independently of the others, as described.

8. Having the spaces between the groups of conducting-bars filled with blocks of the same form of said spaces, and having said blocks secured in their places by a metallic ring, K, as described.

9. Making said metallic conductors in a thin, ribbon-like form, having one edge near the said electro-magnet and the other edge from said magnet, all substantially as described and for the purpose set forth.

WILLIAM WICKERSHAM.

Witnesses:

A. D. PARKER,

JOHN J. LOUD.