No. 742,408. PATENTED OCT. 27, 1903.

H. J. EVANS & T. B. HATCH.

ELECTRODYNAMIC EQUIPMENT FOR SCHOOLS.

APPLICATION FILED AUG. 5, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

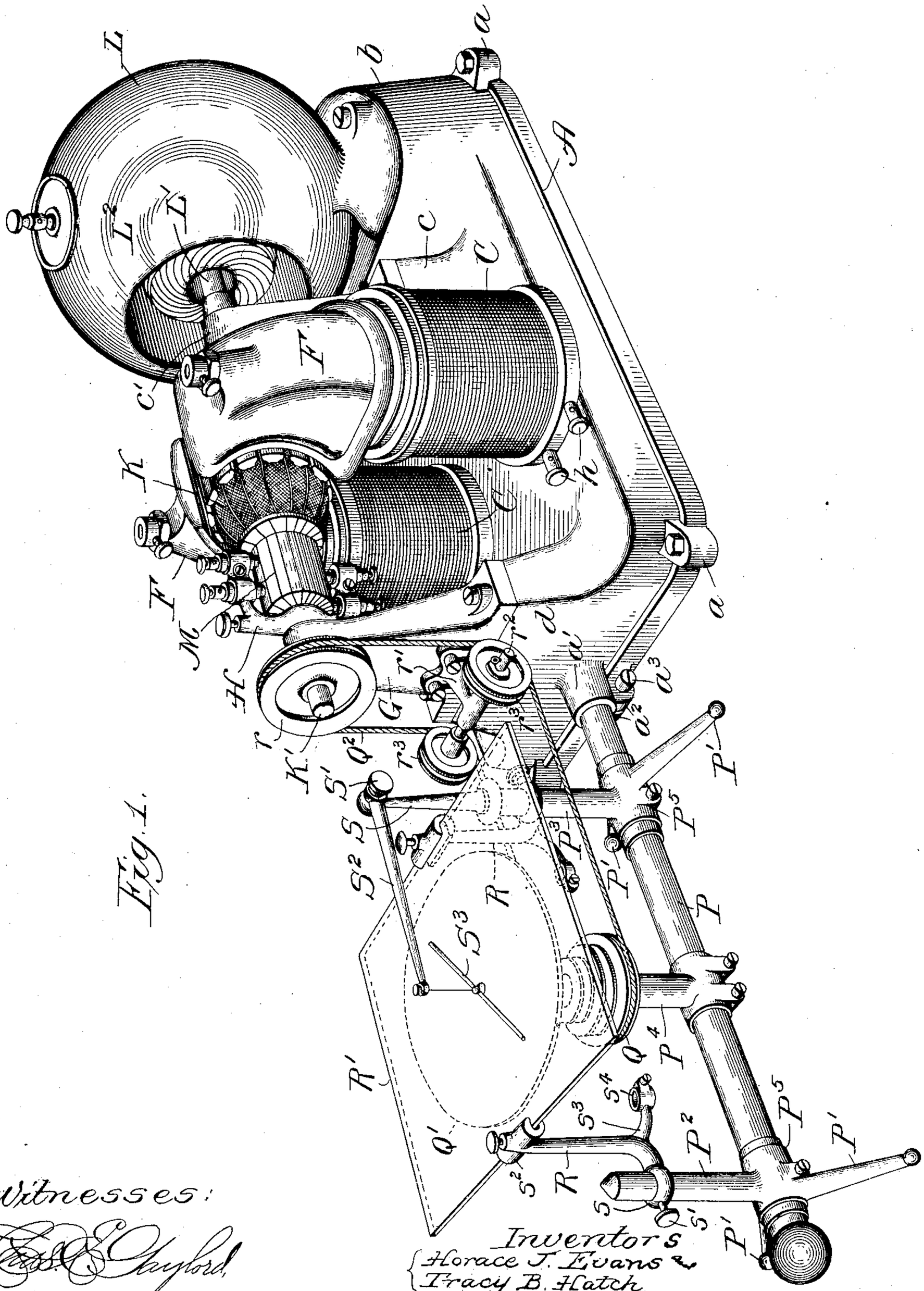

Fig. 1.

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NO MODEL. 4 SHEETS—SHEET 2.

Fig. 2.

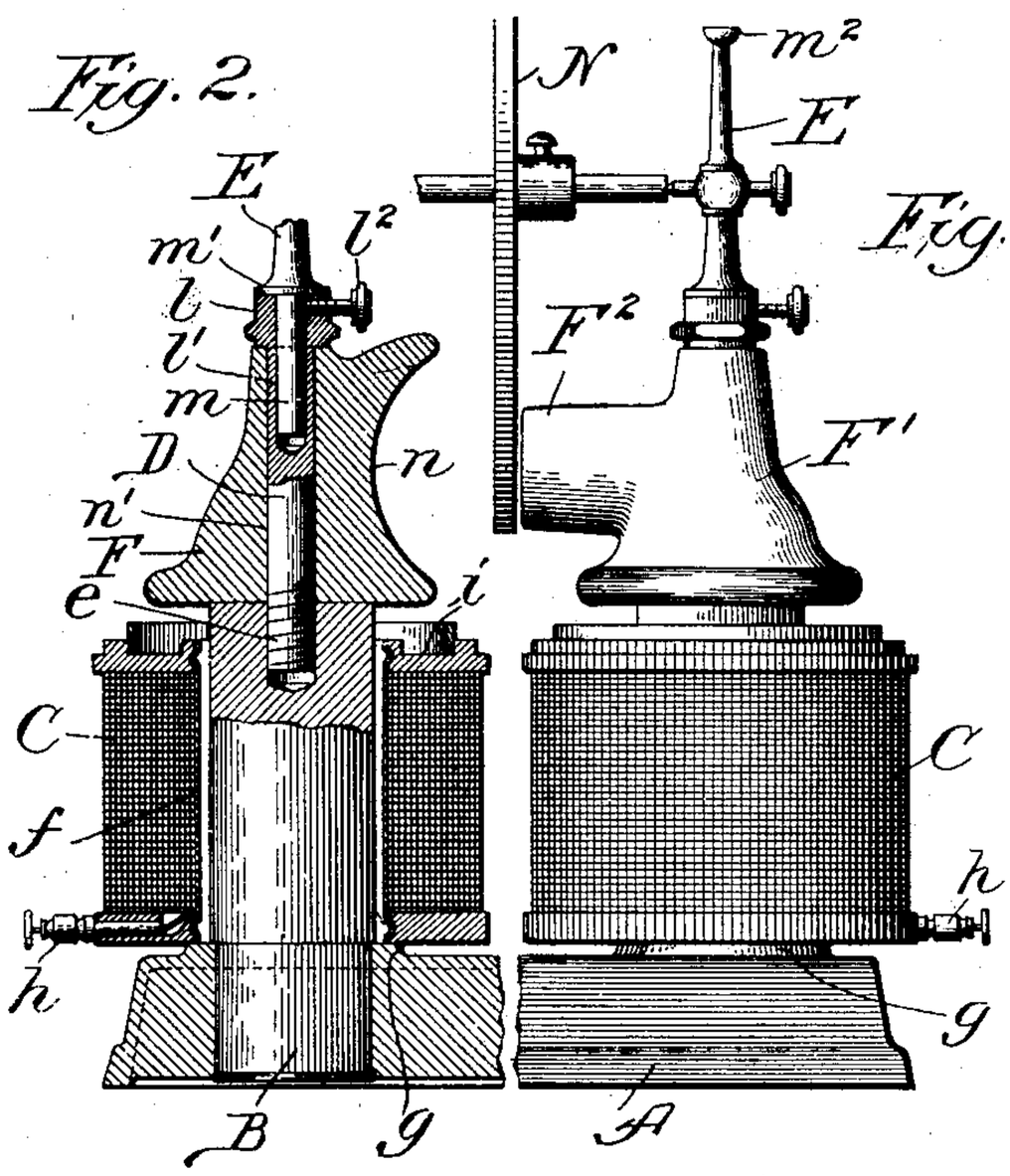
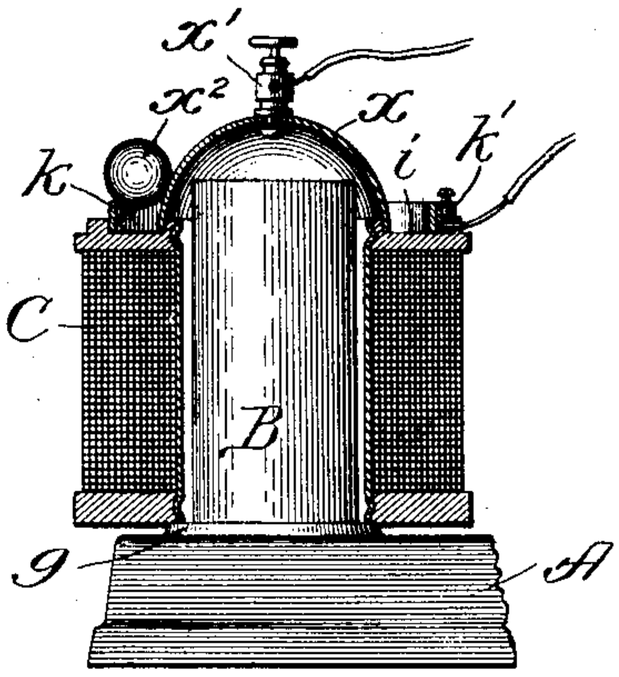


Fig. 3

Fig. 4.



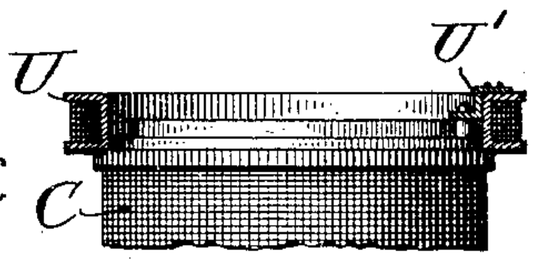


Fig. 6.

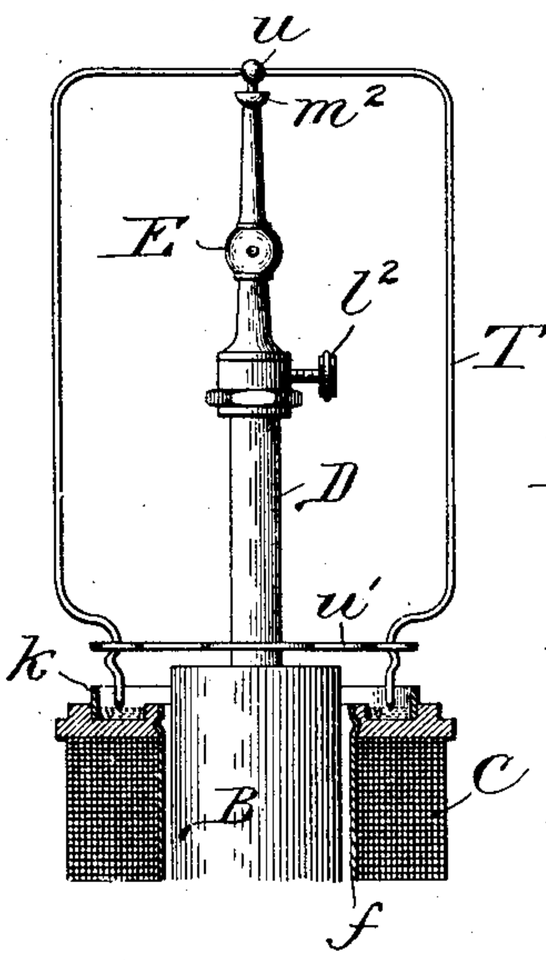


Fig. 5.

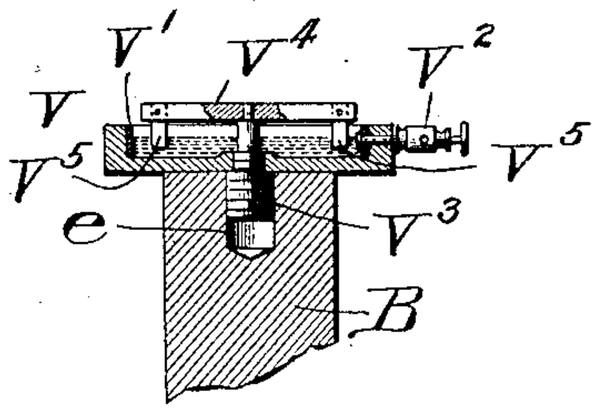


Fig. 7.

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NO MODEL. 4 SHEETS—SHEET 3.

Fig. 8.

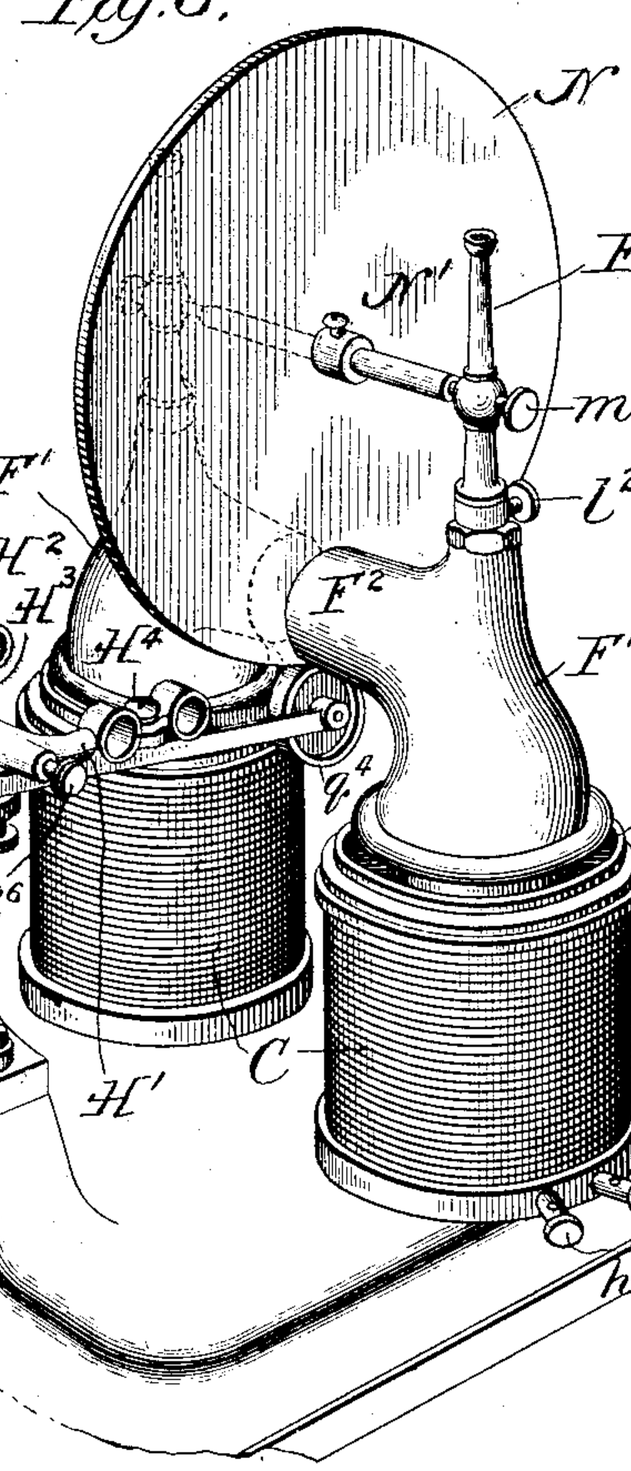


Fig. 9.

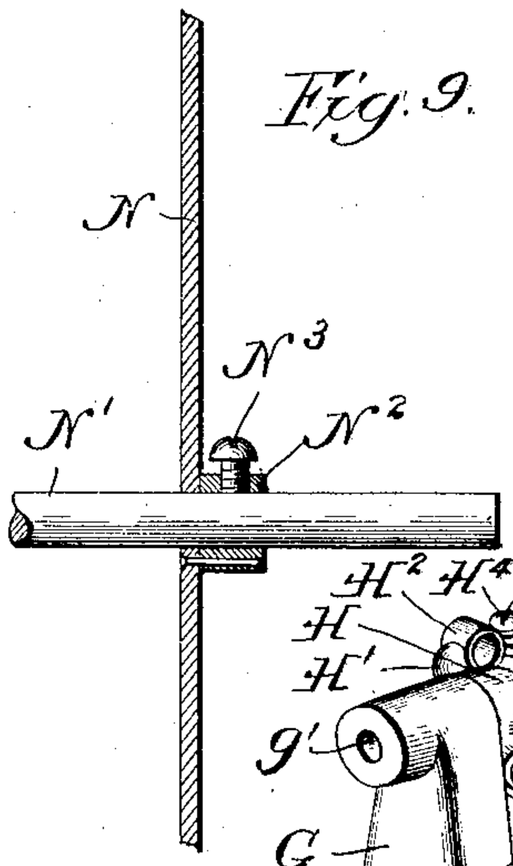


Fig. 10.

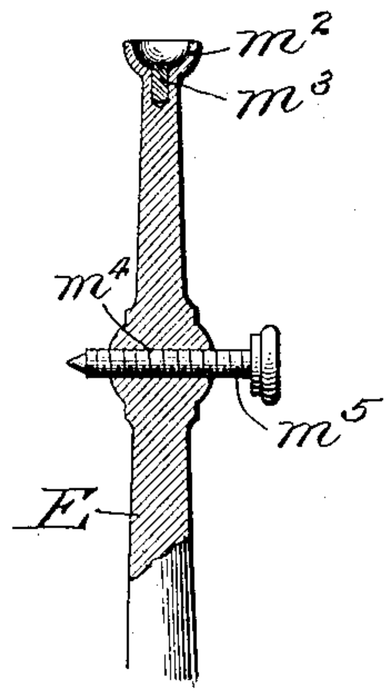


Fig. 11.

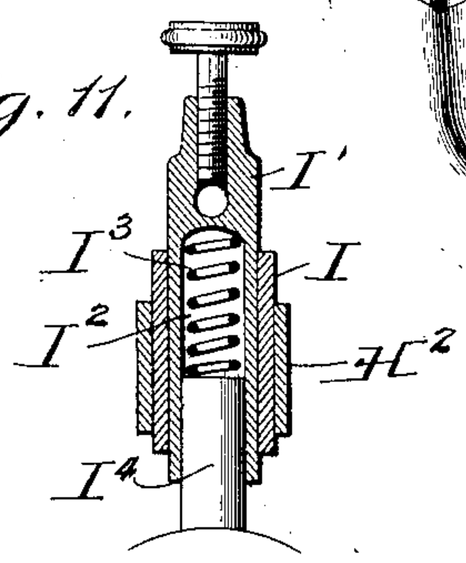


Fig. 12.

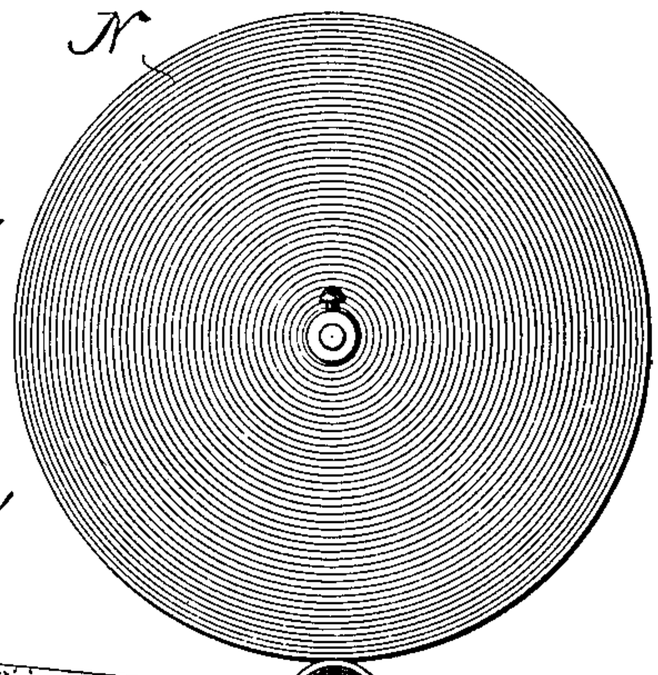
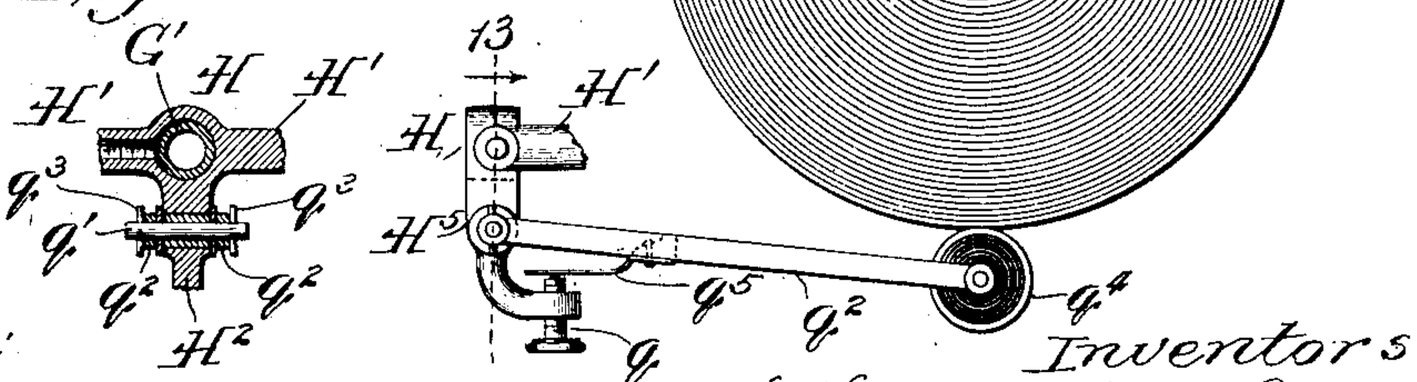


Fig. 13.



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H. J. EVANS & T. B. HATCH.

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APPLICATION FILED AUG. 5, 1903.

NO MODEL. 4 SHEETS—SHEET 4.

Fig. 14.

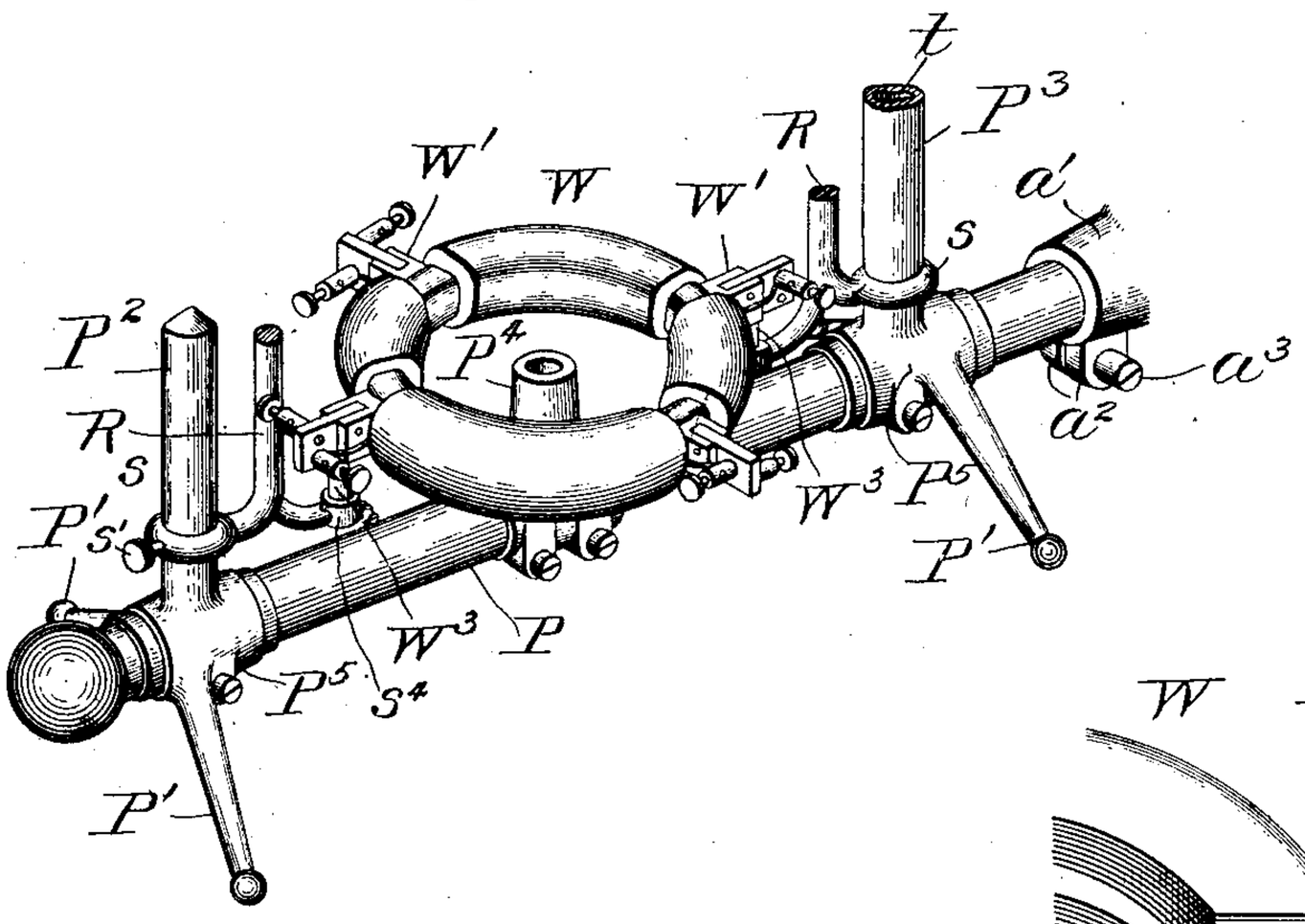


Fig. 15.

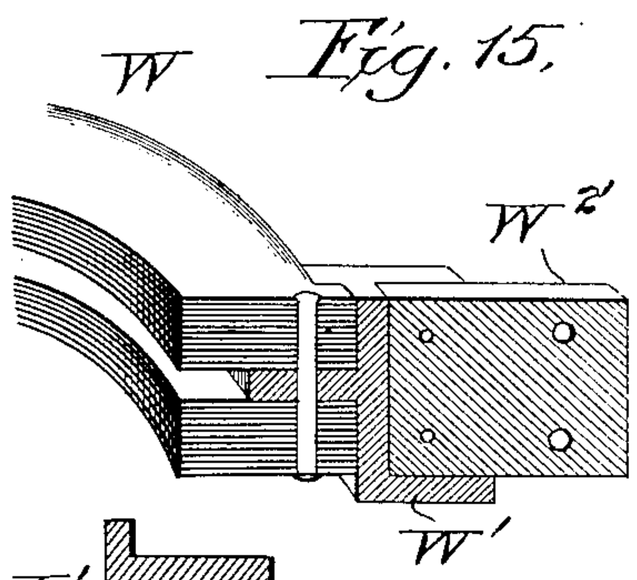
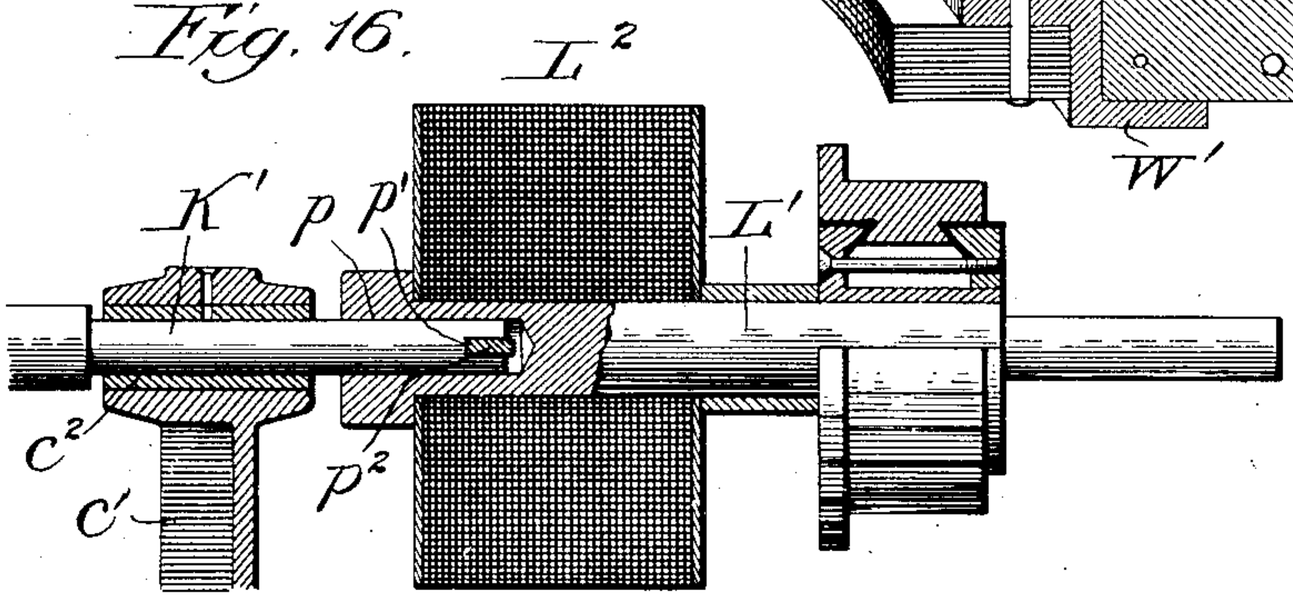


Fig. 16.



Witnesses:
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No. 742,408. Patented October 27, 1903.

UNITED STATES PATENT OFFICE.

HORACE J. EVANS, OF WAUSAU, AND TRACY B. HATCH, OF MENOMONIE, WISCONSIN.

ELECTRODYNAMIC EQUIPMENT FOR SCHOOLS.

SPECIFICATION forming part of Letters Patent No. 742,408, dated October 27, 1903.

Application filed August 5, 1903. Serial No. 168,330. (No model.)

To all whom it may concern:

Be it known that we, HORACE J. EVANS, residing at Wausau, in the county of Marathon, and TRACY B. HATCH, residing at Menomonie, in the county of Dunn, State of Wisconsin, citizens of the United States, have invented new and useful Improvements in Electrodynamic Equipment for Schools, of which the following is a specification.

Our invention relates to improvements in electrical apparatus for use in teaching and learning the principles of applied electrodynamics.

Our object is to provide an electrodynamic equipment of improved construction, consisting of supporting parts and interchangeable attachments by means of which demonstrations may be made for educational purposes, showing more especially progressive steps and phenomena which constitute the foundations upon which has been built the science as it stands to-day.

The particular purpose of the invention is to provide novel, convenient, and attractive apparatus capable of quick and ready adjustment and grouping of parts for carrying out a large variety of demonstrations, whereby in lectures upon the theories of the art practical illustrations may be given to impress the theories upon the minds of the students.

The equipment illustrated in the accompanying drawings is adapted for making a number of practical demonstrations and provides means for holding other attachments and groups of attachments for many additional demonstrations which to avoid prolixity are not illustrated in the present drawings or referred to in detail in the present case.

The equipment comprises a base or support of improved construction for the ready attachment of pole-shoes, brush-holders, and other parts to form a particularly compact and desirable foundation for the reception of readily-applied attachments which may be employed to illustrate in an attractive and impressive manner a large number of well-known electrodynamic, magnetic, and inductive phenomena. It also comprises attachable and detachable pedestal, standards, supplemental supports, and other parts for holding attachments of novel and other construction to be used interchangeably and in combinations for demonstrating various manifestations of forces, either electrodynamic, magnetic, or static, as well as means for placing in position various driving devices for direct or alternating current application or for use with other driving forces.

The apparatus may have associated with it without material change in any part of the equipment auxiliary apparatus involving transformers, boosters, alternating-current regulators, rheostats, and other auxiliary apparatus used in lighting, heating, and power appliances.

Referring to the drawings, Figure 1 is a perspective view of certain of the main features of improvement, showing attachments in place for illustrating a driving electric motor operating a direct-current dynamo and an arrangement for developing Arago's "rotations" and similar inductive effects; Fig. 2, a broken sectional view showing one of the stationary magnet-cores with a removable spool, one form of core-piece or pole-shoe removably mounted upon the core, and a removable pedestal and pedestal extension or standard; Fig. 3, a broken elevation of one of the magnets, showing another form of core-piece and attachments for use in illustrating the Faraday disk dynamo and its phenomena; Fig. 4, a broken sectional view showing attachments for use in illustrating the phenomenon known as "Gore's railway;" Fig. 5, a broken sectional view showing attachments for use in carrying out torsional effects; Fig. 6, a similar view showing an auxiliary coil fitted upon the upper end of a spool for use in illustrating the reaction of one current on another when they are flowing at right angles to each other and with which the rectangular rotating frame shown in Fig. 5 may be employed; Fig. 7, a broken section of one of the magnet-cores, showing an attachment thereon for illustrating the torsional effect of a magnetic field on a current flowing in a liquid; Fig. 8, a broken perspective view showing attachments in place for illustrating the Faraday disk dynamo with a current-supplying trolley; Fig. 9, an enlarged section showing the disk and manner of securing it upon its shaft; Fig. 10, a broken

sectional view of one of the removable standards; Fig. 11, an enlarged sectional view of one of the plunger-brushes, its binding-post, and support; Fig. 12, a broken side elevation of the disk shown in Fig. 8 and the attendant trolley mechanism; Fig. 13, a broken section taken on line 13 in Fig. 12; Fig. 14, a broken perspective view of attachments illustrating the principle of the bipolar field-magnet and multipolar field-magnet, the transformer, and the rotating field used in commercial devices through the medium of different connection groupings; Fig. 15, an enlarged section showing the construction of the laminated core and a connecting projection of the ring employed in the equipment illustrated in Fig. 14; and Fig. 16, a broken longitudinal section through the commutator and armature of a driving-motor, illustrating the means for coupling thereto the shaft of a driven armature—such, for example, as that illustrated in Fig. 1.

A is a base which may be rectangular in form and provided at its corners with perforated ears *a*, through which it may be secured by means of screws or bolts upon a table or other foundation. Integral with the base is a seat *b* for a removable driving-motor L, a seat *c* for a removable bearing-standard *c'*, and a seat *d* for a removable standard G, all shown in Fig. 1.

Passing through the base A and permanently secured in place, as shown in Fig. 2, are magnet-cores B, provided in their upper ends with threaded sockets *e*.

C C are wound spools having central cylindrical walls *f*, adapted to fit loosely over the cores B and rest upon annular bosses *g*, formed upon the base around the cores. The spools have binding-posts *h* at their bases, and in the upper end of at least one of the spools is an annular recess *i*. Fitting the said recess *i* is a flat-sided ring *k*, carrying a binding-post *k'*.

D D are rods or pedestals threaded at their lower ends to screw into the sockets *e* and provided at their upper ends with heads *l*, comparatively deep sockets *l'*, and thumb-screws l^2.

E E are standards adapted at their lower end portions *m* to fit the sockets *l'* and having flanges *m'* to rest upon the pedestal-heads *l*. The upper ends of the standards E are concave to present cups m^2, and in the bases of the cups are hard-metal bearing-pieces m^3. (Illustrated in Fig. 10.) In the standards are transverse threaded openings m^4 to receive adjustable bearing-screws m^5.

F F are pole-pieces, each having a circular concave face *n* and a central opening *n'*. The pole-pieces may be placed in position upon the cores B by passing the pedestals through them and screwing the pedestals into the sockets *e* to clamp the core-pieces between the upper ends of the cores and the heads *l* of the pedestals.

Removably fastened upon the seat *d* is the bearing-standard G, having a bearing-opening *g'* in direct line with a similar bearing-opening c^2 in the standard *c'*. Pivotally mounted upon a boss G', Fig. 13, around the opening *g'* of the standard G is a brush-carrier frame H, having arms H'. The arms H' are each formed with two split brush-holding rings H^2, connected by a split web H^3, provided with a clamping-screw H^4. Brush-holding sleeves I may be passed through the rings H^2 and clamped in place by tightening the screws H^4. The brush-holding sleeves I are of insulating material and fitting through them are binding-posts I', each provided in one end with a deep socket I^2. In the sockets I^2 are springs I^3 and sliding plunger-brushes I^4, outwardly pressed by the springs.

To illustrate a present-day dynamo, an armature K is provided with a shaft K', adapted at one end to pass through the bearing-opening *g'* and at its opposite end to pass through the bearing-opening c^2 and into the socket *p* in the end of the shaft L' of the armature L^2 of the driving-motor L. In the end of the shaft K' is a notch *p'* to fit over a cross-piece or key p^2 in the socket *p*. Either a direct-current armature K, like the one shown, or an alternating-current armature may be placed in position, the standard G being removable and replaceable, as described, to render the operation easy to perform. The brush-holder H is constructed, as shown, for use with either a direct-current commutator M or an alternating-current commutator. As will be readily understood, the cores B, spools C, and pole-pieces F constitute the field of the dynamo, and the armature is driven from the driving-motor L.

To illustrate the Faraday disk dynamo and its phenomena, removable pole-pieces F' are provided of the construction shown in Figs. 3 and 8, having projecting bosses F^2 extending in the direction of, but out of contact with, each other. A suitable aluminium or other metal disk N is mounted centrally upon a shaft N', provided with end sockets. The disk is provided with a hub N^2, fastened thereto with pins, as shown, or otherwise, and is secured to the shaft by a set-screw N^3. The standards E are secured in place by the screws l^2 upon the pedestals, as shown in Fig. 8, the shaft N' being supported to rotate upon the adjustable screws m^5, which have pointed ends to enter and form bearings for the opposite recessed ends of the shaft N'. The brush-holder H is provided with an arm H^5, bent as shown in Fig. 12. Near its free end it has a threaded opening forming a bearing for an adjusting-screw *q*. In the arm in the position shown is an insulated bearing-opening for a pin or shaft *q'*, forming a bearing for a trolley-bar q^2. The trolley-bar is bifurcated and may be placed in position by causing it to straddle at its bifurcated end the arm H^2 to register at bearing-openings with the insulated opening in the arm through which the pin *q'* is passed. Pins or cotters

q^3 are placed in openings in the shaft or pin q' to hold the trolley-bar in place. At its free end the bar carries a trolley-wheel q^4, and on the bar is a spring q^5, which rests upon the insulated end of the adjusting-screw q. By turning the screw q the trolley-wheel may be pressed with desired force to bear yieldingly against the periphery of the disk N. The brush-holding frame is adjustably fastened to the boss G' by a set-screw q^6 and may be turned to extend with its arms vertically, as shown in Fig. 1, or horizontally, as shown in Fig. 8. In illustrating the Faraday dynamo the brushes are or may be removed and the trolley-bar fastened to the arm H^5, as described.

P is a frame comprising a tube adapted to fit at one end in a socketed boss a' in the end of the base A in the position shown in Fig. 1. The boss a' is split and provided with split ears a^2, having a clamping-screw a^3. When placed in position by passing it at its end into the socketed boss a', the frame P may be held rigidly by tightening the clamp-screw a^3. The frame or tube P is provided with legs P', as shown, for supporting it in upright position when removed from the base A. The tube or frame is provided with the end standards P^2 P^3 and a shiftable standard P^4. The legs P' and respective standards P^2 P^3 are cast or formed in one piece with a central hub or sleeve portion P^5, which fit over the tube and are held with set-screws, as indicated. The standard P^4 extends upward from a sleeve which is slidable upon the tube P and may be fastened in adjusted position by means of the screws shown.

In the arrangement shown in Fig. 1 for the development of Arago's rotations a pulley r is mounted upon the shaft K' of the armature K, and a bracket r' is fastened by means of screws against the standard G. The bracket forms a bearing for the shaft r^2 of two idle pulleys r^3. A step-pulley Q is provided, having a shaft which fits at its lower end in a socket in the top of the standard P^4. (Shown in Fig. 14.) The step-pulley shaft carries at its upper end a disk Q', which is indicated by dotted lines in Fig. 1, and a belt or cord Q^2 is passed around the pulleys r, r^3, and Q, as shown. The frame P may be moved longitudinally in the socketed boss a' to adjust the tension of the belt Q^2.

R R are adjustable brackets or holders having collar portions s to fit over the standards P^2 P^3 and set-screws s' for securing them to the standards. One (the upward-extending) arm of each bracket R is formed with a socketed head s^2 to receive the edge of a glass or the like plate R', a set-screw being provided in each head for holding the plate firmly in place. Each bracket R is also provided with a lower arm s^3, carrying a split sleeve s^4 and a clamping-screw therefor.

The standard P^3 is provided in its upper end with a deep socket t, as indicated in Fig. 14, into which may be slipped the lower end of a standard or standard extension S, provided near its upper end with a transverse threaded opening to receive a clamp-screw S'. The clamp-screw forms a bearing for an arm S^2 and may be tightened to fasten the said arm in adjusted position. For the purpose of illustrating Arago's rotations a horizontally-extending rod-magnet S^3 is suspended from the free end of the arm S^2 centrally over the disk Q' on the opposite side of the plate R' therefrom.

To illustrate torsional experiments, a preferably rectangular aluminium frame T is provided, having at the top a central downwardly-projecting pivot-bearing point u. The free ends of the wire of which the frame is formed may be pointed, as shown, and near the free ends the wires are connected by a cross-piece u', having a central opening. In this illustration the spool C, having the ring k, is placed in position as shown and the annular trough in the top of the spool C is filled with a liquid, preferably mercury. The standard E is placed in position as described, with the pin u resting in the bearing-socket m^2 of the standard. In placing the parts in position the cross-piece u' is passed over the pedestal D and the lower ends of the wire frame caused to extend in contact with the mercury.

To demonstrate Gore's railway, a dome x, having a binding-post x', is provided to fit like a cap over the top of a core B and rest in the channel i of a spool C, the ring k forming, with the dome, a track for the ball x^2.

U is an auxiliary coil comprising a channel-ring provided with a suitable winding. On the ring is a perforated bracket U', at which the ring may be fastened by means of a screw to the top of the spool C, as shown in Fig. 6. The auxiliary coil may be employed to illustrate the reaction of one current on another, as before stated.

V, Fig. 7, is a dish-shaped attachment or basin, of insulating material, having a wall provided with an inner metal lining V' and a binding-post V^2. It has a central threaded opening to receive a threaded pin V^3, which may be screwed into the socket e of one of the cores B. The pin V^3 at its upper end forms a pivot-bearing for a rotary bar V^4, having depending ends V^5. Mercury or other suitable liquid is placed in the basin and the depending ends of the bar V^4 caused to extend downward into the liquid.

The attachments shown in Fig. 7 are adapted to illustrate the torsional effect of a magnetic field on a current flowing in the liquid. The liquid rotates, as will be indicated by the rotation of the bar.

W, Figs. 14 and 15, is a laminated ring provided with preferably four socketed lugs W' equidistant apart. Fastened in the socketed lugs are radially-extending blocks W^2, carrying binding-posts. Two diametrically opposite lugs W' are provided with downward-extending pins W^3, adapted to enter the sock-

ets s^4 of the arms s^3 and be clamped in place therein to hold the ring, as shown. By means of the magnetic ring mounted as shown in Fig. 14 may be illustrated the principle of the bipolar field-magnet, multipolar field-magnet, the transformer, and the rotating field used in commercial devices through the medium of different connection groupings.

As the principal object of our improvement is to provide convenient means for illustrating for educational purposes various electrical phenomena, the invention naturally consists more especially in the construction of the main features of the equipment.

It has not been thought necessary to describe the various phenomena above referred to in detail, as they are well known in the art.

While we have shown and described sockets in the base, cores, and pedestals, any other means may be provided in place of the sockets which would present equivalent means for holding the attachments, which in the construction shown enter the sockets to be held thereby.

While we prefer to construct our improvements throughout as shown and described, they may be variously modified in the matter of details without departing from the spirit of the invention as defined by the claims.

What we claim as new, and desire to secure by Letters Patent, is—

1. In an electrodynamic equipment for educational purposes, a base, parallel magnet-cores rising from the base and provided in their upper ends with attachment-holding sockets, and removable magnet-spools fitting over said cores, substantially as and for the purpose set forth.

2. In an electrodynamic equipment for educational purposes, a base, a driving-motor seat upon the base, parallel magnet-cores rising from the base and provided in their upper ends with attachment-holding sockets, and removable magnet-spools fitting over said cores, substantially as and for the purpose set forth.

3. In an electrodynamic equipment for educational purposes, a base, armature-shaft bearings on the base, parallel magnet-cores rising from the base, and provided in their upper ends with attachment-holding sockets, and removable magnet-spools fitting over said cores, substantially as and for the purpose set forth.

4. In an electrodynamic equipment for educational purposes, a base, a magnet-core rising from the base and provided in its upper end with an attachment-holding socket, and a removable magnet-spool fitting over said core and provided in its upper end with an annular liquid-holding receptacle, substantially as and for the purpose set forth.

5. In an electrodynamic equipment for educational purposes, a base, a magnet-core rising from the base, a removable magnet-spool fitting over said core and provided in its upper end with an annular receptacle, a ring, fitting the inner surface of the outer wall of said receptacle, and a binding-post on said ring, substantially as and for the purpose set forth.

6. In an electrodynamic equipment for educational purposes, a base, a magnet-core rising from the base, a removable magnet-spool fitting over said core and provided in its upper end with an annular receptacle, a ring fitting the inner surface of the outer wall of said receptacle, a binding-post on said ring, a removable dome extending over the upper end of the core and fitting around the inner wall of said receptacle, and a binding-post on said dome, substantially as and for the purpose set forth.

7. In an electrodynamic equipment for educational purposes, a base, a magnet-core rising from the base, and a removable auxiliary coil, fitting around the upper end of the spool, with means for securing it in place, substantially as and for the purpose set forth.

8. In an electrodynamic equipment for educational purposes, a base, a magnet-core rising from the base and provided in its upper end with a central socket, a removable liquid-holding basin fitting the top of said core, a pin entending centrally through the base of said basin for engaging the socket in the core below the basin and to present a pivot-bearing above said basin, and a horizontal bar provided with depending end portions centrally supported upon said pivot-bearing, substantially as and for the purpose set forth.

9. In an electrodynamic equipment for educational purposes, a base, a magnet-core rising from the base and provided in its upper end with a socket, and a removable pedestal provided at its upper end with a head and fitting said socket at its lower end, substantially as and for the purpose set forth.

10. In an electrodynamic equipment for educational purposes, a base, a magnet-core rising from the base provided in its upper end with a socket, a removable pedestal having a head provided with a central socket and fitting at its lower end the socket in the core, and a removable standard fitting at its lower end into said pedestal-socket, substantially as and for the purpose set forth.

11. In an electrodynamic equipment for educational purposes, a base, a magnet-core rising from the base and provided in its upper end with a socket, a removable pedestal having a head provided with a central socket and fitting at its lower end into said socket in the core, a removable standard fitting at its lower end into said pedestal-socket, provided between its ends with an adjustable bearing-screw, and having a cup-shaped upper end, substantially as and for the purpose set forth.

12. In an electrodynamic equipment for educational purposes, a base, a magnet-core rising from the base and provided in its upper end with a central socket, a removable pedestal having a socketed head and fitting at its lower end the socket in the core, a remov-

able standard fitting at its lower end the socket in the pedestal and having a cup-shaped upper end, a removable magnet-spool fitting over said core and provided in its upper end with an annular liquid-holding receptacle, and a frame T provided with a central downward-extending bearing projection *u* resting in the said standard-socket, a brace *u'* fitting loosely over the pedestal and connecting the lower free end portions of the frame, said free ends extending downward into said liquid-holding receptacle, substantially as and for the purpose set forth.

13. In an electrodynamic equipment for educational purposes, a base, parallel magnet-cores rising from the base and provided in their upper ends with central sockets, removable pedestals provided at their upper ends with heads and engaging at their lower ends with said sockets, and removable pole-pieces having openings through them for said pedestals and held firmly in place upon the upper ends of the cores by said pedestals, substantially as and for the purpose set forth.

14. In an electrodynamic equipment for educational purposes, the combination of a base, parallel magnet-cores rising from the base and provided in their upper ends with central sockets, removable magnet-spools fitting over said cores, removable perforated pole-pieces on said cores, pedestals having socketed heads and passing downward through said pole-pieces into said core-sockets to clamp the pole-pieces in place, standards fitting at their lower ends into the pedestal-sockets and provided with horizontally-extending adjustable bearing-screws, a shaft journaled at opposite ends on said bearing-screws, a disk centrally mounted upon said shaft, a standard on said base, an attachment upon said standard, a trolley-bar pivotally and removably connected with said attachment, a trolley-wheel on the end of said trolley-bar, a spring on the trolley-bar, and an adjusting-screw on said attachment bearing against said spring to press the trolley-wheel against said disk, substantially as and for the purpose set forth.

15. In an electrodynamic equipment for educational purposes, a base, a standard on the base, a motor upon the base having a shaft journaled in said standard, a removable support fitting at one end a socket in the end of the base, standards on said support, and adjustable brackets on said standards having upper and lower attachment-receiving arms, substantially as and for the purpose set forth.

16. In an electrodynamic equipment for educational purposes, a base having a socket in its end, a standard on said base, a motor on the base having a shaft journaled in said standard, a removable support fitting at one end, and longitudinally adjustable in, said socket with means for fastening it in adjusted position, a standard on said support, a pulley on said shaft, idle pulleys journaled on said standard on the base, a pulley journaled on said standard on the support, an endless driving-belt movable over all said pulleys, and attachment-receiving arms on said support, substantially as and for the purpose set forth.

HORACE J. EVANS.
TRACY B. HATCH.

In presence of—
WILLIAM H. ALLEN,
JOHN HOPWOOD.