No. 684,906. Patented Oct. 22, 1901.

J. BROWN.

ELECTRICAL RECIPROCATING APPARATUS.

(Application filed July 10, 1900.)

(No Model.) 4 Sheets—Sheet 1.

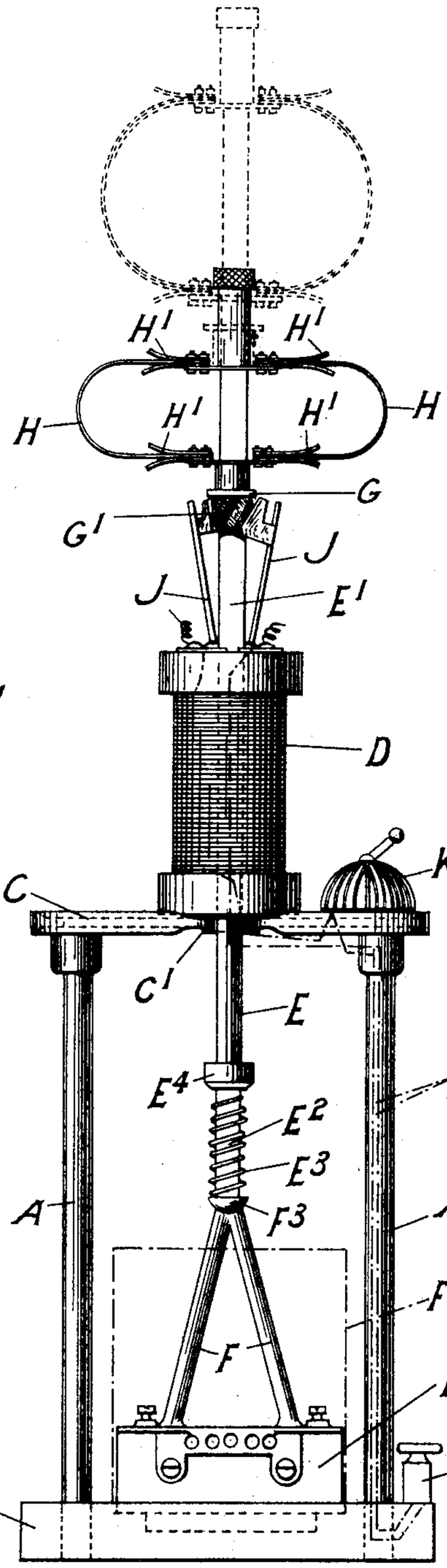

FIG. 1

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C. Montague

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(No Model.) 4 Sheets—Sheet 2.

FIG. 2

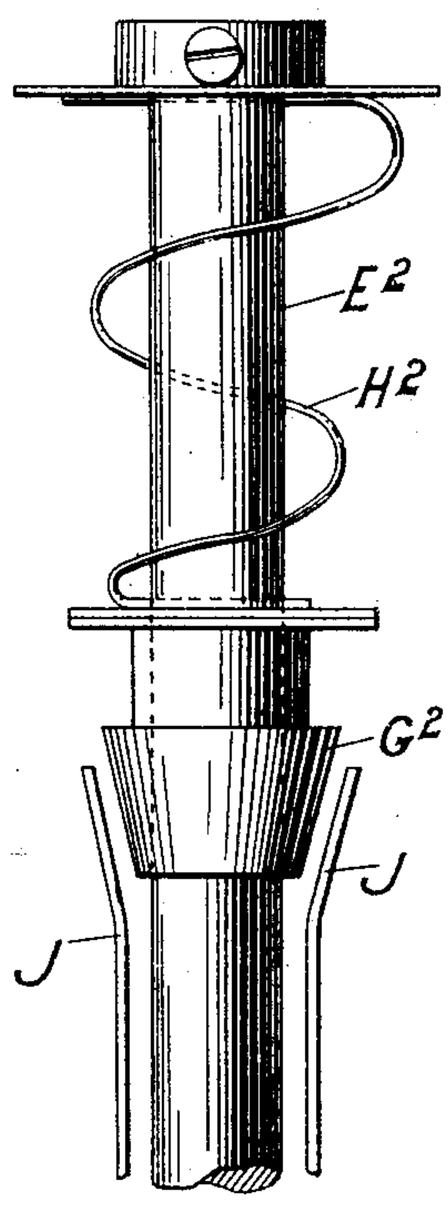
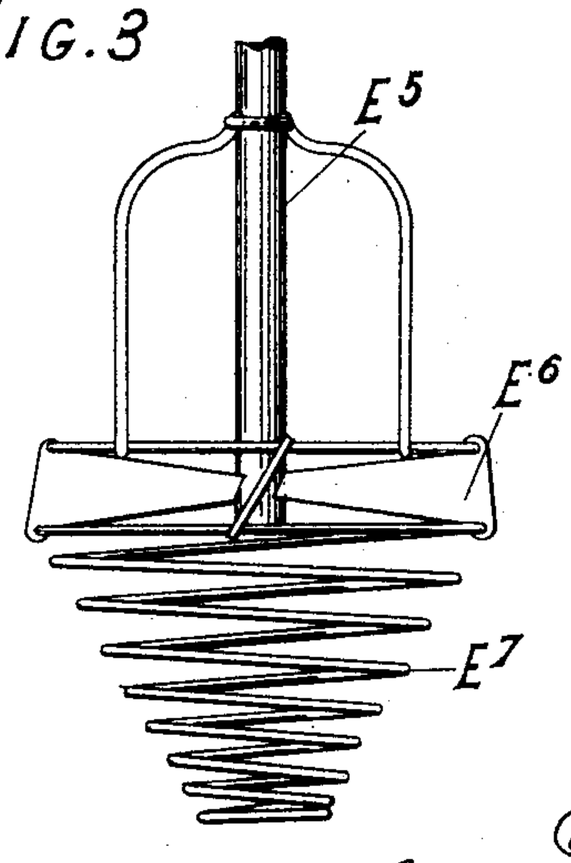


FIG. 3



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(No Model.) 4 Sheets—Sheet 3.

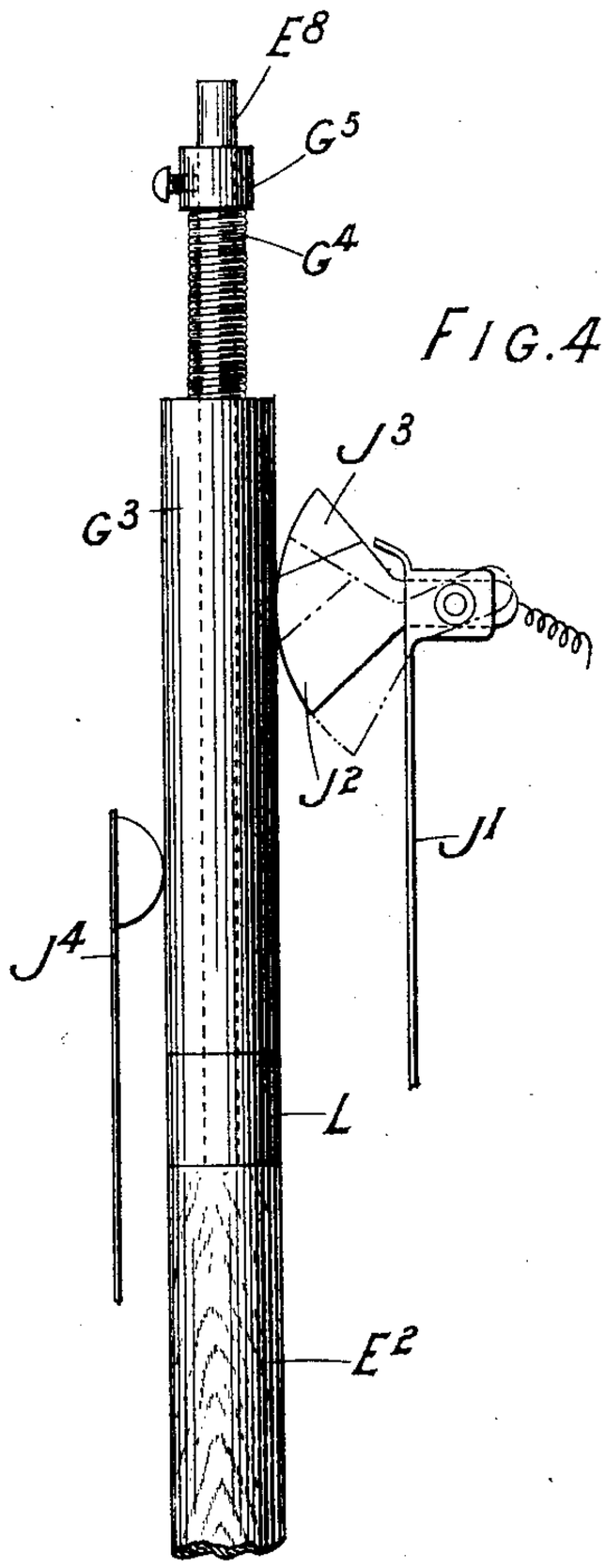

FIG. 4

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(No Model.) 4 Sheets—Sheet 4.

Fig. 5.

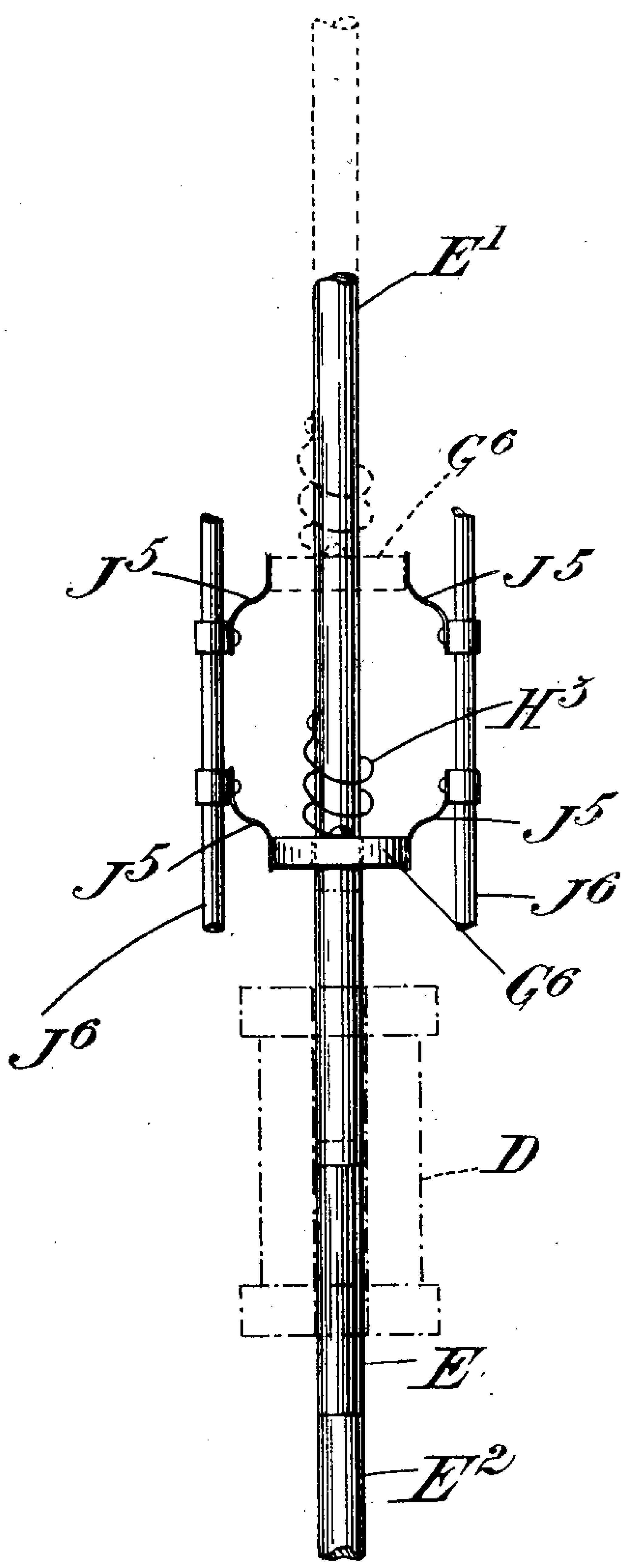
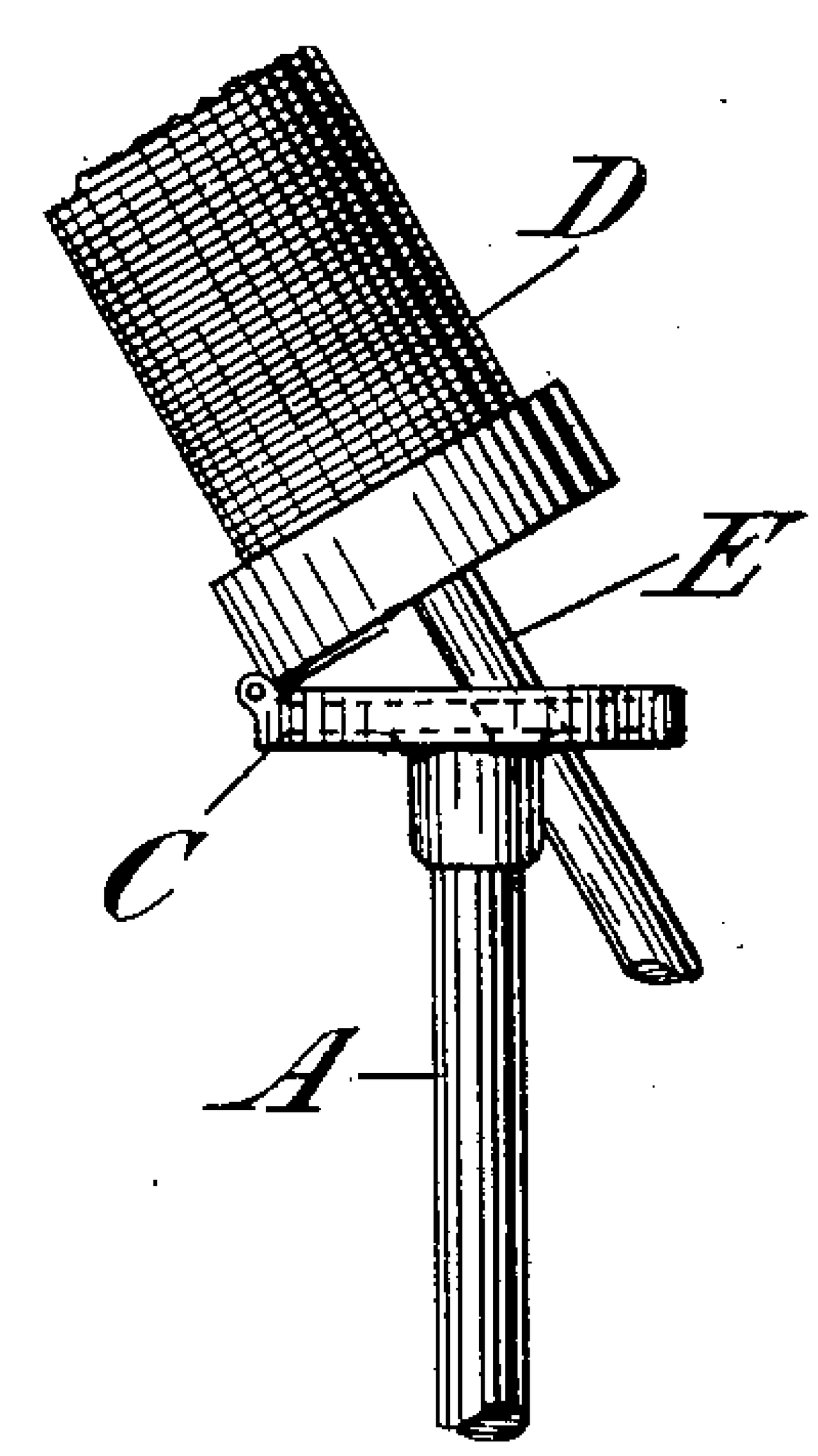


Fig. 1A



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UNITED STATES PATENT OFFICE.

JOHN BROWN, OF BELFAST, IRELAND.

ELECTRICAL RECIPROCATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 684,906, dated October 22, 1901.

Application filed July 10, 1900. Serial No. 23,145. (No model.)

To all whom it may concern:

Be it known that I, JOHN BROWN, a subject of the Queen of England, residing at Belfast, Ireland, have invented certain new and useful Improvements in or Relating to Electrical Reciprocating Apparatus, (for which I have made application for Letters Patent in Great Britain, No. 7,861, dated April 27, 1900,) of which the following is a specification.

This invention relates to the obtaining of a reciprocating motion from an electric current so as to apply the movement to a variety of useful apparatus. The apparatus may be made small or large and used for widely-differing purposes accordingly—for example, small apparatus may be used for beating eggs, chopping meat, &c., and large apparatus for rock-drilling, pumping, &c.

In carrying out this invention I obtain the reciprocating motion by the employment of a solenoid acting in the well-known manner, my invention relating to the means employed for utilizing the power of the solenoid. The instrument by which the reciprocating movement is utilized—for example, a knife, an egg-beater, hammer, saw, rock-drill, &c.—is secured to the movable core of the solenoid. The non-conducting continuation of the core or some connection thereof in one arrangement carries a metal head or collar which at appropriate parts of the stroke engages with spring-contacts connected with the winding of the solenoid. This collar is preferably provided with projections or grooves spirally or obliquely arranged, so as to impart a partial rotary motion to the core as it reciprocates. The collar is loose upon the core extension and may be connected thereto by one or more springs, preferably of a bow shape, though other forms of spring may be employed. The lower portion of the core or an extension thereof beyond the magnet carries a loose collar with a helical spring surrounding the core extension and padded, if necessary.

The operation is as follows: Taking the case where vertical reciprocation is required, the weight of the core, &c., will cause it when not in use to lie in its lowest position when the spring-head at its upper end is in engagement with the previously-mentioned contacts. The application of the current will cause the core to be sucked upward, thereby disengaging the head from the contacts, when, the current ceasing, the movable part will drop of its own weight. The head may be loaded or the spring connection so arranged that it will continue to engage the contacts, while the core and its connections rise to the required distance, too great a rise being prevented by the spring-controlled loose collar underneath it. When the core has risen to such a height as to disengage the head from the contacts, the former will fly up clear of the contacts and will not reëngage them again until the core and its appurtenances have fallen a desirable distance. These parts and the springs can be adjusted so as to obtain the requisite speed and amplitude of movement. The apparatus continues to work so long as the current is applied.

In a modification one of the contacts is provided with a movable curved contact-face, a portion of which is formed of conducting material and another portion of non-conducting material. This face is arranged so as to engage with a sleeve upon the core extension in such a manner that as the latter rises it is in engagement with the conducting portion of the contact, but as it falls it slightly moves the contact and then engages with the non-conducting portion thereof. The sleeve may be weighted or spring-controlled, so that as it becomes eaten away by the sparking it will continue to maintain its proper position against a non-conducting collar upon the core extension. Upon the other side of the sleeve is another contact, preferably placed nearer to the solenoid in order that as the break will then take place at this second contact the previous one, with its movable contact-face, will not be so quickly destroyed.

In another form the previously-mentioned head instead of being grooved has a plain contact-surface, though it is preferably made of a conical shape to enter between the contacts and is connected by a light coiled spring with the core extension in such a manner as to produce a partial rotary effect upon the core.

Where it is desired to obtain the reciprocation entirely by the action of the solenoid, making it operate in both directions, I prefer to provide double contacts with a break between, so that the head or collar upon the

core extension will engage first with one pair of contacts and then, when it has traveled sufficiently far, with the next, one pair moving it in one direction and the other pair in the reverse direction. These contacts, as well as those mentioned in previous modifications, are preferably adjustable either in relation to each other or to the solenoid.

Any desired springs may be added and modifying arrangements to control the speed, extent, or power of the movement, or to prevent shock in working. For example, in the case of the egg-beater the coiled spring may be placed at the extreme lower end of the core extension to prevent the beater itself from striking too hard upon the bottom of the can or vessel containing the eggs or to assist or cause the return movement.

In the accompanying drawings, Figure 1 is a side elevation of one construction of electrical reciprocating apparatus according to this invention, shown, by way of example, arranged for use as a meat-chopping machine. Fig. 1ª is an elevation taken at right angles to Fig. 1 and showing a portion of the apparatus in another position. Fig. 2 is a side elevation of a portion of a modified form of apparatus according to this invention, and Fig. 3 is a similar view of another portion of a modified apparatus. Fig. 4 is a side elevation of a part of another construction of apparatus, also according to this invention. Fig. 5 shows, diagrammatically, a portion of another construction of apparatus, also according to this invention. Figs. 2, 3, and 4 are drawn to a larger scale than Fig. 1.

With reference first to Fig. 1, A represents standards carried upon a base B and supporting a plate C. Upon this plate C is a solenoid D, within which a core E, of magnetic material, can reciprocate freely. The core E is provided with extensions E′ and E^2 at its top and bottom extremities, respectively. The extension E′ is of non-magnetic and preferably non-conducting material, and the extension E^2 is of non-magnetic, though not necessarily non-conducting, material. Secured to the lower end of the extension E^2 is a frame F, carrying a chopper-blade F′. This chopper-blade is intended to work within a cylindrical vessel, which is indicated by chain lines, as at F^2, and in order to facilitate the removal of this vessel the solenoid D is preferably hinged to the plate C, so that the solenoid, with the core and its appurtenances, can be swung out of the vertical, the core E moving in a slot C′, made in the plate C. This hinge is shown in Fig. 1ª. Upon the upper extension E′ of the core E and fitting loosely around it is a contact-head or a sleeve G, provided with spiral slots G′. Attached to the upper portion of the sleeve G are light springs H, the other ends of which are secured to the top of the extension E′. Guard-springs H′ are placed at the extremities of the spring H to stiffen them and to prevent them from breaking. Upon the top of the solenoid D are contact-springs J, portions of which are adapted to enter the spiral slots or grooves G′ in the sleeve G. The current comes from any suitable source of power to terminals upon the base B, one of these terminals being indicated at K. From the terminals the current passes, as shown by chain lines, through wires K′ to a switch K^2, the solenoid D, and the contact-springs J. When the switch K^2 is on and the core E is in its downward position, as shown in Fig. 1, the contact-sleeve G bridges across the gap in the circuit between the contact-springs J, and the solenoid D is energized. As a consequence of this the core E is sucked up into the solenoid D, the current continuing to flow as long as the sleeve G remains in contact with the springs J. Continued upward motion of the core E lifts the contact-sleeve G from between the contact-springs J and breaks the circuit, the upper portion of the apparatus then assuming the position indicated in dotted lines in Fig. 1. The upward movement of the core E is limited by a buffer or cushioning spring E^3, placed between a shoulder F^3 of the frame F and a loose collar E^4 upon the lower extension E^2 of the core E. When the circuit is broken, the weight of the core E and its appurtenances causes it to descend, and contact is again made between the sleeve G and the contact-springs J, the cycle of operations being then repeated. Owing to the spiral form of the slots or grooves G′ in the sleeve G a partial rotary movement is given to the core and its attachments as they reciprocate.

In the arrangement shown in Fig. 2 the contact-sleeve G^2 is conical, the slots G′ being dispensed with, and instead of the bow-shaped springs H a helical spring H^2 is provided to connect the sleeve G^2 with the top of the extension E^2. As the core, with its extension E^2, descends the contact-sleeve G^2 makes contact with the springs J, the spring H^2 being compressed. The core is then sucked upward and the spring H^2 extended until its tension causes the sleeve G to overcome the grip of the springs J. The unwinding of the spring G when being so extended causes a partial rotation of the core and its accessories.

In some cases it is convenient to place a cushioning-spring at the extreme bottom point of the reciprocating portion of the apparatus. This is illustrated by way of example in Fig. 3, where E^5 is the lower extension of the core, carrying blades E^6, suitable, say, for egg-beating purposes and the spiral buffer-spring E^7 for preventing the beater from striking too hard upon the bottom of the containing vessel. When placed in the position, the buffer-spring will of course assist in causing the return movement of the core.

In the arrangement shown in Fig. 4 the core extension E^2 is provided with a non-conducting collar L, against which a contact-sleeve G^3 is pressed by the action of a spring G^4, held between the end of the sleeve G^3 and an adjustable collar G^5, carried by a rod E^8, which

passes through the sleeve G^3 and is secured to the core extension E^2. Upon one side of this contact-sleeve G^3 is a contact-spring J', carrying at its upper end a pivoted head having a curved contact-face, one portion of which J^2 is of conducting material, while the other portion J^3 is of non-conducting material. Upon the other side of the contact-sleeve G^3 is another contact-spring J^4, which is, however, placed lower down than the movable head J^2 J^3—that is, nearer to the non-conducting collar L and the solenoid. The operation of this device is as follows: Supposing the core to be moving up under the action of the solenoid, the contact-sleeve G^3 will rise with it and the movable head J^2 J^3, lying approximately in the position indicated in full lines in Fig. 4, will have its conducting portion J^2 in contact with the sleeve G^3. Continuation of the upward movement of the core will bring the non-conducting collar L under the contact-spring J^4. The current will then cease to flow in the solenoid and the core will return by gravity. As it does so the head J^2 J^3 will be turned upon its pivot and caused to lie, as shown in chain lines in Fig. 4, with its non-conducting face J^3 upon the sleeve. A double break is thus made in the circuit. In this construction in order to start the next upward movement of the core it is necessary to have a buffer-spring or equivalent device which will act at the end of the downward stroke and give the core a sufficient upward movement to turn the movable head J^2 J^3 back again, so that its conducting-face J^2 makes contact with the sleeve G^3. As the lower part of the sleeve G^3 becomes worn away by sparking it is fed down by the pressure of the spring G^4, so as to be always in contact with the collar L. In order to distribute the wear due to sparking equally around the lower end of the sleeve G^3, a rotary motion of the core extension is desirable. Such rotary motion is obtained in the egg-beating form of the apparatus by the action of the inclined blades E^6, Fig. 3, which in their passage through the liquid egg cause the required rotation.

Fig. 5 illustrates, diagrammatically, part of an apparatus in which the reciprocating portion has both of its movements brought about by the action of the solenoid. In this construction there are two sets of contact-springs J^5, supported on rods J^6, and a contact-sleeve G^6, controlled by a spring H^3, completes the circuit through the solenoid, first by bridging across the gap between the one pair of springs J^5 and then by acting similarly in relation to the other pair. In the position shown in Fig. 5 the iron or other magnetic core E is protruding from the lower end of the solenoid D, (indicated in chain lines,) and the contact-sleeve G^6 is between the lower pair of contact-springs J^5. When the apparatus is in this position, the solenoid D is energized and draws the core E upward. The contact-sleeve G^6 is loose upon the core extension E' and is joined thereto by the spring H^3. It therefore does not follow the upward movement of that extension until the tension of the spring H^3 increases sufficiently to pull it from between the contact-springs J^5. When this occurs, the current through the solenoid is broken, but the inertia of the core E and its appurtenances carries them upward until, as shown in dotted lines in Fig. 5, the core E protrudes above the solenoid D. In this position the contact-sleeve G^6 makes connection between the upper pair of contact-springs J^5, and the solenoid D, being again energized, pulls the core down.

When the apparatus is to be used in a horizontal or other position rendering such an arrangement desirable, instead of the return-stroke being brought about by the action of gravity it may depend entirely or partly upon the action of a spring which is compressed during the instroke of the core.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In electrical reciprocating apparatus the combination with a solenoid and a core free to reciprocate therein of fixed contact-springs and a spring-controlled contact-sleeve substantially as described.

2. In electrical reciprocating apparatus the combination with a solenoid and a core free to reciprocate therein of a contact-sleeve operating to give at each stroke a partial rotation to the core substantially as described.

3. In electrical reciprocating apparatus the combination with a spring-controlled contact-sleeve having spiral grooves or slots of contact-springs adapted to enter the grooves or slots substantially as described.

4. In electrical reciprocating apparatus, the combination with a reciprocating shaft, of a contact-sleeve free to slide upon such shaft, and springs H H' connected respectively to the sleeve and to the shaft, substantially as described.

5. In electrical reciprocating apparatus, the combination of a solenoid, a support for such solenoid, a hinge connecting the solenoid to the support, a core free to reciprocate within the solenoid, a contact-sleeve loose upon an extension of the core, and having spiral grooves, a spring connecting the contact-sleeve with the extension of the core and contact-springs adapted to make connection with the contact-sleeve and enter the spiral grooves thereon, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN BROWN.

Witnesses:
EDWARD HARVEY,
THOMAS KINGHAN.