No. 788,450. PATENTED APR. 25, 1905.

P. CENTNER.

ELECTRIC RECIPROCATING TOOL.

APPLICATION FILED JAN. 24, 1905.

4 SHEETS—SHEET 1.

Fig. 1.

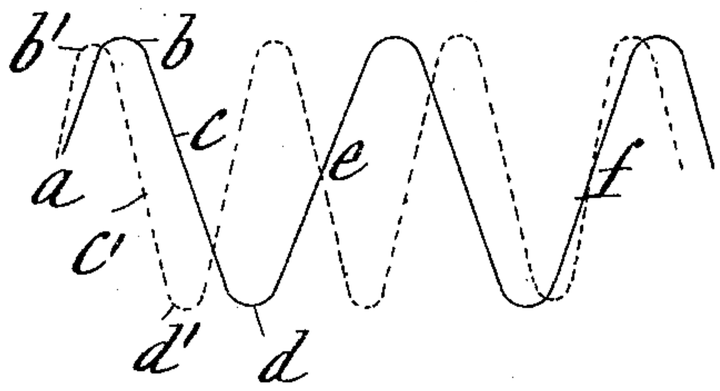


Fig. 2.

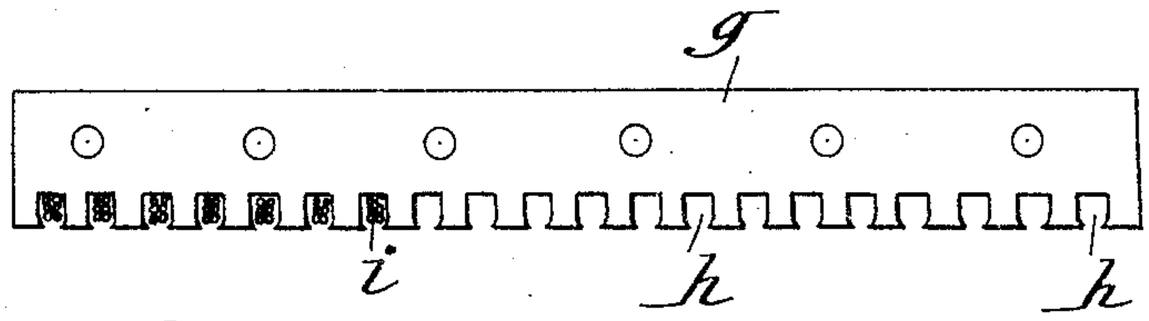


Fig. 3.

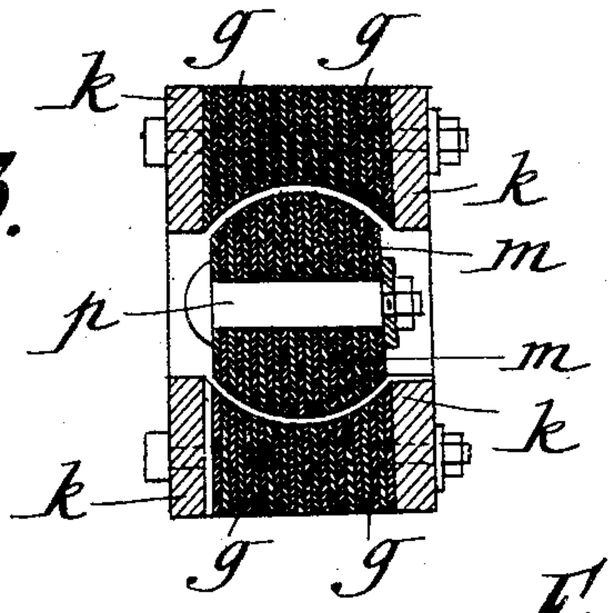


Fig. 4.

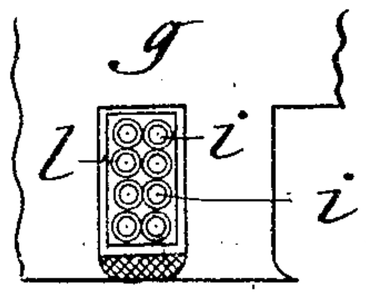


Fig. 5.

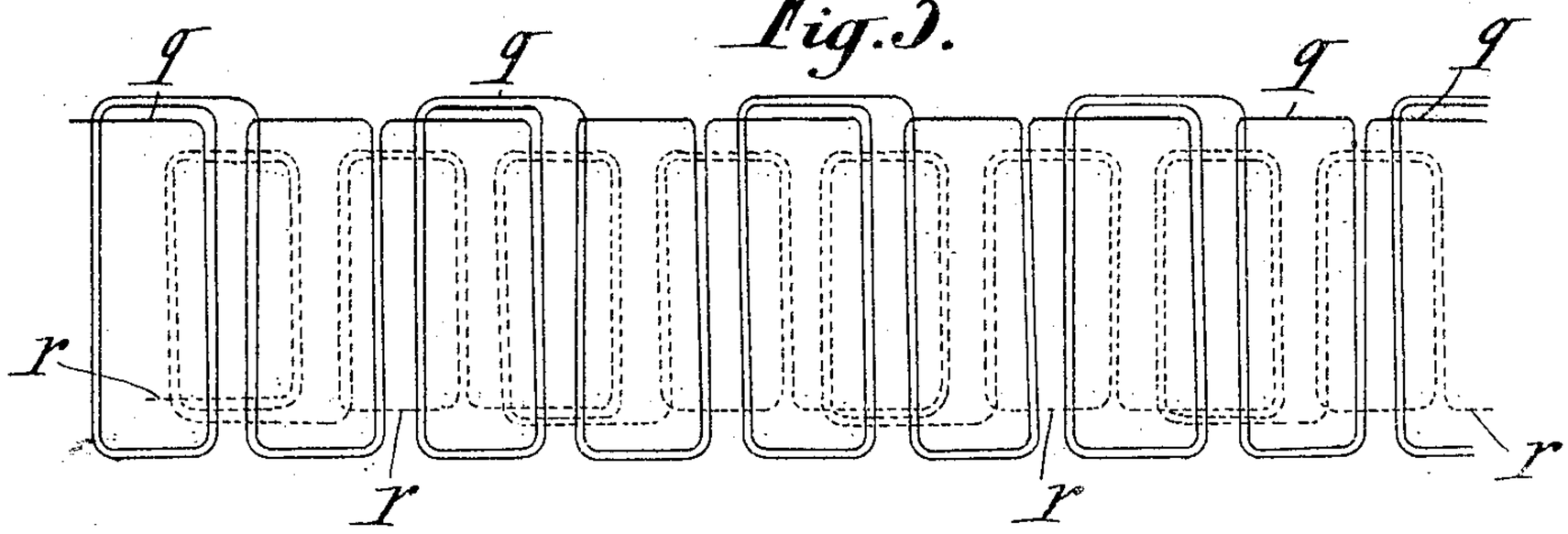


Fig. 6.

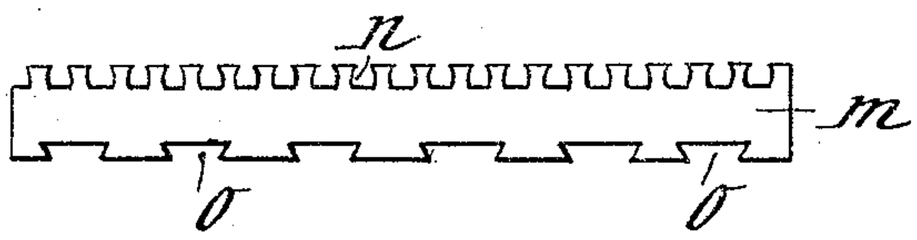
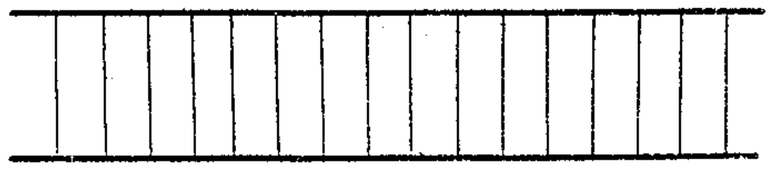


Fig. 1.



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4 SHEETS—SHEET 2.

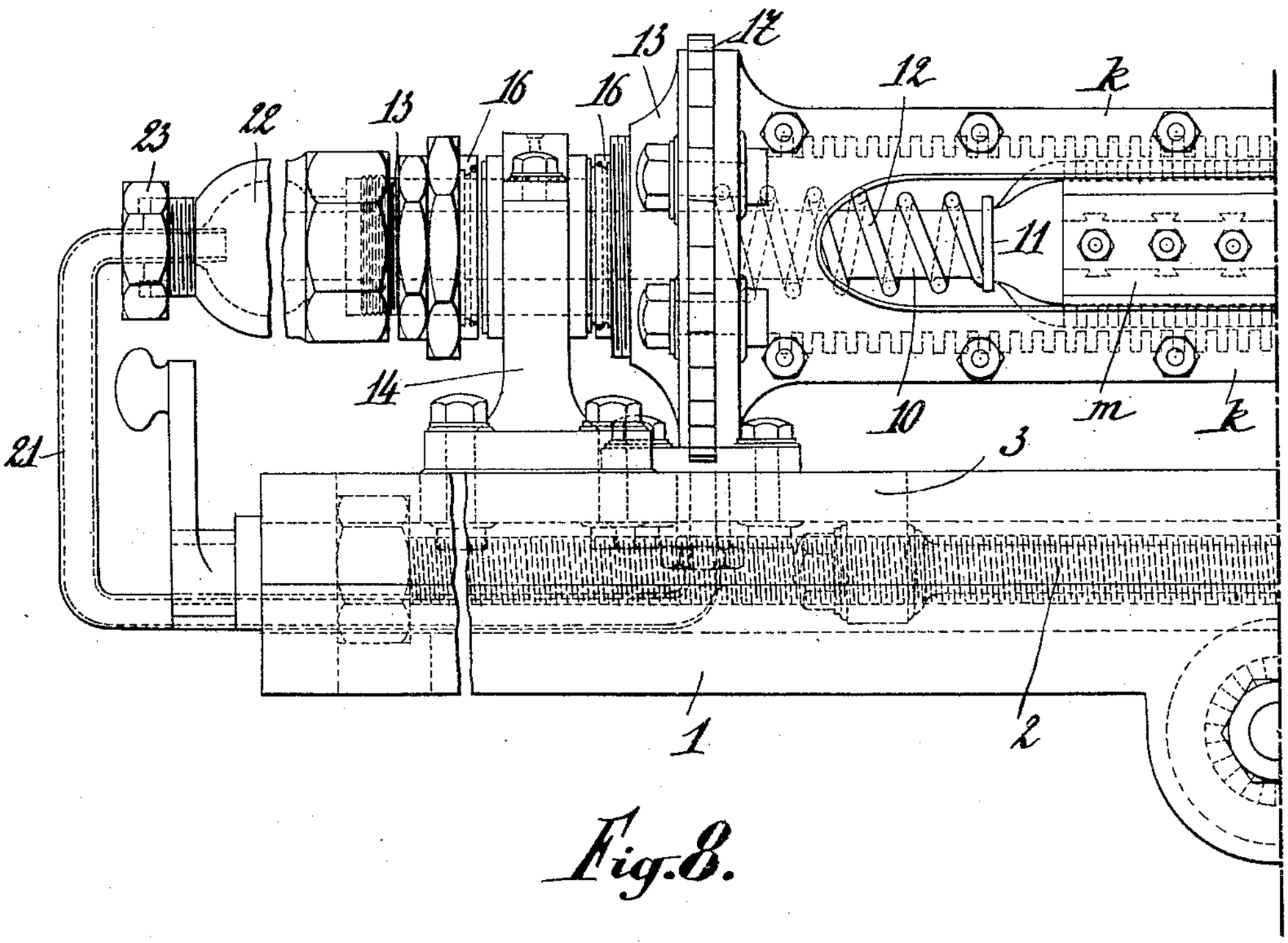
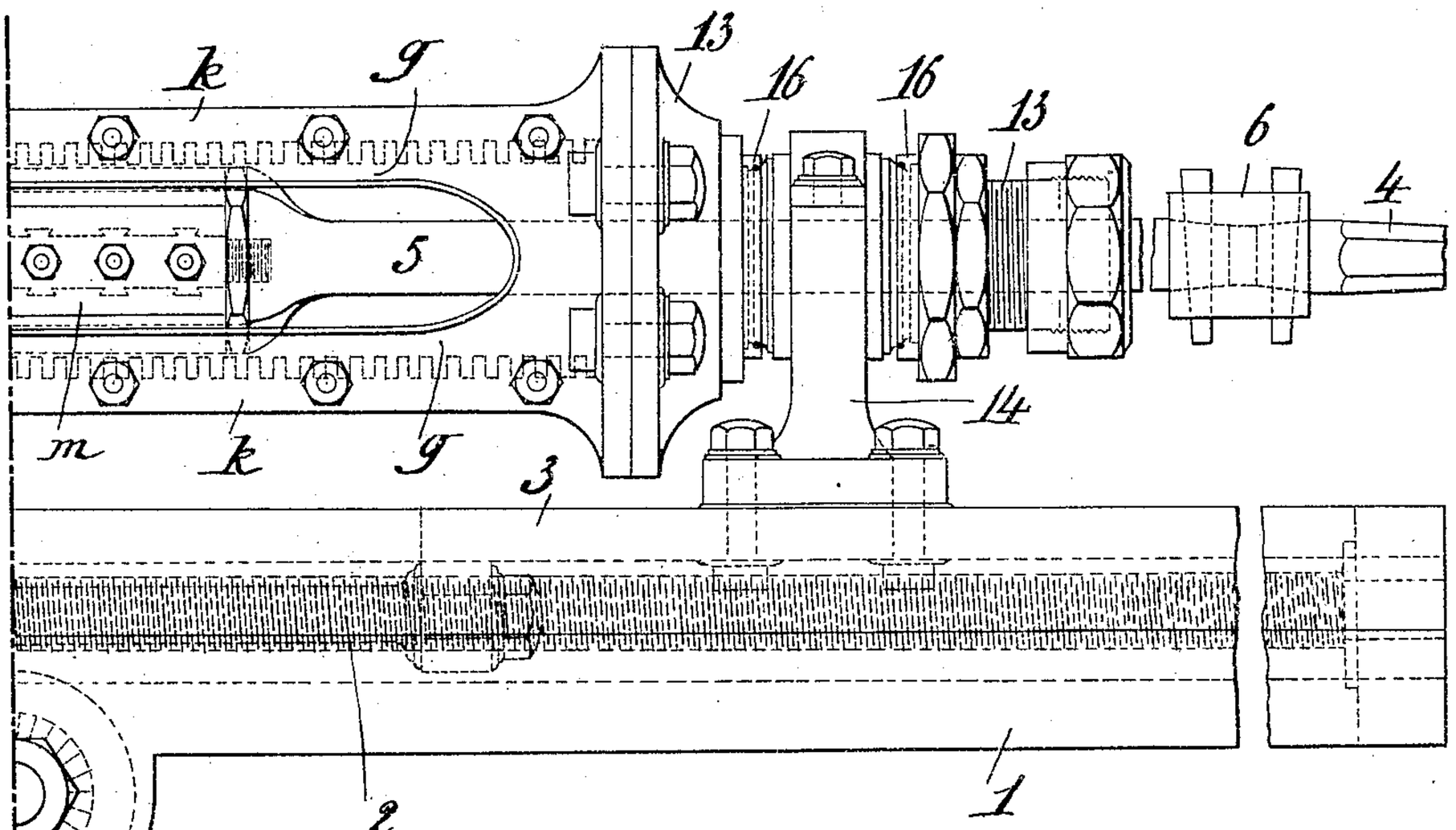


Fig. 8.



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4 SHEETS—SHEET 3.

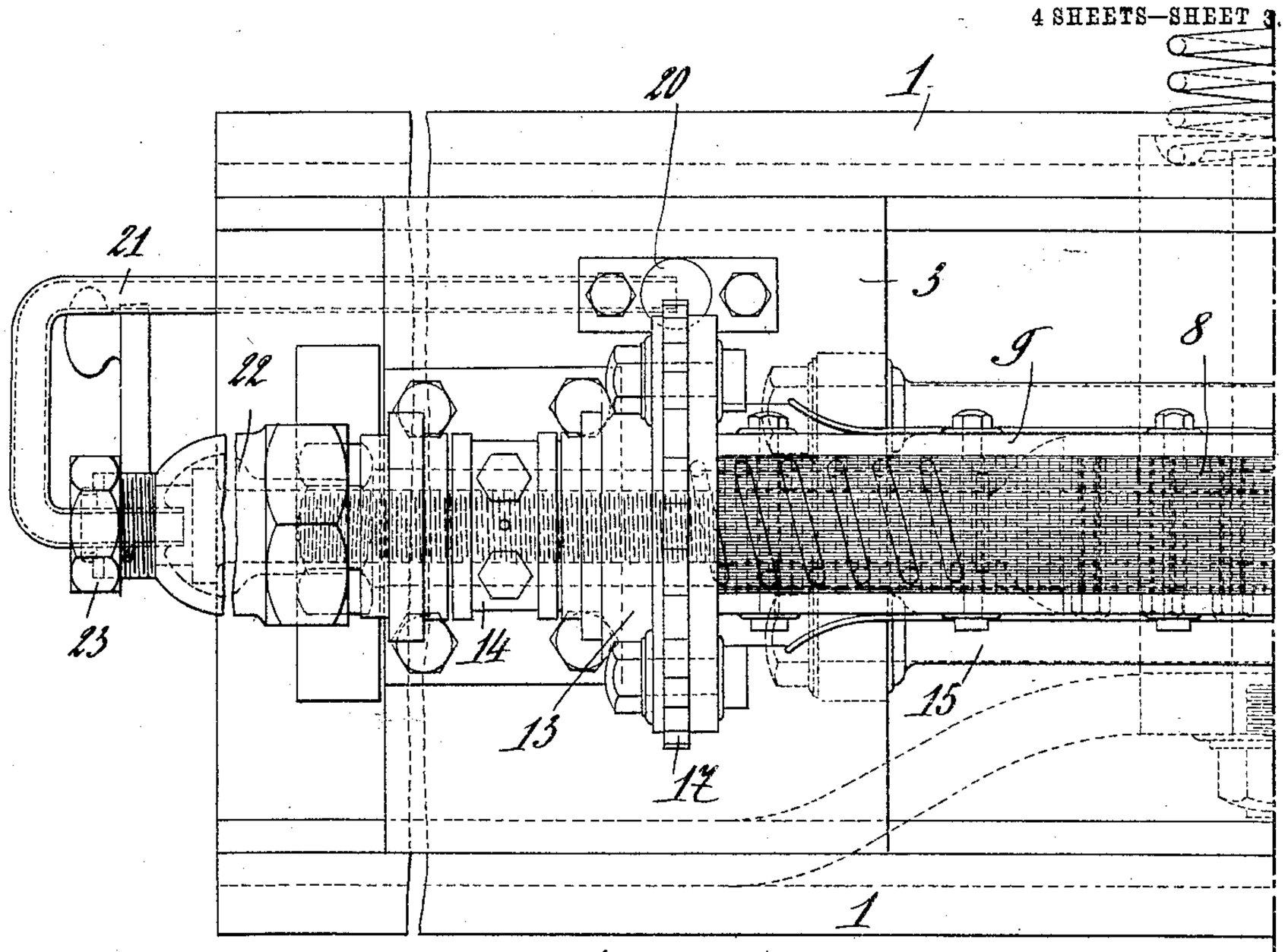
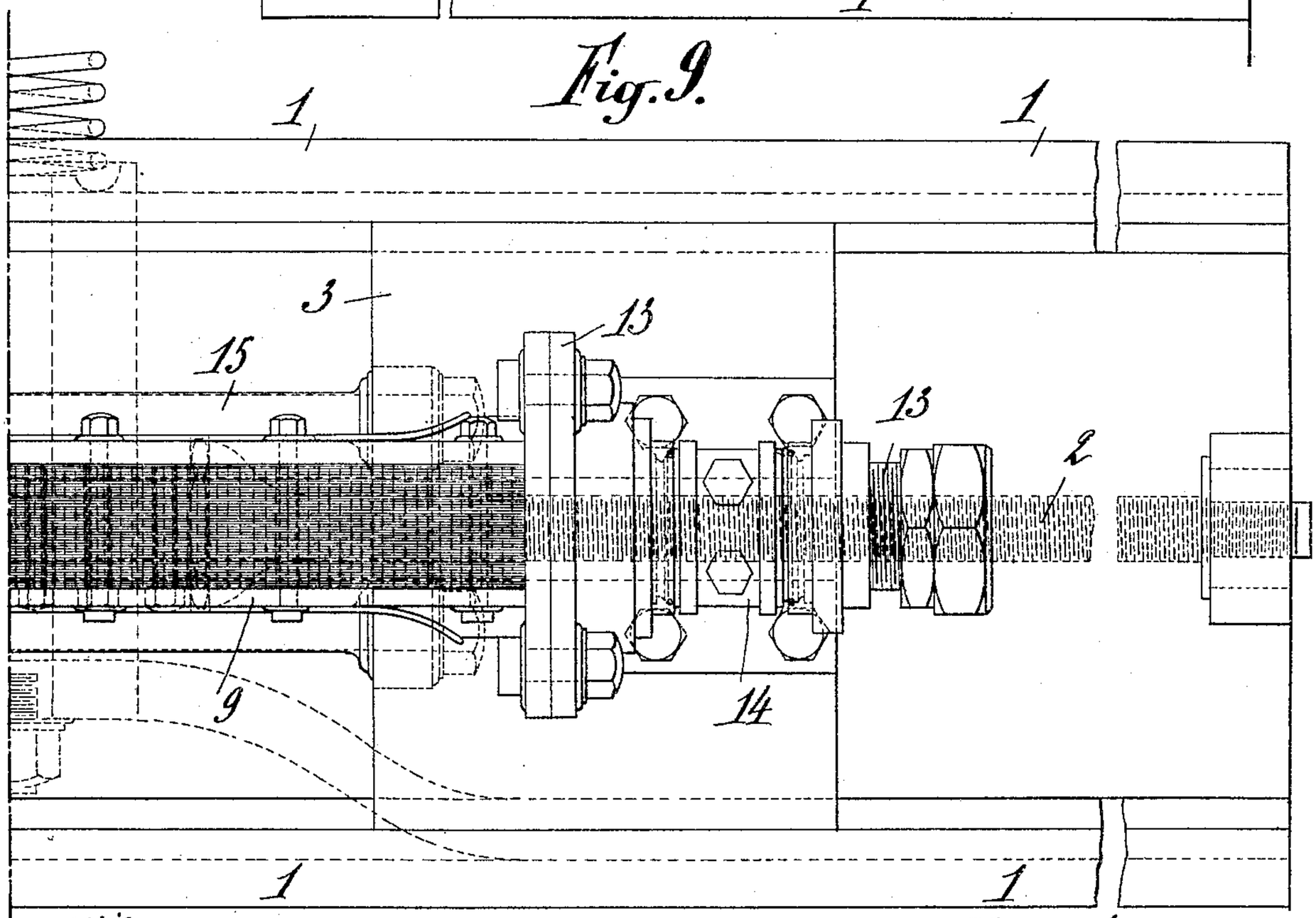


Fig. 9.



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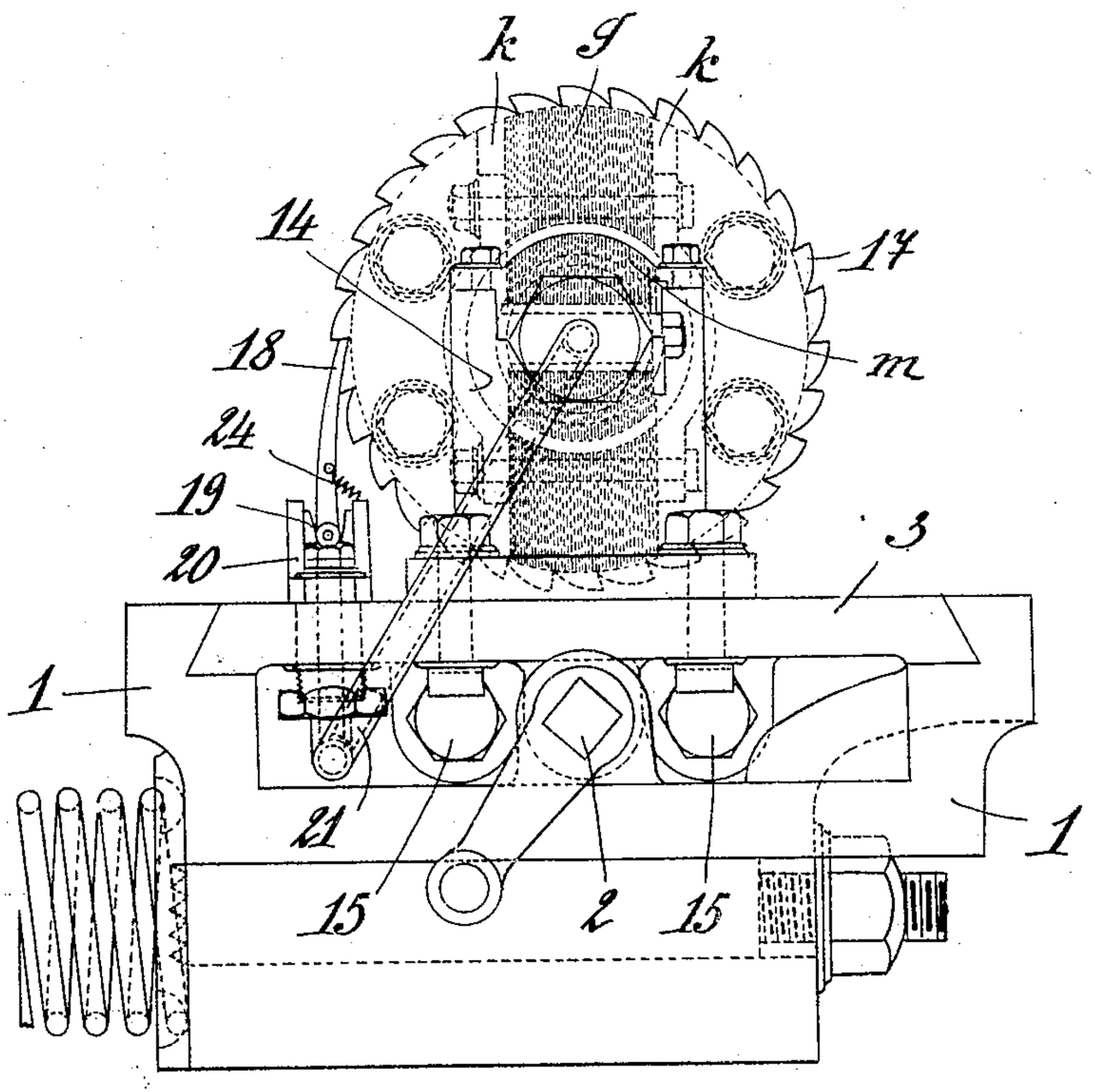
4 SHEETS—SHEET 4.

Fig. 10.



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No. 788,450. Patented April 25, 1905.

UNITED STATES PATENT OFFICE.

PAUL CENTNER, OF VERVIERS, BELGIUM.

ELECTRIC RECIPROCATING TOOL.

SPECIFICATION forming part of Letters Patent No. 788,450, dated April 25, 1905.

Application filed January 24, 1905. Serial No. 242,550.

To all whom it may concern:

Be it known that I, PAUL CENTNER, engineer, a subject of the King of Belgium, and a resident of Rue des Six-Cents Franchimontois, Verviers, Belgium, have invented certain new and useful Improvements in Electric Reciprocating Tools, of which the following is a specification.

This invention relates to improvements in electric tools having a reciprocating rectilinear motion, such as percussive drills and the like. Its main object consists in producing a rectilineally-reciprocating magnetic field for obtaining the reciprocating motion of the tool without resorting to the use of a commutator of any kind.

For the sake of clearness the invention will be hereinafter described as applied to a percussive drill; but it is to be understood that it may be applied to any kind of electric tool having a rectilinear reciprocating motion.

In the annexed drawings, Figures 1 to 7, inclusive, are diagrammatical views of the electric part of a percussive drill constructed according to the invention. Fig. 8 shows a side elevation of the percussive drill. Fig. 9 is a plan view, and Fig. 10 an end view, thereof.

As a principle the rectilineally-reciprocating field is obtained by means of a biphase winding, in which are sent two alternating currents of different frequency. Thus, referring to Fig. 1 of the accompanying drawings, the two sinoidal curves *a b c d* and *a b' c' d'* represent the two currents of different frequency. From the point *a*, which is common to both curves, the phase difference increases to the point *e*, where the phases of the two currents are in opposition. From the point *e* the phase difference diminishes again up to the point *f*, from which point the above cycle is repeated. Calculation shows that the direction of displacement of the magnetic field depends upon the size of the angle of shift between the two currents, from which it results that the direction will change at each of the points *a e f*, &c.—that is, at the moments when the differences of phase assume successively the values zero and maximum—so that the induced part will have its motion reversed at those points by the reversed action of the magnetic field.

The part of the apparatus which produces the field, and which I will call the "stator," is constituted by a number of thin soft-iron laminæ *g*, Fig. 2, of suitable dimensions and provided with notches *h*, in which are arranged the conductors *i* of the biphase winding. The laminæ *g* are bolted together between cheeks *k*, as shown, at the cross-section of the entire apparatus at Fig. 3, and they are varnished upon one of their faces in order to obviate Foucault currents. The laminæ *g* are so arranged that on the side facing the air-space between the stator and the moving part the combined laminæ have the form of a portion of a hollow cylinder for the purpose of diminishing the reluctance of the air-space, as under these conditions the opposite active surfaces of the stator and the moving part are considerably increased relatively to the width of the stator. The conductors *i*, covered with suitable insulating material, are arranged in the notches *h* with the interposition of a layer of a suitable insulating fabric *l*, as shown to an enlarged scale at Fig. 4. The winding of the conductors is arranged according to the diagram shown at Fig. 5. One of the currents flows through the conductors *q*, (shown in full lines,) the conductors *r* (shown in dotted lines) having the other current flowing through them. The several coils are wound alternately in opposite directions. The movable induced part is also constructed of thin iron laminæ *m* with notches *n*, as shown at Fig. 6, the length of this part being equal to about half the length of the stator. The notches *n* are filled with conductors formed as a developed squirrel-cage winding arranged as shown in the diagram at Fig. 7. On the side opposite to the notches *n* the laminæ are formed with dovetailed notches *o*, which serve for fixing the same upon corresponding dovetailed projections on the middle part *p*. As shown at Fig. 3, the construction is made double—that is to say, it is composed of two stators constructed as described, between which is situated the moving part composed of two sets of the laminæ

m, which are both connected to the part p, as above described. The two stators being suitably fixed to a support and the moving part being so carried as to be capable of sliding to and fro between the stators, if now there be passed through the windings q and r of the latter alternating currents of different frequency the resulting field having an alternating rectilinear motion will produce a corresponding alternating motion of the moving part, the amplitude of which will depend upon the frequency of the two currents and the number of poles of the winding.

As above stated, the above-described apparatus is applicable with advantage for producing the reciprocating motion of tools, such as percussive drills and the like, such tools being directly connected to the moving part of the apparatus.

The above-described electric arrangement having been understood, I will now refer to Figs. 8 to 10, which show how the same is to be applied in the special case of an electric percussive drill.

The drill is composed of two main parts—a fixed part or support 1, which carries the advancing screw-spindle 2 and which may be of any convenient known construction, and a moving part which can slide upon the support 1 by means of two slides 3 and which is composed of the operative devices for imparting the reciprocating motion to the drilling-tool 4, the motion of which is obtained by means of a magnetic field having a reciprocating rectilinear motion, which is produced as above stated. The cylindrical stem 5, one end of which is fixed by means of a socket-piece 6 and keys to the drilling-tool 4, is screwed at the other end to the central support of the induced movable part m of the electric motor with magnetic field having a reciprocating rectilinear motion. As hereinbefore described, this movable part is arranged parallel to the stator, which is constituted by two similar elements $g\,g$, secured between two cheeks $k\,k$ by means of screw-bolts. Under the influence of the two alternating currents of different frequency sent through the windings of the stator the movable part m has a reciprocating rectilinear motion imparted to it relatively to the stator, which motion is consequently also imparted to the drilling-tool 4. The moving part m has attached to its rear end a rod 10 of square section and with a collar 11, against which bears a helical spring 12, bearing with its other end against a cross-head fixed to or formed in one with the cheeks k. This spring serves to store up the energy of the back stroke of the moving parts and to impart the same thereto during the forward stroke. The construction of the stator and the moving part is such that the latter cannot receive any rotary motion relatively to the stator. For this reason it is necessary that the stator g shall receive the necessary intermittent rotary motion that has to be communicated to the drilling-tool 4. The arrangement for this purpose is as follows: The ends of the cheeks $k\,k$, carrying the stator, are bolted, respectively, to two pieces 13, which are made to constitute journals capable of turning in bearings 14, fixed to the slides 3, which are secured together by connecting-bolts 15 and which slide in dovetail guides on the frame 1, as shown at Fig. 10. Between the bearings 14 and collars on the journals 13 are interposed rings with antifriction-balls 16, which reduce the frictional resistance and at the same time take the thrust of the journals. For the purpose of adjusting the ball-bearings for making good wear and preventing looseness the ends of the journals 13 are formed with screw-threads, on which are screwed adjusting-nuts with lock-nuts. The rear journal 13 carries a ratchet-wheel 17, with which is engaged a pawl 18, Fig. 10, by means of which an intermittent rotary motion is imparted to the ratchet-wheel and trunnion. The pawl 18 is mounted upon a piston or plunger 19, contained in a small cylinder 20, which communicates by a pipe 21 with the outer end of a cap 22, screwed upon the end of the journal 13. The connection of the tube with the cap is effected by means of a stuffing-box 23, which allows of the rotation of the cap relatively to the tube 21. At each back stroke the rear end of the rod 10 of the induced part, which slides through a square hole in the journal 13, enters the cap 22 and compresses the air therein, so that the compressed air is made to raise the piston 19 and the pawl 18. The latter thus causes the ratchet-wheel 17 to turn through a distance of one tooth, whereby both the stator and the moving part of the drill, together with the drilling-tool 4, are all turned to a corresponding extent, the induced part being made to turn with the stator by reason of the square part of the rod 10 being carried around by the corresponding square hole in the journal 13. A spring 24, connected at one end to the pawl 18 and at the other end to an extension of the small cylinder 20, keeps the pawl in engagement with the ratchet-wheel 17 and also draws the pawl down again after it has been raised, as described.

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

1. In electric percussive drills and like tools, a device for obtaining a magnetic field having a rectilinear reciprocating motion, consisting of a biphase winding in which are sent two alternating currents of different frequency.

2. In electric percussive drills and like tools, a device for obtaining a magnetic field having a rectilinear reciprocating motion, consisting of a stator formed of a group of

iron laminæ secured side by side and having notches in which are arranged conductors forming a biphase winding through which two alternating currents of different frequency are made to pass, so as to produce a reciprocating field causing a reciprocating rectilinear motion to be imparted to a moving induced part arranged parallel to the stator and composed of iron laminæ, in notches of which is arranged a winding of a developed squirrel-cage form, substantially as described.

3. In electric percussive drills and like tools, a device for obtaining a magnetic field having a rectilinear reciprocating motion, consisting of a stator formed of two parallel groups of iron laminæ secured side by side and having notches in which are arranged conductors forming a biphase winding through which two alternating currents of different frequency are made to pass, so as to produce a reciprocating rectilinear motion to be imparted to a moving induced part arranged parallel to the stator and composed of two sets of iron laminæ having notches in which is arranged a winding of a developed squirrel-cage form, substantially as described.

4. In electric percussive drills and like tools, a device for obtaining a magnetic field having a rectilinear reciprocating motion, consisting of a stator formed of two parallel groups of iron laminæ secured side by side and having notches in which are arranged conductors forming a biphase winding through which two alternating currents of different frequency are made to pass, so as to produce a rectilinear motion to be imparted to a moving induced part arranged parallel to the stator and composed of two sets of iron laminæ having notches in which is arranged a winding of a developed squirrel-cage form, the active surfaces of said stator and of said moving part being respectively of a concave and a convex form, substantially as described.

5. In combination in an electric percussive drill, a stator provided with notches, said notches locating a biphase winding in which are sent two alternating currents of different frequency producing a rectilineally-reciprocating magnetic field, a movable induced part rigidly connected to the drilling-tool, and provided with notches in which is arranged a winding of a developed squirrel-cage form, said movable part being mounted upon rods 5 and 10 which pass through journals 13 fixed to the framing of the stator, said rod 10 being of square section passing through a square hole in the rear journal 13, and penetrating at its back stroke into a cap 22 so as to compress the air therein, a cylinder 20, a tube 21 connecting said cap with said cylinder, a piston 19 in said cylinder, a pawl 18 carried by said piston, a ratchet-wheel 17 fixed to the framing of the stator, said ratchet-wheel being engaged by said pawl, whereby a step-by-step motion is imparted to said stator together with said movable part and said drilling-tool, substantially as described.

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

PAUL CENTNER.

Witnesses:
JOS. LAFFIN,
ED. THIRIONET.