(No Model.)

4 Sheets—Sheet 1.

M. J. ROBERTS.

ELECTRO OSTEOTOME.

No. 436,304. Patented Sept. 23, 1890.

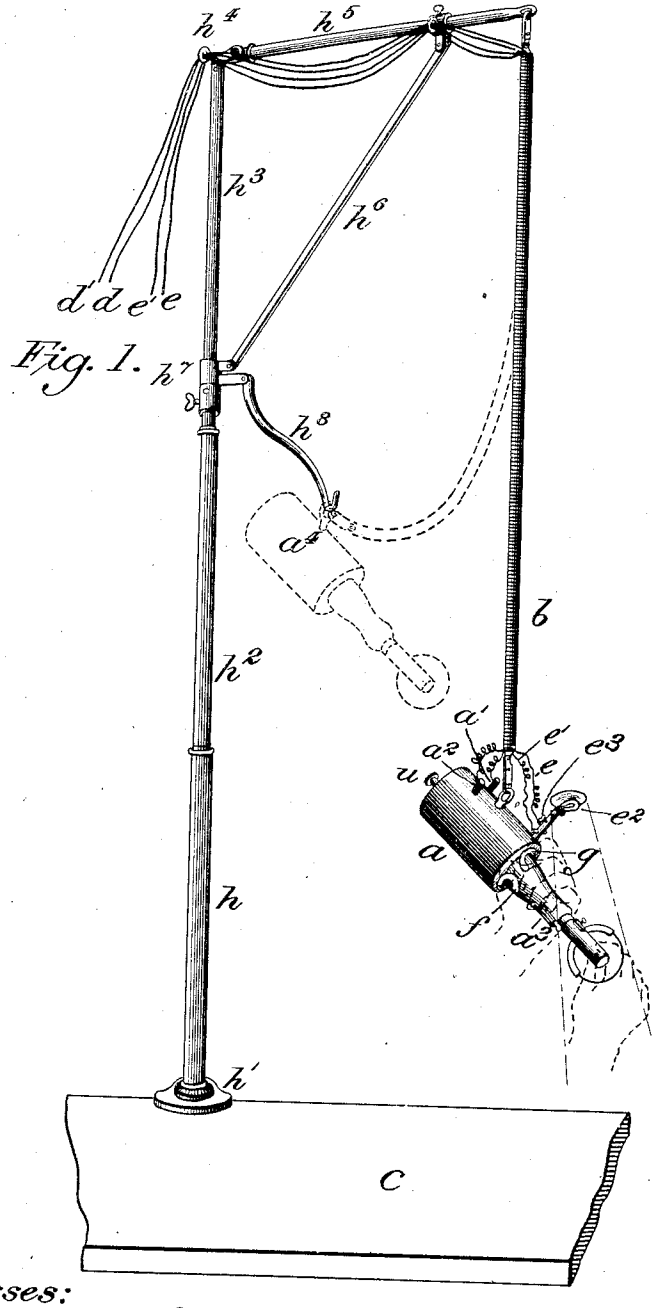

Fig. 1.

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Inventor:
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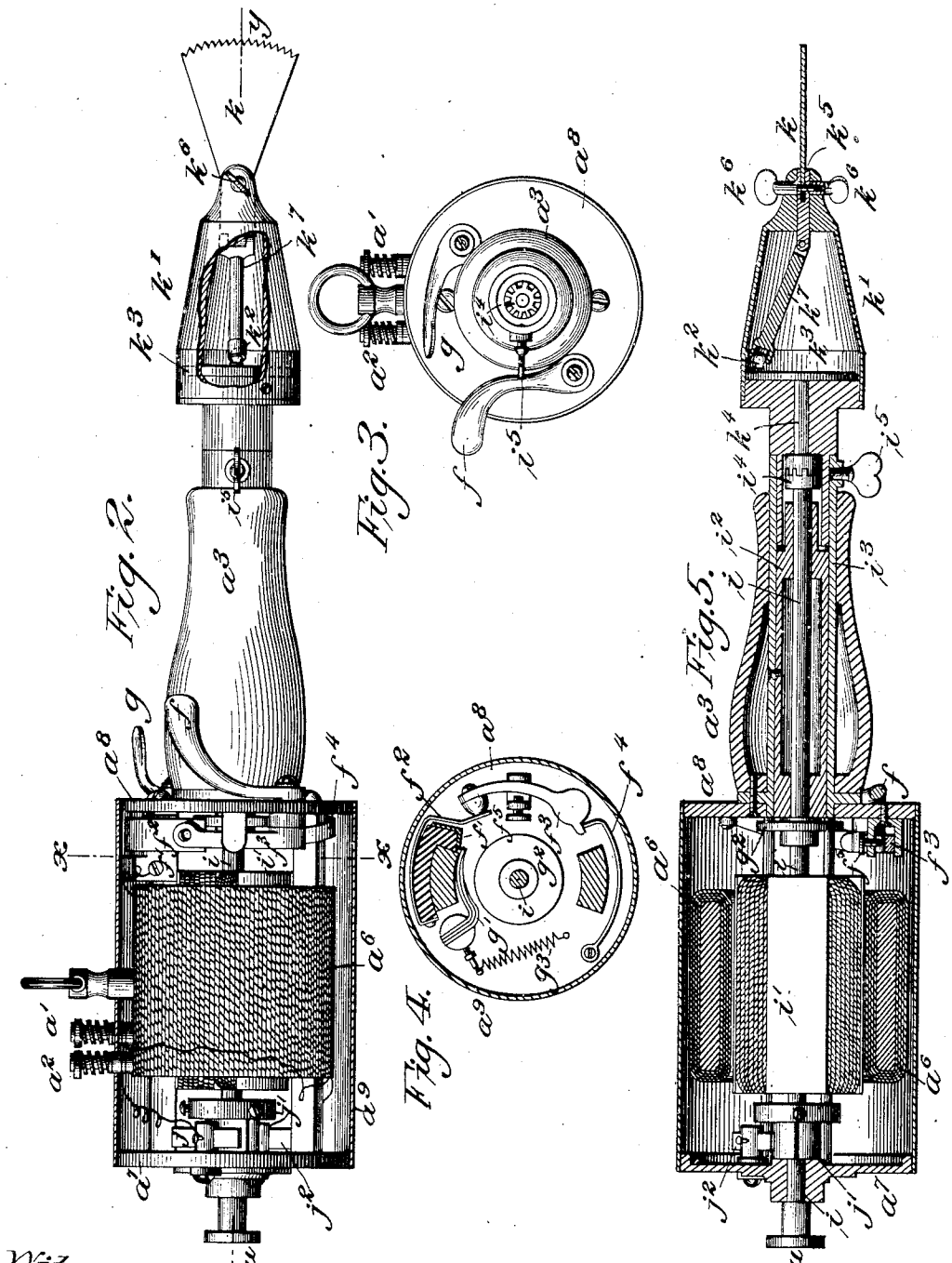
(No Model.) 4 Sheets—Sheet 2.

M. J. ROBERTS.

ELECTRO OSTEOTOME.

No. 436,804. Patented Sept. 23, 1890.



Witnesses:
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Inventor:
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(No Model.)

4 Sheets—Sheet 3.

M. J. ROBERTS.

ELECTRO OSTEOTOME.

No. 436,804. Patented Sept. 23, 1890.

Fig. 6.

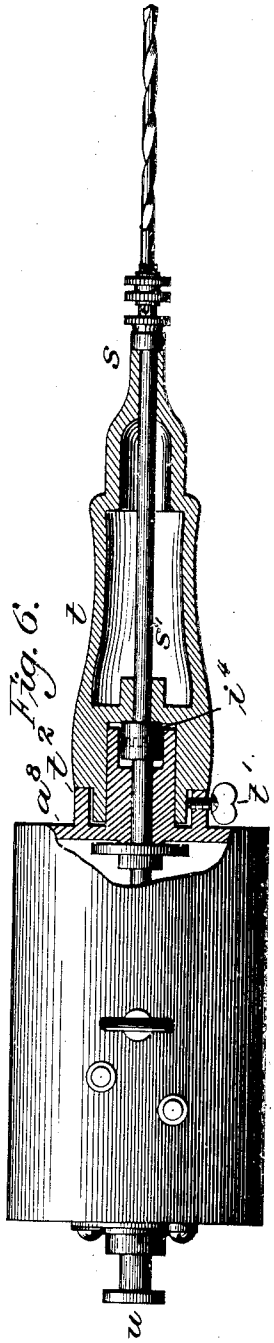
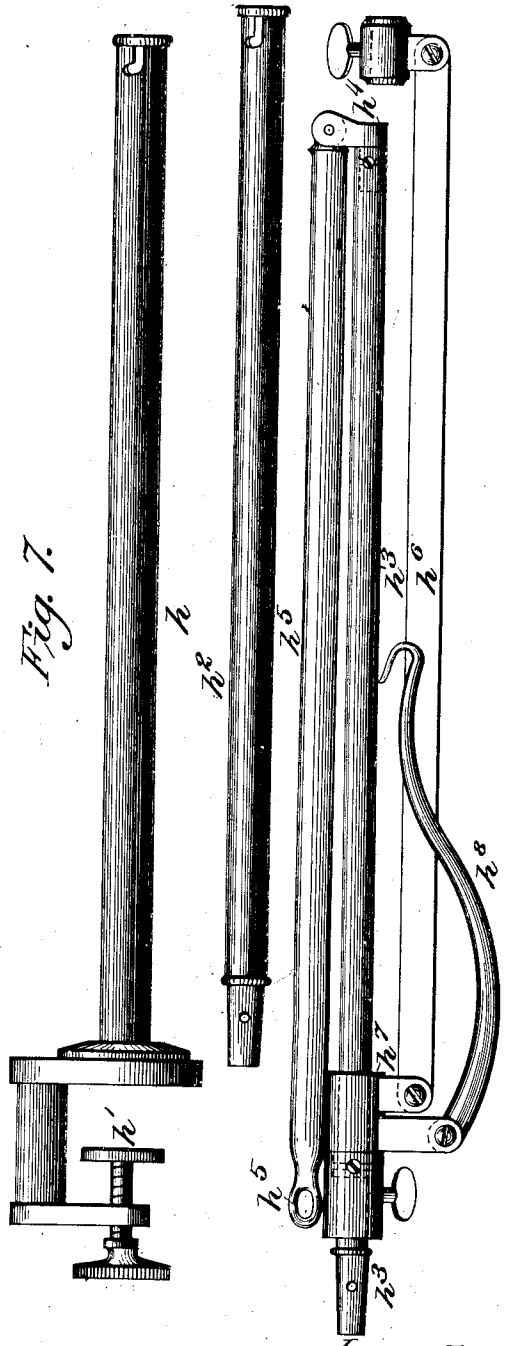


Fig. 7.



Witnesses:
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(No Model.)

4 Sheets—Sheet 4.

M. J. ROBERTS.

ELECTRO OSTEOTOME.

No. 436,804.

Patented Sept. 23, 1890.

Fig. 9.

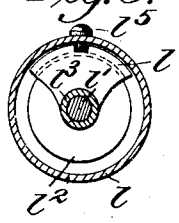


Fig. 8.

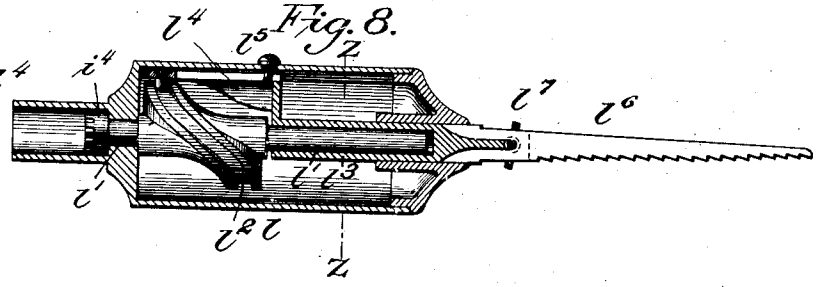


Fig. 10.

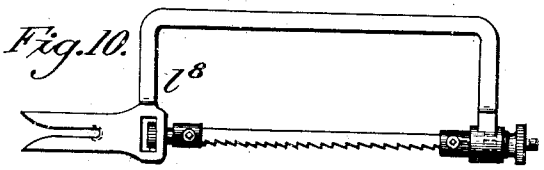


Fig. 11.

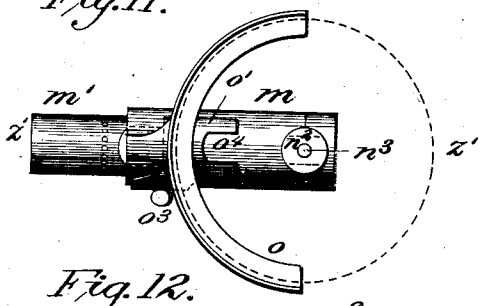


Fig. 12.

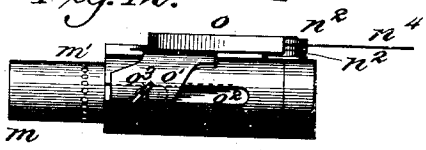


Fig. 13.

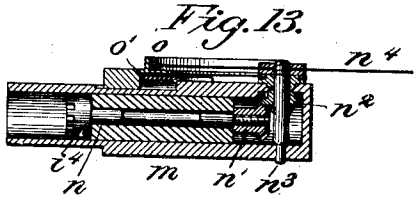


Fig. 14.

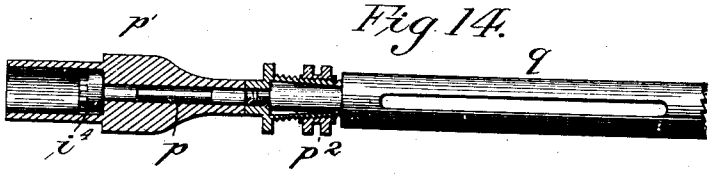


Fig. 15.

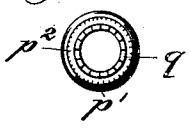
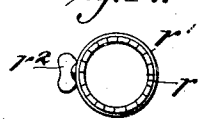


Fig. 16.

Fig. 17.



Witnesses:

Jas. W. Graham

Albin N. Long.

Inventor:

Milton Josiah Roberts.

UNITED STATES PATENT OFFICE.

MILTON JOSIAH ROBERTS, OF NEW YORK, N. Y.

ELECTRO-OSTEOTOME.

SPECIFICATION forming part of Letters Patent No. 436,804, dated September 23, 1890.

Application filed December 4, 1889. Serial No. 332,598. (No model.)

To all whom it may concern:

Be it known that I, MILTON JOSIAH ROBERTS, a citizen of the United States, and a resident of New York, county and State of New York, have invented certain new and useful Improvements in Electro-Osteotomes, of which the following is a specification.

The object of my invention is to supply means by which operations in bone surgery may be quickly and efficiently performed.

As the apparatus devised by me to carry out the object of my invention is actuated by means of electricity, I have designated it the "electro-osteotome."

By the use of the improved apparatus hereinafter described any operation in bone surgery can be rapidly, smoothly, and with positive certainty performed in a fraction of the time heretofore required for such work, the construction of my electro-osteotome being such that the operator's attention and strength are directed solely to guiding and controlling the instruments.

To particularize, my invention embraces an electromotor embodying new features of constructions, which enable the operator to firmly grasp the instrument and control its operation. These consist of, first, a suitably-formed hand-piece secured to one end of the motor, through which the shaft of the armature passes, thus imparting motion to the various tools held in special tool-holders attached to the end of the hand-piece; second, a lever connected to a switch in the motor and projecting from the body thereof in close proximity to the hand-piece and arranged to be actuated by the thumb of the hand which grasps said hand-piece, by the manipulation of which the motor-circuit may be opened and closed, as desired; third, a lever located under the forefinger of the hand and connected to a brake-shoe opposed to a disk on the armature-shaft, by the manipulation of which the speed of the motor can be regulated or its motion instantly arrested. I have also devised an adjustable crane, from which the motor is suspended by means of an elastic cord supporting it in convenient position over the operating-table, the elasticity of which permits the motor to be moved freely into any desired operative position.

The invention further embraces a variety of interchangeable tool-holders adapted to be readily attached to and removed from the motor, and other novel features of construction, all of which will be hereinafter fully described, reference being had to the accompanying drawings, in which—

Figure 1, Sheet 1, is a perspective view of my improved electro-osteotome and supporting-crane in operative position. Fig. 2, Sheet 2, is a side elevation of the electromotor with an oscillating saw attached, partly in section. Fig. 3, Sheet 2, is an end view of the motor with the instrument removed. Fig. 4, Sheet 2, is a transverse section on the line $x\,x$, Fig. 2. Fig. 5, Sheet 2, is a longitudinal section on the line $y\,y$, Fig. 2. Fig. 6, Sheet 3, shows a modification in the hand-piece of the motor. Fig. 7, Sheet 3, represents the parts of the supporting-crane detached and folded for transportation. Fig. 8, Sheet 4, is a longitudinal central section of a reciprocating-tool holder and saw attached thereto. Fig. 9, Sheet 4, is a transverse section of the same on the line $z\,z$, Fig. 8. Fig. 10, Sheet 4, is a side elevation of a bow-saw. Fig. 11, Sheet 4, is a front view of a circular-saw holder. Fig. 12, Sheet 4, is a side elevation of the same. Fig. 13, Sheet 4, is a central section on the line $z'\,z'$, Fig. 11. Fig. 14, Sheet 4, is a central section of a chuck holding a crown or cylindrical saw. Fig. 15, Sheet 4, is an end view of the same. Fig. 16, Sheet 4, is a side elevation of a trephine; and Fig. 17, Sheet 4, is an end view of the same.

In Fig. 1, a represents the electro-magnetic motor in position for use suspended by the spiral spring b from the crane which is clamped to the edge of the operating-table c. The electric conductors $d\,d'$, guided in eyes on the upper end of the crane, pass down through the spring b and are clamped in the binding-posts $a'\,a^2$ of the motor, thereby completing the circuit of the motor with the source of electricity connected to the other ends of the conductors $d\,d'$. Another pair of electric conductors $e\,e'$, arranged parallel with the conductors $d\,d'$, connect the small electric lamp e^2 to another source of electricity. These conductors are so formed where incased by the suspending-spring b as to expand and contract with it.

The manner in which the apparatus is used

is clearly shown at Fig. 1, the handle a^3 being grasped by one of the hands, (represented by dotted lines,) and the end of the handle or tool-holder attached thereto being controlled and guided by the thumb and forefinger of the other hand, (also shown by dotted lines.) The whole weight of the motor is sustained by the supporting-spring b, which permits it to be moved into any desired position without exertion on the part of the operator, his whole energies being directed to the guidance of the cutting-tool actuated by the motor.

Several devices are employed to connect a variety of bone cutting and drilling tools to the motor, and in Fig. 1 is shown a circular saw arranged to rotate in a plane parallel to the axis of the motor-shaft and adapted to perform simple, cuneiform, and longitudinal osteotomes.

Means are provided for giving the operator perfect control over the motor without releasing his hold thereon—viz., the switch-lever f, projecting from the end of the motor and conveniently located under the thumb of the hand, by a simple movement of which the motor-circuit can be opened and closed at pleasure, and the brake-lever g, located under the forefinger of the hand, by the manipulation of which the speed of the motor may be regulated to a nicety or its motion instantly arrested.

The stem of the electric lamp e^2 fits into a hole in the motor-frame and is readily detached therefrom, it being only required when the part operated upon is insufficiently lighted from other sources, a reflector being used to direct its light thereon, and it is provided with a switch e^3 for opening and closing its circuit.

All of the conducting-wires d d' e e', as before stated, pass down the interior of the spring b, thus avoiding as much as possible all chances of entanglement and obstructions to the speedy and effective use of the instrument. Any arrangement of these wires may be made by which these objects are attained.

The crane is composed of several pieces so constructed as to occupy but little space when taken apart, as shown at Fig. 7, Sheet 3, which are securely connected together and form a rigid support for the instrument, as shown at Fig. 1. It consists of the inferior piece h, provided with a clamping device h' at its lower end and a bayonet-slot at its upper end, a middle piece h^2, having a plug and pin at one end adapted to fit into the upper end and bayonet-slot of the inferior piece h and at its other end a bayonet-slot, a superior piece h^3, having a plug and pin at its lower end adapted to fit into the end and bayonet-slot of the middle piece h^2 and a swiveling piece h^4 at its upper end, an arm h^5, pivoted to the swiveling piece h^4 and provided with an eye at its free end, to which the suspension-spring b is attached, a brace h^6, pivoted to a sleeve on the arm h^5, adapted to be clamped thereto and to a swiveling sleeve h^7 on the superior piece h^3, and a hook h^8, pivoted to the piece h^7, on which the electromotor can be hung out of the way of the operator, as shown by the dotted lines a^4, Fig. 1.

By the construction of the upper part of the crane the arm h^5 and attached parts may be raised and lowered into any position desired.

The details of the electromotor are shown in Figs. 2 to 5, Sheet 2. The cylindrical field-magnet a^6 with the plates a^7 and a^8, secured to the ends of the pole-pieces of the magnet, constitute the frame of the motor. The shaft i of the armature i' rotates in bearings in the plates a^7 and a^8, the front bearing consisting of the piece i^2, secured to the sleeve i^3, which is fastened to plate a^8, and on which is secured the handle a^3. On the end of the shaft i in the sleeve i^3 is secured one half of the clutch-coupling i^4, the other half of which is secured to or forms a part of the shaft of the tool-holder held in the end of the sleeve i^3 by means of the thumb-screw i^5 passing through the sleeve with its end set into one of a series of depressions made in the shank of the tool-holder. By this means the tool-holders are rigidly connected to the motor, and may be set in any desired position relatively thereto. One of the brushes j of the commutator j' is connected with the binding-post a^2 and the other brush j^2 to one end of the field-magnet wire, the outer end of which is connected to the binding-post a'. This field-magnet wire at the other end of the motor is broken, one part being joined to the fixed plate f' and the other to the spring f^2, which when in its normal condition is away from the plate f'. To close this motor-circuit, an arm f^3, located inside the motor, is arranged to act on the spring f^2 and is connected to the thumb-piece f, before described, which is in close proximity to the handle a^3. The thumb-piece f is held away from the handle a^3 by the spring f^4 bearing against the tail of the arm f^3, and the movements of the arm f^3 and thumb-piece f are limited by means of the adjustable stop f^5. The brake-lever g is secured to the shoe g', arranged inside the motor so as to bear on the periphery of the disk g^2, secured to the armature-shaft i. This shoe g' is normally held away from the disk g^2 by means of the spring g^3.

The tool shown attached to the motor in the views, Figs. 2 to 5, comprises a sectional saw k, projecting from the end of the conical case or holder k' and having imparted to it an oscillating motion. The means employed for converting the continuous rotary motion of the motor-shaft i into the oscillating motion consists of the spherical crank-pin k^2 on the disk k^3, secured to the short shaft k^4, which is connected to the motor-shaft by the clutch-coupling i^4, the split jaw k^5, pivoted in the end of the conical case k' by the thumb-screw and nut k^6, which also clamps the crank of the saw k in the jaw k^5, and the bar k', hinged at one end to the pivoted jaw k^5 and having at its other end a cylinder-hole fitting over

the spherical crank-pin k^2. As the crank-pin k^2 rotates the attached end of the bar k^7 is carried around with it, the other end of the bar being held in line with the axis of the crank-shaft k^4, but free to move in one direction by its hinged connection to the jaw k^5. The jaw, with the saw held therein, is oscillated on the thumb-screw and nut k^6.

A reciprocating device for holding straight saws adapted to be used in making cross-cuts and other straight cuts is shown at Figs. 8 and 9, and consists of a cylinder-body l, in which is fitted to rotate a central shaft l', provided with a part of the clutch-coupling i^4 and carrying the peripheral cam l^2. The forward end of this shaft l' rotates in the sleeve l^3, which is fitted to reciprocate in the front bearing of the body l, and is provided with an arm l^4, extending over the cam l^2, a pin on the arm fitting therein. A screw-stud l^5, passing through the body, fits into a longitudinal slot formed in the arm l^4, thereby preventing it from rotating with the arm l^2. The front end of the sleeve l^3 is slotted in such a manner as to leave a central web, the straight saw l^6 being clamped therein by the screw l^7, as shown in Fig. 8. This holder is adapted to hold the bow-saw l^8, Fig. 10, and other instruments requiring a reciprocating movement.

The construction of the holder for operating circular saws in a plane parallel to the axis of the motor-shaft, by which similar cuneiform and longitudinal osteotomes may be performed, is given in Figs. 11, 12, and 13. The body m fits into the sleeve i^3 and is held therein by the screw i^5. The depressions m' in the shank of the body m, in which the end of the screw i^5 fits and by which the two may be held in any desired position relatively to the motor, are clearly shown in Figs. 11 and 12. In bearings in the body m is fitted to rotate the central shaft n, provided with a part of the clutch-coupling i^4, by which it is connected to the armature-shaft i and has secured to its other end the miter-gear n', which meshes into the miter-gear n^2, secured to the transfer-shaft n^3. The hub of this miter-gear n^2 projects from the side of the body m and has flat surfaces formed on it, as clearly shown at Fig. 11, the object of which will be hereinafter explained. The projecting end of the shaft n^3 is provided with a screw-thread, on which is fitted the hub of the circular saw n^4. In a dovetailed slot formed in the body is fitted the shank of the guard o, which is shaped, as shown, so as to cover the central shaft and the periphery of the circular saw n^4. The shank of the guard o and the slot in which it fits are so made that the guard can only be removed from the body m by sliding it forward toward the front end of the body, and when it has been placed in position and the saw m^4 fixed on the shaft n^3 it is prevented from moving forward by means of the locking device o', formed of sheet metal to closely inclose the body and having a dovetailed projection arranged to fit into the longitudinal dovetailed slot o^2, formed in the body. This locking device is firmly clamped in position by means of the thumb-screw o^3.

The front end of the locking device o' has an opening o^4, which when the device is sliding forward embraces the flat sides of the head of the miter-gear n^2 and acts as a wrench to hold the shaft n^3 stationary while the saw is being screwed on or removed from the shaft. By this construction it is evident that saws and guard-plates of different sizes may be attached to and removed from the holder with facility, which is very essential with this class of instrument, as it is often necessary to change the cutting-tool in the middle of an operation.

A clutch adapted to hold common and hollow drills, trephines, circular saws, and other rotating tools is shown at Figs. 14 and 15. It is formed to fit into the sleeve i^3 of the motor, and has a central shaft p passing through the body p', and connected to the shaft i by the clutch-coupling i^4. The front end of the shaft p is provided with ordinary screw-clamp jaws p^2 for holding the shank of the tool placed therein, which in the drawings is represented as a hollow or cylindrical drill q.

The trephine r, Figs. 11 and 12, for removing circular pieces of bone, has a shank adapted to be held by the screw-clamping jaws p^2. It is provided with a cylindrical gage r', clamped thereon by the screw r^2, and by means of which the depth of the cut is determined.

Instead of the various tool-holders being attached to the end of the hand-piece a^3 of the motor, their body portions may be enlarged so as to constitute hand-pieces, the electromotor being attached directly thereto. This modification is shown at Fig. 6 applied to an ordinary chuck s for holding drills and other rotating tools, whose shaft s' is provided with one shaft of the clutch-coupling i^4 for connection to the motor-shaft i', as in all of the other previously-described devices. The bearing of the end plate a^8 of the motor is prolonged and fits into the end of the hand-piece, which is firmly held therein by the thumb-screw t' passing through the flange t^2, extending from the end plate a^8 and bearing against the hand-piece or into one of a series of depressions formed therein.

The rear end of the motor-shaft i is provided with a knob or milled hold u, by means of which the shaft is held or rotated when desired.

The motor is entirely surrounded by a light casing a^9 to cover up and protect all of the working parts.

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

1. In combination, an electric motor, a handle or hand-piece in substantially the same axial line as the motor at the one end thereof, by which the motor is held and controlled, an armature or motor rotating shaft arranged to

pass longitudinally through said handle for operating the tool to be worked, and a circuit opening and closing switch connected with the motor outside of the handle and to one side of it for operation by a digit of the hand which grasps the handle, substantially as set forth.

2. In combination, an electromotor, a hand-piece connected thereto, by which the motor is held and controlled, a crank-lever located over the hand-piece, and a brake-shoe connected thereto arranged to act on the motor-shaft and retard the speed of the same when the lever is depressed by one of the digits of the hand grasping the hand-piece.

3. In combination, an electromotor, a hand-piece connected thereto, by which the motor is held and controlled, a switch-lever located over the hand-piece in position to be operated by the thumb of the hand grasping the hand-piece to open and close the motor-circuit, a brake-lever, also located over the hand-piece in position to be operated by the fore-finger of the hand, and a brake-shoe connected to the brake-lever arranged to act on and retard the speed of the motor-shaft when its lever is depressed.

4. In an electro-osteotome, in combination, an electro motor, a hand-piece projecting from one end thereof, in which the armature-shaft rotates, a detachable tool-holder adjustably attached to the end of the hand-piece, a shaft in the tool-holder connected to or actuating the tool held thereby and provided with a clutch-coupling connecting it to the motor-shaft, substantially as set forth.

5. In an electric osteotome, in combination, an electric motor, a hand-piece at one end of the motor, an armature or motor rotating shaft arranged to pass through said hand-piece, a detachable tool-holder, and an adjustable supporting-crane and an elastic suspension cord or spring by which the motor is suspended from the crane, substantially as set forth.

6. In an electro-osteotome, in combination, an electromotor provided with a hand-piece and a detachable tool-holder, an adjustable supporting-crane, a hollow elastic suspension cord or spring, and electric conductors connected to the motor passing through the suspension cord or spring and guide-eyes on the upper part of the crane, substantially as set forth.

7. In an electro-osteotome, in combination, an electromotor, a hand-piece projecting from one end thereof, in which the armature-shaft rotates, a detachable tool-holder adjustably attached to the end of the hand-piece, a shaft in the tool-holder connected by a coupling to the armature-shaft and provided with a crank, a split tool-clamping jaw pivoted in the end of the tool-holder, and a bar hinged to the inner end of the pivoted jaw end held and controlled at its other end by the crank-pin, substantially as set forth.

8. In an electro-osteotome, in combination, an electromotor, a hand-piece projecting from one end thereof, the armature-shaft of the motor passing through the hand-piece and provided with a clutch at its end, a tool-holder having a shank fitting in the end of the hand-piece, a shaft in the tool-holder provided at its end with the counterpart of the clutch on the armature-shaft, and a screw passing through the hand-piece and fitting into one of a series of depressions in the shank of the tool-holder to clamp it firmly in place, substantially as set forth.

9. In an electro-osteotome, in combination, the electromotor comprising the armature i' and field-magnet a^6, the plate or head a^8, the switch-lever f and arm f^3, pivoted therein, the spring f^4, the spring-plate f^2, against which the end of the arm f^3 bears, connected to the field-magnet wire, and the fixed plate f, also connected to the field-magnet wire, substantially as set forth.

10. In an electro-osteotome, in combination, the electromotor comprising the armature i' and field-magnet a^6, the armature-shaft i, the disk g^2, secured thereon, the plate or head a^8, the brake-lever g and brake g', pivoted therein, and the spring g^3, substantially as set forth.

11. In an electro-osteotome, in combination, the case or cylinder k', the shaft k^4, rotating therein, the disk k^3, secured on the end of the shaft k^4, the spherical crank-pin k^2, projecting from the disk, the split jaw k^5, pivoted to the holder k', the connecting-bar k^7, hinged to the jaw k^5 and fitted over the spherical crank-pin k^2, the sectional saw k, and the thumb-screw and nut k^6, forming the pivot for the jaw and clamping the saw-spring, substantially as set forth.

12. In an electro-osteotome, an electromotor provided with a hand-piece and a detachable tool-holder, an electric light attached to the motor, an adjustable supporting-crane, and an elastic suspension cord or spring by which the motor is suspended from the crane, substantially as set forth.

The foregoing specification of my new and improved electric osteotome signed by me this 13th day of November, 1889, in the presence of the below-subscribed witnesses.

MILTON JOSIAH ROBERTS.

Witnesses:
EDGAR TATE,
E. M. CLARK.