No. 711,065. Patented Oct. 14, 1902.

J. F. MUMFORD.

MACHINE FOR MAKING BRUSHES.

(Application filed Aug. 18, 1900.)

(No Model.) 5 Sheets—Sheet 1.

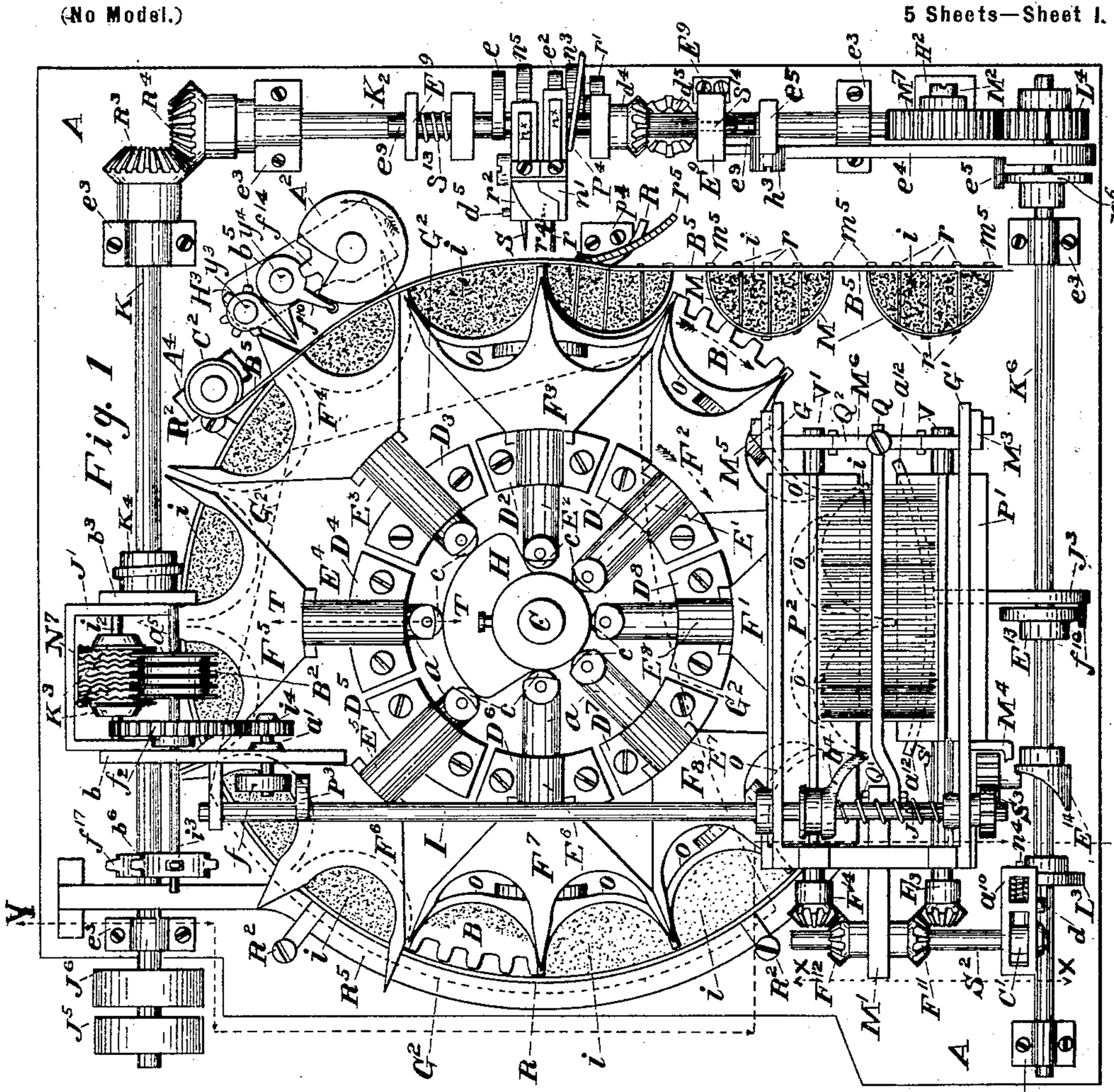

Fig. 1

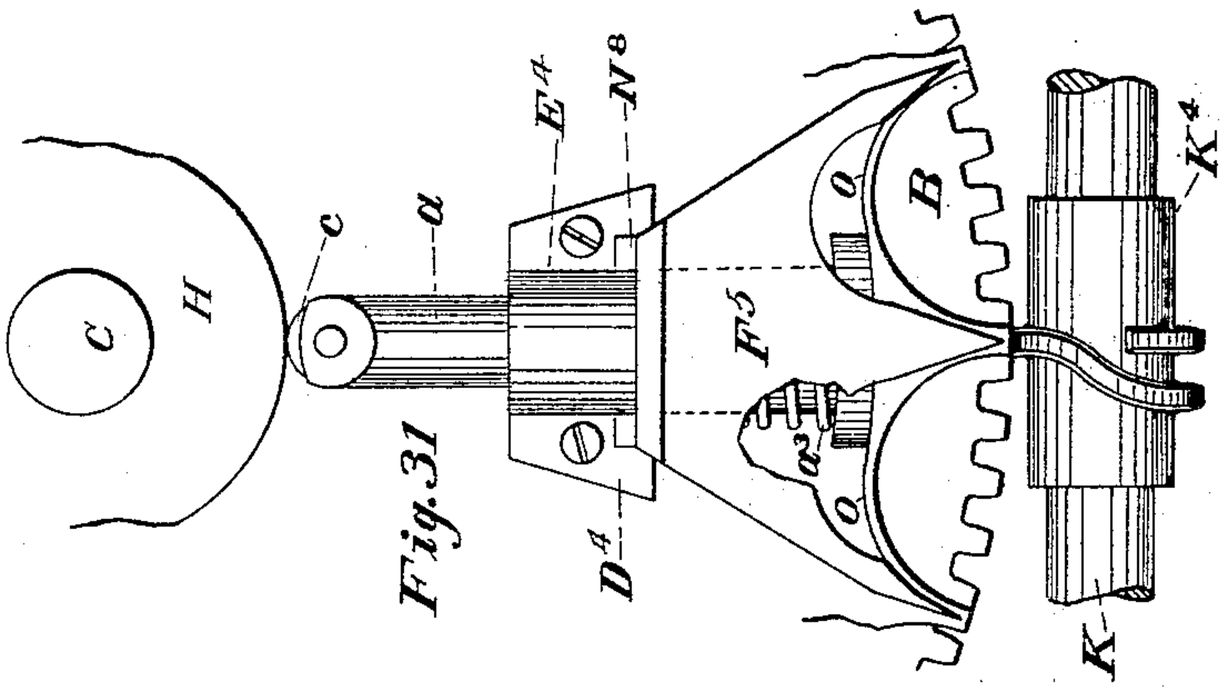

Fig. 31

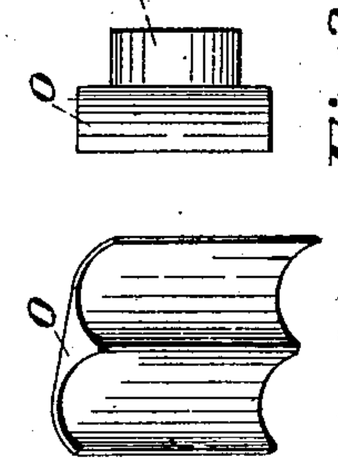

Fig. 30

Fig. 32

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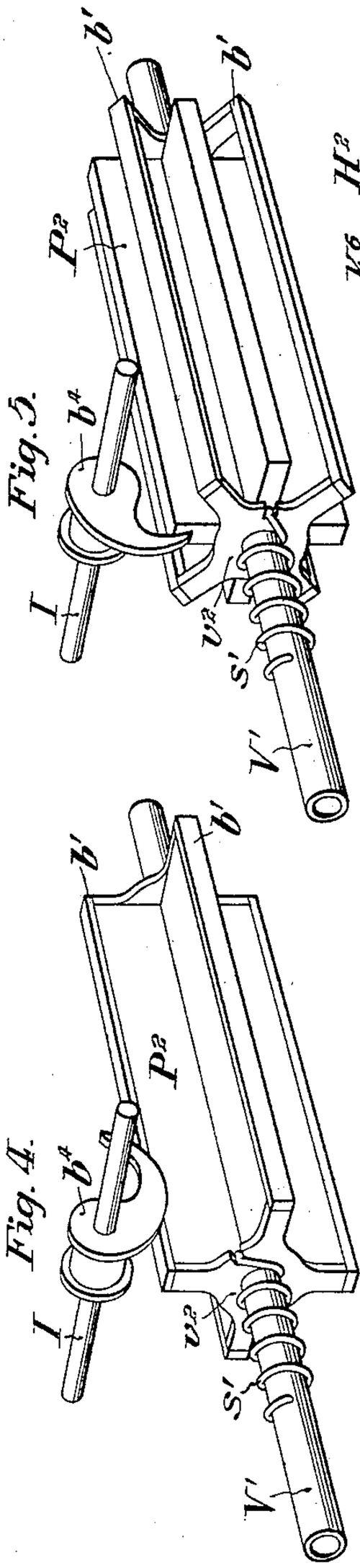

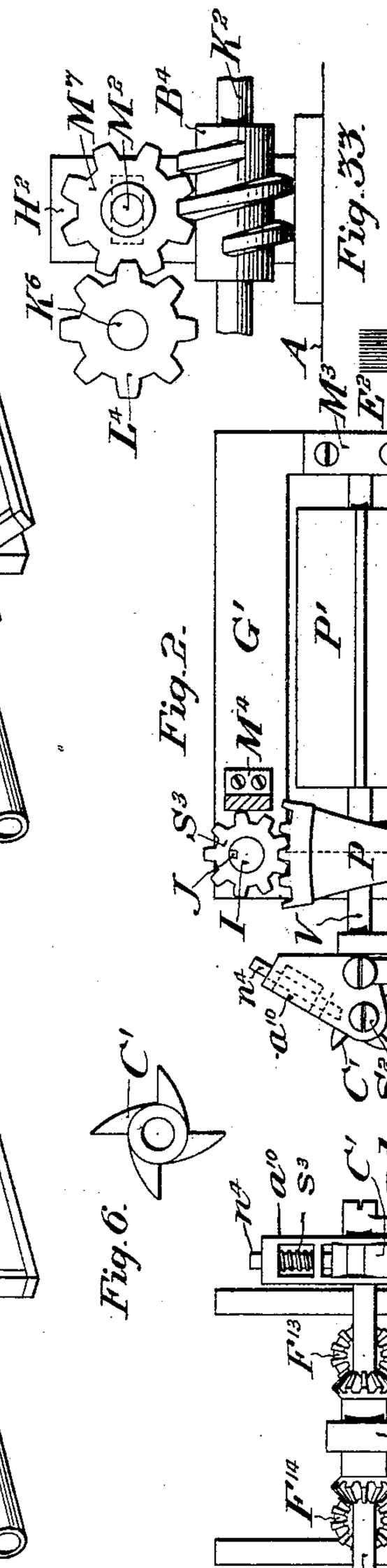

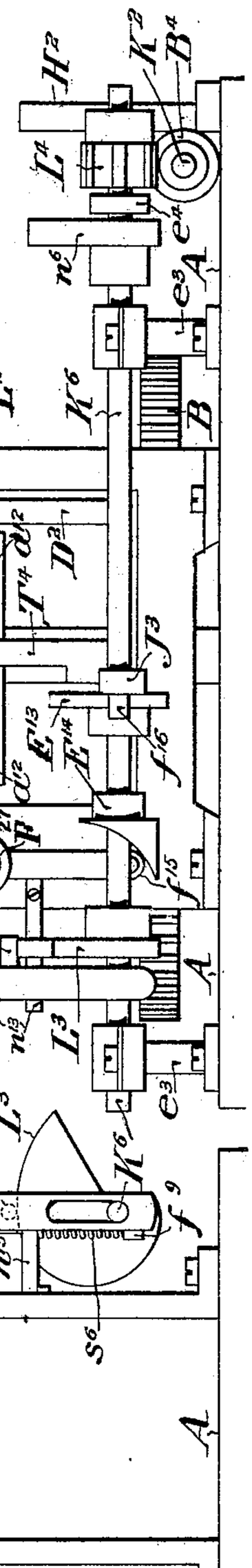

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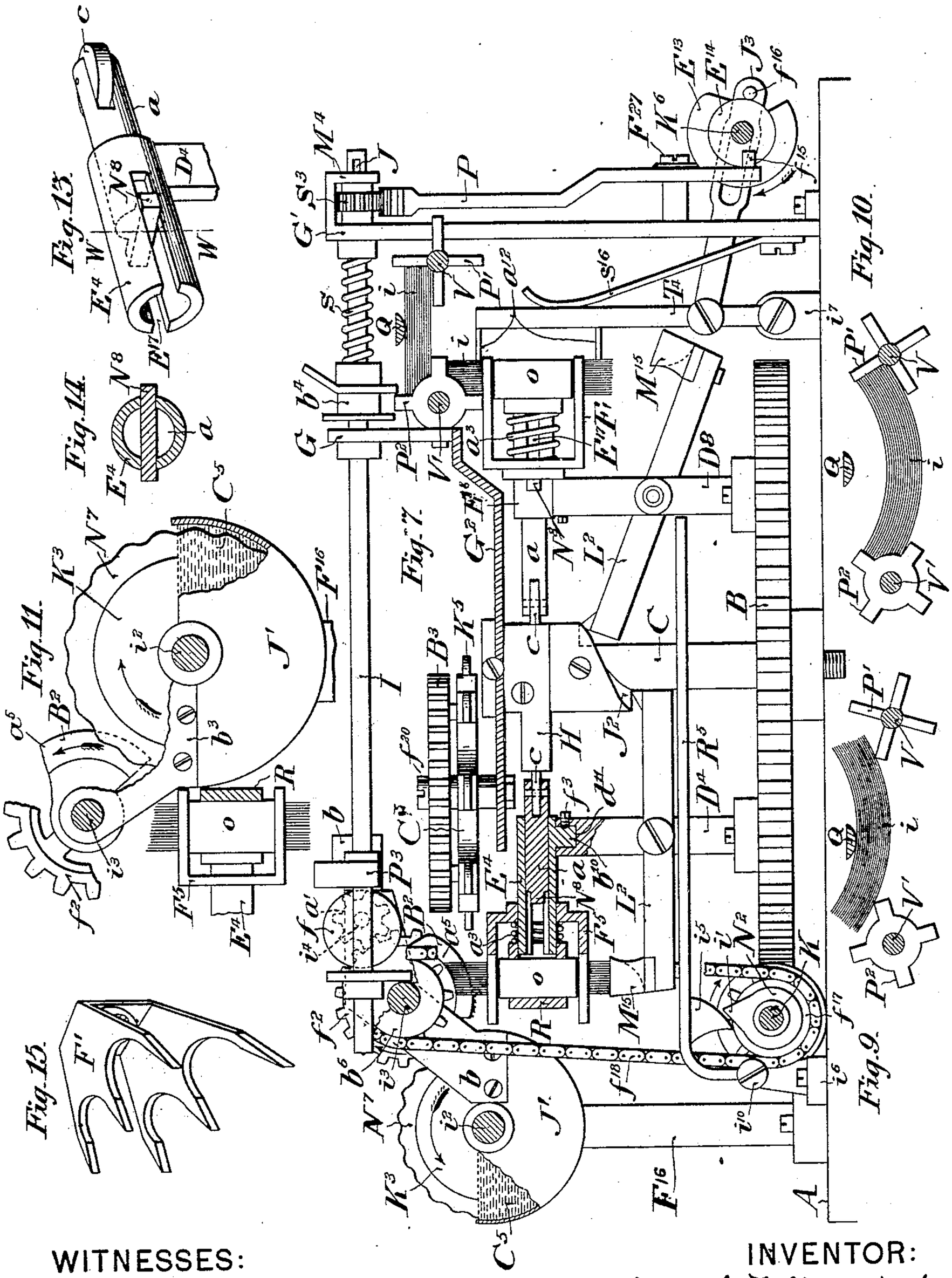
(No Model.) 5 Sheets—Sheet 3.



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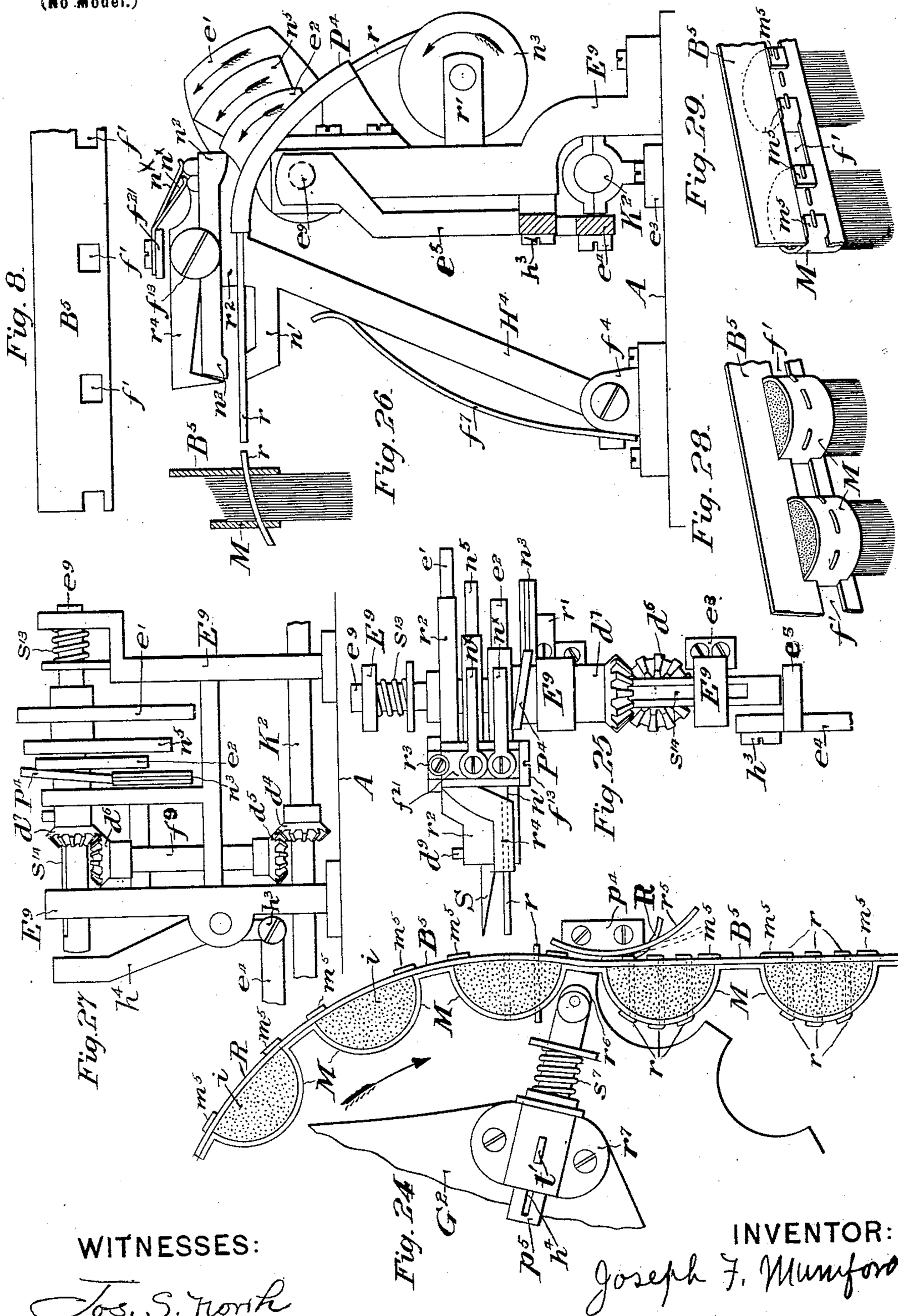
(Application filed Aug. 18, 1900.)

(No Model.) 5 Sheets—Sheet 4.



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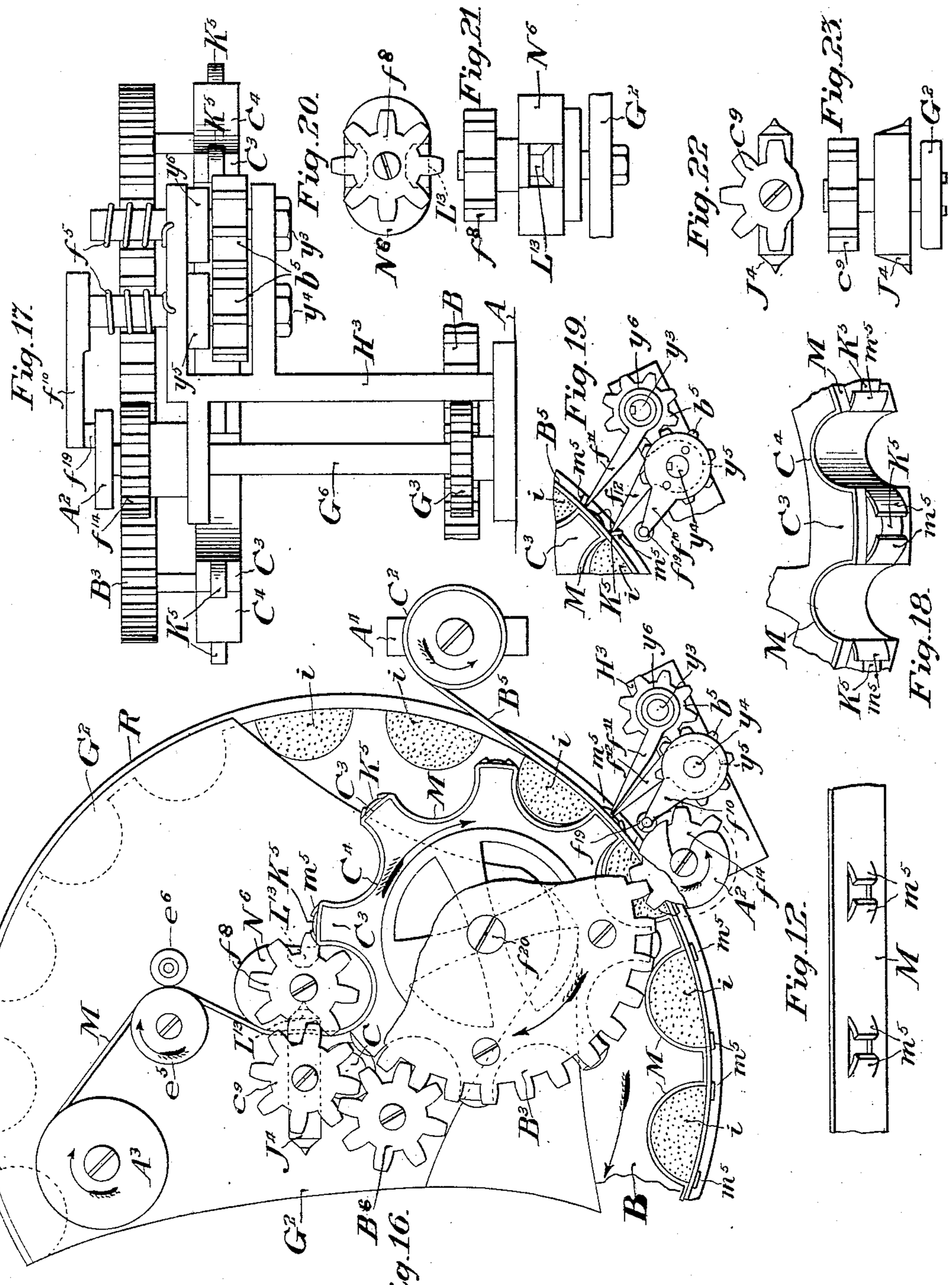
(Application filed Aug. 18, 1900.)

(No Model.) 5 Sheets—Sheet 5.



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JOSEPH F. MUMFORD, OF PHILADELPHIA, PENNSYLVANIA.

MACHINE FOR MAKING BRUSHES.

SPECIFICATION forming part of Letters Patent No. 711,065, dated October 14, 1902.

Application filed August 18, 1900. Serial No. 27,352. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH F. MUMFORD, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented new and useful Improvements in Machines for Manufacturing Brushes, which improvement is fully set forth in the following specification and accompanying drawings.

The object of my invention is to provide a machine for the automatic, continuous, and rapid manufacture of half brush-knots, said half-knots to be subsequently made up into brushes used for various purposes, such as lather-brushes, paint or varnish brushes, &c.; and it consists of half brush-knots in which the bristles are bound between two continuous strips of thin sheet metal, one of the strips having tongues slit therein and bound by said tongues to the other strip, which has perforations cut therein, the mass of bristles being then bound together with wires through aforesaid strips and are then ready to be made up into brushes.

Generally stated, my improved machine, considered as an entirety, in its preferred form comprehends, first, mechanism for holding and rocking a charge of bristles; second, mechanism to deliver the bristles from the rockers to the forms; third, a series of forms and cups to hold and carry the bristles around the machine for manipulation; fourth, mechanism to impart an intermittent rotary motion to the forms and cups; fifth, means to impart a vibratory motion to the cups; sixth, mechanism to close and compress the bristles; seventh, means to cement the ends of the bristles; eighth, mechanism to slit tongues in a strip of sheet metal of selected width; ninth, mechanism to pass said strip into recesses and convey said strip to bristles; tenth, means to upset the tongues in said strip against another strip, also of selected width; eleventh, mechanism to perforate the mass of bristles and strips and also force a piece of wire through the said perforation and cutting the wire therefrom; twelfth, means to clench projecting ends of wire against sides of strips to hold all the parts securely together, and means to regulate a portion of said machine. All the aforesaid mechanism is contemporaneously operated in the running of the machine.

In the accompanying drawings I show and herein I describe a good form of a convenient embodiment of my invention, the particular subject-matter claimed as novel being hereinafter definitely set forth.

In the accompanying drawings, Figure 1 is a plan view of a machine embodying a good form of my invention. Fig. 2 is a view in front elevation, showing that portion of the machine in which the rocking and delivery mechanisms are located. Fig. 3 is an end view of Fig. 2 on the dotted line $x\,x$, Fig. 1, showing that portion of the apparatus for turning the rockers and delivering the bristles to the forms. Fig. 4 is an enlarged view in perspective of one of the rockers with the grip closed by a cam. Fig. 5 is another view of the aforesaid rocker with the grip released from the aforesaid cam. Fig. 6 is a view of a ratchet employed in turning the rockers. Fig. 7 is a view in side elevation, sight being taken on the supposed dotted line Y Y, Fig. 1. With this view is shown a section of one of the forms and its movements, section being shown on the dotted line T T, Fig. 1. Fig. 8 is a view of a portion of one of the binding-strips. Figs. 9 and 10, respectively, are views of the rockers, bristles, and bending-bar, showing positions assumed in action. Fig. 11 is a view in side elevation of the cement-pot with supply and delivery mechanism. Fig. 12 is a view of one of the binding-strips, showing the slitted portion with the tongues projecting therefrom. Fig. 13 is a view of radial arm with a portion of stand, the compressor-rod and shoulder, and cam-roller. Fig. 14 is a sectional view of Fig. 13 on dotted lines W W. Fig. 15 is a perspective view of the compressor. Fig. 16 is a top plan of forming-wheel on a supporting-plate G^2 and binding mechanisms, showing metal strip, forming-die, and punch for slitting tongues in the strips, forming the strips in recesses in the forming-wheel, conveying same to bristles, and upsetting and binding the tongues against another strip, said plan being taken separately from Fig. 1, as it would obscure view in said Fig. 1. The position said plate G^2 will occupy when in place over the forms on Fig. 1 is shown by the dotted lines G^2 G^2 G^2 G^2 in said Fig. 1. Fig. 17 is a view in front elevation of the forming-wheel and the upsetting

and driving mechanism. Fig. 18 is a view of a portion of the forming-wheel, showing recesses and projections with a portion of the metal strip formed therein. Fig. 19 is a separate view of the upsetting device, showing the jaws in action on the tongues in the metal strip. Figs. 20 and 21 are, respectively, views of a plan and elevation of the forming-die. Figs. 22 and 23 are also views of a plan and elevation of the punch for slitting the metal strip. Fig. 24 is a top plan view of the device with the bristles bound by the two metal strips and ready to be bound by the wires. The clenching device on the supporting-plate is also shown in this view. Fig. 25 is a top plan view of the device to perforate and wire the mass of bristles and strips together. Fig. 26 is a view in side elevation, showing a portion of Fig. 25. Fig. 27 is a view in rear elevation of Fig. 25, showing the shifting device and driving mechanism. Fig. 28 is a front view in perspective of a section of the finished half-knots. Fig. 29 is a rear view of Fig. 28. Figs. 30 and 32 are views in front and side elevations of the bristle-carrying forms. Fig. 31 is an enlarged plan view of the radial arm, bristle-form, bristle-compressor, compressor rod and roller with spring, and a portion of cam to operate the compressor. In this figure is also shown a view of the screw-cam which operates a part of the machine. Fig. 33 is a view in elevation of a part of my apparatus to regulate the speed of a portion of the machine which carries the cams.

In the organization of my improved machine as shown in the accompanying drawings the operative parts are mounted upon and in connection with a suitable framework or support (designated A) and which, provided it serves to support the working parts in operative position, can be of any preferred form.

Similar letters of reference indicate corresponding parts in the several figures.

Referring to the drawings, A designates the table-top of machine, in which is journaled a main driving-shaft K, the latter being provided with a driving-pulley J^5 and a loose pulley J^6. Secured to the shaft K is a gear R^3, which meshes with a similar gear R^4, and fastened to a shaft K^2, running at right angles to shaft K, and also journaled to table A. To the front end of shaft K^2 is fastened a worm B^4, which engages the gear M^7, mounted on a movable stud M^2 in the stand H^2. (See Fig. 33.) Also journaled to the table A is what I call the "cam-shaft" K^6 and running at right angles to shaft K^2, to a part of which is fastened the gear L^4, which meshing with the gear M^7 receives motion therefrom, which motion is communicated to the shaft K^6 and the cams mounted thereon, shafts K, K^2, and K^6 working in the similar bearings e^3, said shafts mounted on stands.

Near the center of the table A and at right angles thereto the large stud C is securely fastened, and mounted loosely thereon is the gear-plate B, upon which is fastened a series of stands D' D^2 D^3 D^4 D^5 D^6 D^7 D^8, with radial arms E' E^2 E^3 E^4 E^5 E^6 E^7 E^8, said stands also supporting an equal number of forms *o*, Figs. 1 and 7.

Secured to the driving-shaft K and in mesh with the gear B is a screw-cam K^4, the thread thereof running idle a portion of its turn and the other part of its turn engaging a tooth of the gear-plate B and moving said gear forward a tooth to each revolution of the driving-shaft K, thus imparting an intermittent forward movement to the gear-plate and all its fixed appendages, Figs. 1 and 31.

Located on what I call the "front" of machine and partly over the gear-plate B are two frames or housings G G', in and through which are mounted and running the instrumentalities for turning the "bend" in the bristles and then delivering the bristles to the forms *o*. (See Figs. 1, 2, 3, and 7.)

Fastened to the frames G G' are the brackets M' M^3 M^5, in which are journaled two rocker-shafts V V'. Upon each shaft are fastened at right angles thereto four blades P' P^2, the blades P' on rocker-shaft V being plain, while the blades P^2 on rocker-shaft V' are supermounted by the grip-frame *b'*, the said frame being acted upon by the spring *s'* and controlled by the cam b^4, Figs. 4, 5, and 7, said grip-frame being also supported and guided by the shaft V'. A supply of the bristles *i* sufficient to fill one set of the forms *o* is placed on the rocker-blades P' and P^2, so that the ends of said bristles will rest on one blade of each rocker and lie in a horizontal position on the said blades, the ends of the bristles abutting against the sides of the blades, which rise at right angles to the blades upon which they are resting, (see Figs. 1 and 7,) the root ends of the bristles being always placed on the blade on shaft V', the bristles being held centrally in position by the bender-bar Q, working on a stud-bolt Q', which is fastened to an arm of the bracket M', the other end of the bar being fastened by a screw Q^2 to a brace M^6, said brace being fastened by the ends to the brackets M^3 and M^5, the bar Q being raised upward when it is desired to place a supply of bristles on the rockers P' and P^2. Only an end section of the bar Q is shown in Fig. 7, the bracket M' and the gearing mounted thereon being removed so as to show the cam b^4 and the ends of the rockers the more clearly.

Journaled through the arm of bracket M' is a shaft S^2, to which are secured two miter-gears F^{11} F^{12}, said gears meshing with two other similar gears F^{13} F^{14} and fastened to the ends of the rocker-shafts V V', Figs. 1 and 3.

On and near the end of shaft S^2 and above the cam-shaft K^6 an open semicircular frame a^{10} is loosely mounted, and within a portion of the frame and bearing upon the same shaft S^2 a ratchet-wheel C' is securely fastened. To the upper part of the frame a^{10} and work-

ing through guides in said frame and over the ratchet C′ is a pawl n^4, said pawl being kept in close contact with a tooth of said ratchet by the spring s^3, the ratchet C′ having just four teeth cut thereon at equal distances apart, (see Figs. 1, 2, 3, and 6,) the object of the pawl and ratchet being through the action of levers (to be hereinafter described) to impart rotary motion to the shaft S^2 and the gears F^{11} F^{12} mounted thereon, said gears meshing with like gears F^{13} and F^{14} on the rocker-shafts V and V′, so that the rockers may be revolved one-quarter of a turn at a time.

Pivoted to the frame a^{10} at a point tangential to the shaft S^2 is a short lever d, from which is also hung a longer lever d', the long lever being slotted at lower end to allow cam-shaft K^6 to pass through the said slot and act as a convenient guide to said lever d', Fig. 3.

To one side of lever d' is a projection f^9, to which is fastened a pin s^4, which passes through the guides n^{13}. Over the pin and below the guides is placed a spring s^6, and a roller-pin v^4 is secured to the lever d' just above the slot, said pin being adapted to engage a cam L^3, which is secured to shaft K^6, the pin being kept in contact with the cam by the spring s^6, Figs. 2 and 3, the function of the cam L^3 being to lift the levers d d', and thus turn the frame a^{10}, carrying the pawl around the ratchet until it engages a tooth thereon. The spring s^6, being drawn to extreme tension, will when the pin v^4 is released from said cam draw the levers down and turn the rockers one-fourth a revolution and no more. By the action described a charge of bristles will be delivered to the forms o from the rockers P′ P^2. (See Figs. 2, 3, 7.)

On the portion of the shaft I, working through the housing G′ and the bracket M^4 and over the groove J, a small pinion S^3 is mounted, said pinion being adapted to carry a key fitting loosely in the groove J, the pinion, by means of the key, imparting a rotary motion to the shaft I and allowing said shaft to reciprocate in a line parallel with its axis without causing any lateral displacement to said pinion, the pinion having a neat fit between the housing G′ and bracket M^4, the bracket being cut away partly in Figs. 1 and 2, so as to show the pinion S^3 the more clearly, but is shown more fully in Fig. 7.

Immediately under and in mesh with the pinion S^3 is a toothed segment P, fulcrumed on a stud F^{27}, the bottom end of the sector having a roller-pin f^{15} attached thereto, said pin being always kept in contact with a cam E^{14} on shaft K^6 by the spring s^9, Figs. 2 and 7, the function of the segment P, in mesh with the pinion S^3, being by the agency of the cam E^{14} on the cam-shaft K^6 to impart a semirotary motion to the shaft I and the parts attached to said shaft at regular periods.

On the shaft I, between the housings G G′ and in line with the grip-frame b', a double eccentric or two-spur cam b^4 is securely fastened, one spur of said cam being longer than the other and adapted to engage at regular periods and keep closed the grip-frame b' and also impart a rocking motion to the rockers. A spring s is also placed on the shaft I between the housing G′ and the cam b^4, the tension of said spring always keeping a cam P^3 on the other end of shaft I against another eccentric f, the functions of shaft I, the spur-cam b^4, and the cam P^3 to be hereinafter more fully described.

a^{12} designates a bristle holder and guide supported by the upright bar T^4, the bottom end of said bar working on a stud fastened to the stand i^7, said stand being secured to the table A. The upright bar T^4, with bristle holder and guide a^{12}, is operated or caused to work to and from the bristles i by means of the lever J^3, Figs. 2 and 7, one end of said lever working on a stud affixed to the upright bar T^4, the other end of the lever being slotted and through which slot passes the cam-shaft K^6, the slot being long enough to allow the lever to reciprocate backward and forward and also forms a convenient bearing over the cam-shaft K^6. On and near the end of the lever, but outside the cam-shaft K^6, a roller and pin f^{16} is affixed, said roller being adapted to ride in contact with the face of the cam E^{13}, said cam being secured to the cam-shaft K^6, the cam in its revolution drawing the lever J^3 outward and also the bar T^4, with bristle guards and holders a^{12}, down and away from the forms o, thus allowing said forms to be open and free to receive a charge of bristles from the rockers P′ and P^2. Immediately after the bristles have been delivered to the forms o the lever J^3, being released from the cam E^{13} by reason of a depression in face of said cam, the spring s^{16} will return the bristle holder and guides a^{12} to the forms and hold the bristles in their place for a definite period.

P′ and P^2, Figs. 9 and 10, are end views of bristle-rockers and show the positions which the bristles i will assume when being rocked. In Fig. 9 by the upward movement of blades of the rockers P′ and P^2 the bristles will be worked upward and centrally against the bending-bar Q. In Fig. 10 by the downward movement of the said rockers the bristles are caused to abut against the sides of the rocker-blades. These movements repeated for a definite period will cause the bristles to turn and arrange themselves according to their natural curve and remain so curved while passing through the machine.

Radiating from the center of the gear-plate B and secured to the said plate is a series of stands D′ D^2 D^3 D^4 D^5 D^6 D^7 D^8 and having secured to their respective ends the radial arms E′ E^2 E^3 E^4 E^5 E^6 E^7 E^8. (See Figs. 1 and 7.) To the outer end of each radial arm a double-bristle form o is attached. These forms can be of any of the various shapes in which brushes are made—either round, flat,

or oval. In the drawings a circular form is shown and is adapted to form half brush-knots for lather-brushes, sash-tools, or stencil-brushes, the forms, as shown in Fig. 1, Fig. 2, Fig. 7, and Figs. 30 and 32 being made so that each double form contains within its respective section two semicircular forms of the same size, the object of forms being to hold loosely within their respective radii sufficient of the bristles *i* to form a half brush-knot—that is, each section or double form will hold enough bristles to make two half-knots. The several double forms or sections are secured to the radial arms so that their outside line will be over the outside line of the gear-plate B. (See Fig. 1, Fig. 2, Fig. 7, and Fig. 31.)

Fulcrumed to each of the stands D′ D^2 D^3 D^4 D^5 D^6 D^7 D^8 are levers L^2, to the outer ends of which and beneath the forms *o* are attached the bristle-cups M^{15}, the insides of which are formed so as to hold and give the bristle ends a rounded or beveled contour.

The inner ends of the levers L^2 ride in contact with a cam J^2, secured to the stud C, and will cause the levers to rise or lower, as may be required. When the levers L^2 are parallel to the face of the gear-plate B, the cups M^{15} are in a position to hold and contour the ends of the bristles *i*. (See Fig. 7.)

R designates a curved belt or apron extending around a large part of the machine and so arranged that the inner or concave side is always in close contact with the outside edges of the forms *o* and keeping the bristles *i* intact in said forms, the apron beginning at a point within the housing G and ending at the clenching-plate p^4, said apron being supported by the stands R^2, fastened in the table A, Fig. 1, Fig. 2, and Fig. 7.

It is obvious that the sizes and shapes of the cups and forms can be made to suit the requirement of the brush half-knot to be formed.

A portion of the stand D^4, all of radial arm E^4, and compressor-bar *a*, together with a part of the compressor F^5, is shown in section in Fig. 7 and clearly illustrates the working parts thereof, the section being taken on the dotted line T T, Fig. 1.

In the socket d^{11} in the stand D^4 (see section in Fig. 7) the radial arm E^4 is held securely in position by the lug b^{10} and set-screw f^3.

a is a compressor-bar having two shoulders N^8 on one end thereof, said bar *a* working through a hole in the radial arm E^4, the shoulders N^8 being guided by and working in a slot E^{17}. In the radial arm E^4 on the other end of the compressor-bar a roller *c* is affixed, the said roller being adapted to ride against a stationary cam H and kept in contact therewith by means of the spring a^3, said spring being held in place over the arm E^4 by the form *o*, the spring bearing also against the inside of the compressor F^5, the outside or rear end of the compressor bearing against the shoulders N^8 of the compressor-bar *a*, and thus forcing the roller *c* hard against the cam H. (See Figs. 7, 13, and 14.) Now in the movement of the forms *o* around the machine the bristles *i* at the point F^6 are first compressed by means of the compressor-bar *a* working against the said cam H, the compression thus affected forcing and holding the bristles *i* against the guard or apron R and hold them thus compressed while they move around the machine for operations (to be described hereinafter) and they have reached a point where the operative parts cease to act upon the bristles. Then the roller *c*, being released from the face of the cam H by reason of a depression in its face, the spring a^3 will force the compressor F^3 and bar *a* back, so as to leave the bristles and parts attached thereto free to leave the forms *o*, the guard R at this point also receding away from the form. (See Figs. 1 and 7.) The forms *o* are now open and free to receive a new supply of the bristles when they reach their position under the rockers P′ and P^2, as at F′, Fig. 1.

Fig. 13 is a perspective view of the radial arm and compressor-bar *a*, with the shoulder N^8, showing the movement of said bar and shoulder through the groove E^{17} when forcing the compressor against the bristles. Fig. 14 is a section on the dotted lines W W, Fig. 13, and shows the compressor-bar within said arm.

One of the compressors is shown in perspective in Fig. 15. The view illustrates the preferred form for making a round brush and shows the top and bottom and a portion of the rear end with a hole therein, said hole working over the radial arm and guiding the compressor.

Secured to the table A is the stand i^6, on which loosely mounted in the stud-screw i^{10} is a semicircular rim R^5, passing partly around the left side of the machine and directly under the cup-levers L^2. Attached to the under side of said rim and over the shaft K is a spur i^5, Fig. 7. Secured to and rotating on the shaft K is a spur-wheel N^2, said spur contacting in its rotation with the spur i^5 on the rim R^5 and alternately lifting and dropping the rim, which in turn imparts a vibratory motion or shock to levers L^2 and cups M^{15} and causing the ends of the bristles held in the cups to assume whatever shape or contour the insides of the cups may be.

The cement-pot J′ occupies a position in what I call the "rear" of the machine, Figs. 1 and 7, and consists of an ordinary metal vessel and holds the cement C^5 and is mounted on the stand F^{16}, which is secured to the table A, the sides of the pot being straight and flat, while the ends are of circular form. (See Figs. 1, 7, and 11.) In bearings conveniently located inside the cement-pot J′ travels a shaft i^2, on which is mounted a broad-faced hub K^3, to the face of which is fastened side by side a number of flexible disks N^7, Figs. 1, 7, and 11. Fastened to one side of the pot J′ is a long bracket *b*, and on the op-

posite side of the pot another but shorter bracket b^3 is also fastened, and in the two brackets is journaled the shaft i^3, Figs. 1, 7, and 11. To said shaft is secured a sectional cementing-wheel B^2, composed of a number of thin metal disks a^5, between which are also interposed a number of thicker disks, but of smaller diameter. (See Figs. 1, 7, and 11.) On the shaft i^3 is also fastened a gear-wheel f^2, which meshes with a very small pinion a', mounted on a short shaft i^4, which is journaled in the bracket b, on which a boss has been cast to afford the necessary bearing, Figs. 1 and 7. To the outside end of shaft i^4 an eccentric f is fastened and will abut against the eccentric P^3 on shaft I when said eccentric P^3 is in alinement therewith, Figs. 1 and 7. On the extreme end of shaft i^3 is mounted securely a sprocket-wheel b^6, Figs. 1 and 7, part of which is cut away to show the shaft I. Over said sprocket passes the sprocket-chain f^{18}, which in turn passes around the sprocket-wheel f^{17} of the same diameter as sprocket b^6, the sprocket f^{17} being mounted on driving-shaft K and receiving motion therefrom imparts the same to the chain f^{18}, which in turn drives the cementing-wheels and all the parts adjunctive thereto in the brackets b and b^3, Figs. 1 and 7.

In Fig. 16, G^2 designates a stationary plate of special form, said plate being keyed to the stud C, and thus held rigidly thereto. The plate G^2 is shaped so that a portion of its edge will project over some of the forms o containing the bristles i in that portion of the machine over the vibrator R^5, the object of having the plate G^2 projecting beyond the line of the bristles i being to prevent said bristles from working out at the top of the forms o, while the cups M^{15}, holding the bristles, are being subjected to the shock or action of the vibrator R^5, as the bristles have a great tendency to work out or away from the forms while being subjected to the action of the vibrator R^5, (see Figs. 1, 7, and 16,) the position of the plate G^2 being shown in Fig. 1 by the dotted lines G^2 G^2 G^2 G^2 because a full view of the working parts thereon would have obscured so much that was necessary to be shown in said Fig. 1. It will be seen, however, that at a point just before the bristles in forms o will reach the cementing-wheel B^2 the plate G^2 recedes or curves away from the tops of the bristles and allows them to have a free pass, so that all the work necessary to be done on said bristles can be done and said plate offers no further obstruction, all of which will be explained, (see Fig. 1,) the primary function of the plate G^2 being to hold and carry all the instrumentalities for punching, forming, and placing in position one of the binding-strips M.

Arranged on the top of the plate G^2, Fig. 16, are the devices to slit and form a sheet-metal strip M and secure said strip around the tops of the bristles i in the forms o.

A^3 is a reel loosely mounted on the plate G^2, upon which is wound the strip M.

e^5 and e^6 represent tension-rollers, which pass and guide aforesaid metal strip.

Secured by a stud f^{20} to the plate G^2 is a forming-wheel C^3, which has a series of recesses C^4 cut in its face, as in Figs. 16 and 18, the said recesses being similar to the shape and form of the bunches of bristles i, produced by the compressors F' to F^8. The recesses C^4 do not entirely take up the face of the forming-wheel, there being a space between each recess to be occupied by a portion of the strip M, for a purpose to be hereinafter described. Secured to the top of the forming-wheel C^3 and traveling on the same stud is the gear B^3, said gear and forming-wheel being of the same diameter, Fig. 16, the gear B^3 being partly cut away, so as to show a portion of the recess-wheels more clearly.

Rotating on a stud in plate G^2 and in register with the recesses C^4 in wheel C^3 is the forming-die N^6, the form of which bears a relation to the shape of recesses C^4. In the spaces between the circular ends of said forms a die L^{13} is cut on both sides, (see Figs. 20 and 21,) said dies being also in register with a punch J^4. Fastened to the top of forming-die N^6 and working on same stud is a gear f^8. (See Fig. 16.) Also traveling on a stud in plate G^2 is a rotating punch J^4, the function of said punch being when in register with the forming-die to slit tongues m^5 in the metal strip M. Fastened to the top of the punch J^4 and running on the same stud is a gear c^9, said gear meshing with the gear f^8 and also with the intermediate B^6, which in turn meshes with the gear B^3 on forming-wheel C^3, the function of the circular ends of the forming-die being to carry the slitted strip M into the recesses C^4 of the forming-wheel, the die L^3 also causing the tongues m^5 to be forced outward by a projection to be described. (See Figs. 16, 22, and 23.)

In the center of the spaces before referred to, between the recesses C^4 in the forming-wheel C^3, there is a segmental projection K^5, occupying centrally about one-fourth the width of the face in said space. (See Figs. 7, 16, 17, and 18.) Now when the binding-strip M has been slitted and the portion between the tongues m^5 has been drawn within the recesses C^4 by the circular ends of the forming-die N^6 the other part of the strip M, with the tongues cut therein, will be forced against the projection K^5 by the face of the die L^{13} acting on the portions of the strip M on both sides of the tongues m^5, and thus setting the tongues against the projection K^5, where they will remain until the forming-wheel C^3 in its revolution will present the tongues m^5 to be clenched through perforations in another wider strip

Secured to the table A is the stand A^4, upon which and in line with the forming-wheel C^3 is mounted the reel C^2, around which is wound a

sheet-metal strip B^5, said strip being perforated at regular intervals, as at f', throughout its entire length. (See Figs. 8 and 16.) Also fastened to the table A is the stand or frame H^3, Figs. 16 and 17. Journaled in the frame is a vertical shaft G^6, to the lower end of which is fastened a gear G^3, said gear being in mesh with the large gear B. To the top end of said shaft is also fastened a gear f^{14} of the same diameter as gear G^3, the gear f^{14} being in mesh with and driving gear B^3 on forming-wheel C^3. (See Figs. 16 and 17.) Also journaled in the arms of frame H^3 and projecting above the arms are the shafts y^3 and y^4. Between the arms and fastened to said shafts are the gears b^5, and secured to the gears by the circular plates y^5 y^6 is a pair of recessed jaws f^{11} and f^{12}, set at a tangent to the axis of the plates y^5 y^6. On the extended tops of shafts y^3 y^4 is placed a pair of springs f^5, said springs having a tendency to always keep the jaws f^{11} f^{12} open when said jaws are not closed by the cam A^2, Figs. 16, 17, and 19. On the top of the shaft y^4 a bar f^{10} is fastened, said bar having a pin f^{19} attached to the end thereof, the pin being adapted to contact with the face of the cam A^2, said cam being fastened to the gear f^{14}, a part of the cam being cut away so as to show the union of the gears f^{14} and B^3. The cam A^2 is circular in form and has a depression cut in its face. Now when the face of the cam rides against the pin f^{19} it will hold the bar f^{10}, and the jaws f^{11} and f^{12} will be closed and kept closed until the cam in its rotation will present the aforesaid depression to the pin f^{19}, when bar f^{10}, influenced by the springs f^5 on the shafts b^5, will drop into the said depression and open outwardly the jaws f^{11} and f^{12}, so that they will engage and turn back the tongues m^5 in the strip M, the said jaws being, as aforesaid, fastened to the gears b^5, said gears meshing with each other, the cam A^2 returning the bar f^{10} and closing the jaws f^{11} and f^{12} again, Figs. 16, 17, and 19. Now it is evident that at a point in the revolution of the cam A^2 the bar f^{10} will be released, and the jaws f^{11} f^{12} will through the influence of springs f^5 open outwardly and working at a tangent to their axis engage the tongues m^5, which have been presented by the forming-wheel C^3, the said tongues having been pushed through the perforations f' in the wide strip B^5 by the projections K^5 and turn and upset the tongues back and against the strip B^5, so as to hold and clench the two strips M and B^5 and the bristles i firmly together. The jaws f^{11} and f^{12} will then by the agency of the cam A^2 be closed again. (See Figs. 16, 17, 18, 19, 28, and 29.) The gear G^3, receiving motion from gear B, will through gear f^{14} impart its motion to gear B^3, which in turn will move the gears B^6 C^9 f^8, all the respective parts working in correct time and harmony.

Secured to the table A is the frame E^9, in which is journaled a vertical shaft f^9, to the ends of which are secured miter-gears d^5 d^6, the lower gear d^5 meshing with a similar gear d^4, which is fastened to the shaft K^2, the upper gear being in mesh with and driving a like gear d^7 on a shaft e^9, said shaft being journaled in the uprights of the frame E^9. (See Figs. 25, 26, and 27.) On the shaft e^9 are respectively fastened three cams e' n^5 e^2, whose functions are to impart during their revolution a certain movement to the perforating, wiring, and wire-cutting devices, Figs. 25 and 26.

H^4, Fig. 26, represents a bar which supports and carries the parts required to perforate and wire the bristles i and strips m and B^5. The bar H^4 is mounted in the stand f^4, said stand being secured to the table A, the bar H^4 and bar-head r^2 being moved on its axis in the stand f^4 by the cams e' n^5 e^2 by the rotation of shaft e^9, to which said cams are secured, the bar H^4 being always kept in contact with the cams by the spring f^7, bearing hard against front of said bar, the spring f^7 being also fastened to the stand f^4.

n' and n^2 are respectively the lower and upper jaws of a form of pliers adapted to move a wire forward, the lower jaw n' being stationary and part of bar-head r^2 and the upper jaw n^2 moving on the stud f^{13}, said stud f^{13} being attached to the bar-head, the movable jaw n^2 being closed over the wire r by the cam e^2 in the forward movement of bar-head r^2, said jaw n^2 being released from cam in the return movement of bar-head r^2. Working on the stud f^{13} and beside the wire jaw n^2 is a cutting nipper or shear r^4, the shear of which will slightly overlap the lower stationary jaw n' and will in its downward movement by the cam n^5 cut the wire r from the portion forced through the bristles, Fig. 26.

S is a sharp angular punch, slightly curved and held rigidly in the bar-head r^2 by the set-screw d^9.

$n^\times$ $n^\times$ are flat springs held in place by the plate f^{21}, said plate being secured to the bar-head r^2, said springs lifting the jaw n^2 and shear r^4 when same are released from the cams on the return movement of the bar-head r^2.

Secured to back of the frame E^9 is a curved pipe P^4, through which is carried the wire r from the reel n^3, mounted on the frame-arm r', Fig. 26.

In the end of shaft e^9 toward the front of the machine a groove or channel s^{14} is cut, the said gear d^7 imparting motion to the shaft e^9 by means of a key fastened in said gear and working in the groove s^{14}. This will allow the shaft e^9 to have a lateral movement, so that the lever h^4, fulcrumed in the frame E^9, said lever being secured to the bar e^4 by the shoulder-screw h^3 and operated by the cam n^6 on the cam-shaft K^6, the bar e^4 working over the cam-shaft K^6 and having a roller-pin e^5 attached to the end thereof, said pin working against the cam n^6 and can push the shaft e^9, with the cams e' n^5 e^2, out of line or contact with the perforating, wiring, and

wire-cutting devices and hold said shaft for a period, when the bar e^4 being released from the cam n^6 the spring s^{13} on the other end of shaft e^9 will return said shaft to position and again bring the cams e' n^5 e^2 into action, all the aforesaid cams, bar-head, punching, wiring, and shearing devices being timed and in harmony of movement.

Fastened to the plate G^2 is a bearing r^7, through which slides a bar p^5, said bar having a groove h^4 in the center thereof, said bar also having a lateral movement through the bearing and guided by a key t' in the top of said bearing r^7. On one end of the bar p^5 a roller r^6 is affixed. A spring s^7 on the bar p^5 will always keep the roller in contact with the wires r and metal strip M and cause the wire ends to be turned over and clenched as they successively present themselves to the said roller r^6.

p^4 is a stand, also secured to the said table A, and mounted on the stand and in line with the bristle-wires r is a curved plate r^5, a portion of the convex side of which is always in contact with the ends of the wires r when they pass and will turn said wires down and clench them against the strip B^5.

The worm-gear B^4, in combination with gears M^7 and L^4, Figs. 1, 2, and 33, is used to regulate the speed of shaft K^6, as it is desired that cam-shaft K^6 shall make but one revolution for each section of the forms o, thus bringing all the operative parts dependent on cams mounted on cam-shaft K^6 in action once during the passage of said section, a section being that portion included in the space occupied by one of the forms and one of the compressors.

Obviously my improved machine may be constructed with a greater or less number of forms, and obviously the shapes and sizes of the forms may be changed to suit the requirements of the half brush-knots to be formed without departing from the spirit of the invention.

The operation of the machine in detail is as follows: The quantity of bristles required for a section of the forms o is delivered by any convenient means to the rocker P' P^2 and the bending-bar fastened in place. The machine being started, the vibrator-shaft I and cam b^4 receiving motion from the gearing mounted on the cement-pot J' imparts a rapid vibratory motion to the blades P' P^2. The result of such action on the bristles i will cause them to assume a curve natural to themselves, before referred to. This step in the operation is known technically as "turning the bend," the action being well illustrated in Figs. 9 and 10, where the upward strokes of rocker-blades, Fig. 9, will cause the bristles to work centrally against the bar Q, and in the downward movement, Fig. 10, the bristle ends will abut against the blades, said movements causing the bristles to assume their natural curve, for no matter how carefully the bristles may be straightened before being placed in the machine there is always a slight natural curl or "bend" left in the bristles. In some bristles, more particularly the longer ones, this bend is more pronounced, and in the movements just described the bristles will be all turned, so that their natural curve or bend will always be in one direction. After being rocked for a period the bristles are ready to be delivered to the forms o, which in their movement around the machine will successively present empty sections to the rockers. The grip-frame, being released from the cam b^4 by the agency of the toothed sector P and cam b^4, will spring over and grip the bristles on the blade P^2 and will hold said bristles while being delivered to their respective forms, the said frame being at once returned by the cam b^4 to its respective position. The delivery is effected by means of the gearing on rocker-shafts in connection with the pawl and ratchet and the levers mounted thereto. The cam L^3 in its rotation will lift the levers d d' and cause the pawl to engage the ratchet C' one-quarter turn and hold same idle until at a point in the rotation of said cam, the lever-pin v^4 being released, the spring s^6 will pull the levers down and cause the ratchet to turn the rockers one-quarter turn and no more, thus bringing the rocker-blades and bristles from a horizontal to a vertical position and in line with forms o, as in Fig. 7. Immediately upon delivery of the bristles to the forms o the bristle-holder a^{12} will be thrown in position and hold the bristles in the forms until the cup M^{15} has received the bristles and they have also passed back of the bristle-guard R. Held in the forms by the guard R and cups M^{15} the bristles will be subjected to a succession of shocks from the vibrating rim R^5 as they pass around a portion of the machine. The result of the above action on the bristles now held loosely in the forms will cause the ends of said bristles i to assume a contour similar to that of the cup in which they are being settled, the vibration ceasing at section F^6. The compressor F^6, influenced by the bar a in the radial arm E^5 and operating against the cam H, will push the compressors outwardly, and the compressors being of smaller diameter than the forms will compress the bristles to the size required for cementing and binding, Figs. 1 and 7. The forms, with the bristles now compressed, will move forward to have cement applied to the ends thereof. This is accomplished through the medium of the disk-wheel B^2, which, drawing its supply of cement from the supply-wheel K^3, leave a portion of the cement in the ends of will work its disks through the bristles and the same, Figs. 1, 7, and 11. Now it is evident that the ends of the bristles while in motion must have a perfectly-free pass, as any interference therewith would have a tendency to disarrange and pull the bristles out of the forms, and to prevent this the cement-wheel is so formed that it will only be in contact with the bristles i while the cam K^4 is

running idle and the gear-plate B is at rest, (see Fig. 11,) the said cementing-wheel B^2 having a portion of its disks cut away, so that only a part is in contact with bristles and then only when the forms *o* are at rest, the disks then leaving the bristles until the forms come at rest again, Figs. 7 and 11. The next step will be to bind the cemented ends of the bristles with two sheet-metal strips. The strip M, having been slitted and formed in the recesses in the forming-wheel C^3 and registering with the bristles *i* in one of the compressors F^4, so that the center of one of the projections K^5 will occupy a point exactly opposite the points of the upsetting-jaws f^{11} f^{12}, it will be seen in Fig. 1 that the center of the compressor F^4 has not been moved so as to come directly under the upsetting-jaws, as it is desired to show the compressor points and jaws f^{11} and f^{12} the more clearly. The proper construction is, however, correctly shown in Fig. 16. (See Fig. 16.) The strip B^5, perforated, as shown in Fig. 8, having been drawn from the reel C^2 and to a point beyond the projections K^5, so that the said projection, with the tongues m^5, from strip M will pass through one of the perforations f' in strip B^5. Now at this point in the operation the compressor F^4, with bristles *i* and the forming-wheel C^3, will be at rest, due to the cam K^4 running idle through the gear-plate B. The bar f^{10} at this point is also released from the cam A^2, and the upsetting-jaws f^{11} and f^{12}, influenced by the springs f^5, will turn the jaws outwardly and engage and upset the tongues m^5 against the strip B^5, thus clenching and binding the bristles and strips together, Figs. 16 and 19. The bristles and strips are next bound with wire, and the mass as formed is brought forward in the movement of the machine to a point opposite the punch S in the bar-head r^2 and the wire-jaws n' n^2, Figs. 1, 25, and 26. The gear-plate B being at rest at this point, the punch S, moving on its axis in the stand f^4 and operated by the cam e', will pierce a hole slightly curved through the mass of bristles *i* and strips M and B^5. The cam e' in its rotation will now release the bar-head r^2, and by pressure of spring f^7 on the bar H^4 the punch will be withdrawn and return to position shown in Fig. 26. The next forward movement of the bristles will present the pierced hole to the wire *r*, retained by the jaws n' n^2, and during the rest in the movement before referred to the wire *r* will be forced through the hole and beyond the strip M. The cutting-shear by the action of cam n^5 will now cut the wire *r*, leaving an end projecting beyond strip B^5. In the same movement that the wire is forced in the bristles the punch S will also make another hole, the punching and wiring being repeated as often as necessary. The wire *r* is carried through a curved pipe P^4, said curve producing sufficient friction on the wire to retain the wire in position when the jaws n' n^2 release the said wire on their return movement. As it is not desired to wire the spaces occupied by the tongues between the half-knots, the lever h^4, operated by the bar e^4 and cam n^6 on cam-shaft K^6, will throw cams e' n^5 e^2 out of action at the desired stroke and releasing will allow said cams to be returned to action by the springs s^{13}. The final step in the operation will be to clench the projecting wire ends *r*, and is effected by the clenching-roller r^6, against which said wire ends are drawn on the side M, the curved plate r^5 turning the wire ends on the B^5 side. The half brush-knots as now completed are passed away from the machine by any convenient means.

Figs. 28 and 29 are perspective views of the finished product and show a very good form of the half-knots as they come from the machine.

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

1. In an organized machine, for making half brush-knots, in combination, a suitable frame, mechanism to hold and turn a bend in bristles, means to impart motion to same, mechanism to deliver said bristles to forms, means to actuate the same, mechanism to temporarily hold and guide said bristles, means to move the same, a rotatable geared plate, means to impart an intermittent motion thereto, a series of stands and forms mounted on said gear, substantially as set forth.

2. In a machine for making half brush-knots, in combination, a suitable housing, a pair of bristle-rockers, a grip-frame over one of said rockers, means to support and guide same, a grip cam and shaft, and means to support and reciprocate same, substantially as set forth.

3. In a machine, for making half brush-knots, in combination, a frame, a pair of bristle-rockers, a grip-frame on one of said rockers, means to support and guide same, a grip cam and shaft, means to support and reciprocate same, a toothed sector, in combination with a cam and pinion, and means to impart a rotary motion to same, substantially as set forth.

4. In an organized machine, for making half brush-knots, in combination, a suitable housing and frame, a pair of bristle-rockers, with supporting-shaft, adapted to carry gears, a geared shaft in combination therewith, a frame mounted thereon, a ratchet and pawl within said frame, adapted to turn said shaft, substantially as set forth.

5. In an organized machine, for making half brush-knots, in combination, a suitable housing and frame, a pair of bristle-rockers, with supporting-shafts, adapted to carry gears, a geared shaft in combination therewith, a frame mounted thereon, a ratchet and pawl within said frame, a pair of levers to raise and lower said frame, a pin and spring attached to one of said levers, a cam to oper-

ate said levers, and means to impart motion thereto, substantially as set forth.

6. In an organized machine, for forming half brush-knots, in combination, a suitable frame, a rotatable geared plate, mounted on a stud, said plate carrying a series of vertical stands, provided with radial arms, to support bristle-forms, means to convey a charge of bristles to same, said forms adapted to present said bristles, successively to the operative parts of the machine, and means for imparting intermittent and rotatory motion to geared plate, such means consisting of a screw-threaded cam, engaging said gear, substantially as set forth.

7. In an organized machine, for forming half brush-knots, in combination, a suitable frame, a rotatable geared plate, mounted axially on a stud, said plate carrying a series of vertical stands, provided with radial arms, to support bristle-forms, means to convey a charge of bristles to same, said forms adapted to present said bristles, successively to the operative parts of the machine, and means for imparting, intermittent rotary motion to geared plate, such means consisting of a screw-threaded cam, engaging said gear, a series of bristle-compressors, adapted to work over said bristle-forms, substantially as set forth.

8. In an organized machine, for forming half brush-knots, in combination, a rotatable geared plate, a series of vertical stands, provided with radial arms, supporting bristle-forms, said forms adapted to present bristles to the operative parts of machine, a series of bristle-compressors, working over said forms, a shouldered compressor-bar, a roller affixed thereto, a compressor-cam, adapted to move said bar, and a spring adapted to move said compressor, substantially as set forth.

9. In an organized machine, for forming half brush-knots, in combination, a suitable frame, a rotatable geared plate, means to actuate the same, a series of vertical stands with radial arms, a series of bristle-forms, a lever pivoted to each stand, a bristle-cup affixed to one end of said lever, a cam to operate said levers, a curved apron or belt adapted to hold and guide said bristles, substantially as set forth.

10. In an organized machine, for forming half brush-knots, in combination, a suitable frame, a vibrating rim, a spur attached to said rim, said rim to contact with bottom of lever-cups, means to impart vibratory motion to said rim and cups, such means consisting of a rotating spur-wheel in contact with rim-spur, and adapted to lift and drop said rim-levers and bristle-cups, and cause said bristles to assume a contour like inside of cups, means to actuate same, substantially as set forth.

11. In an organized machine, for forming half brush-knots, in combination, a suitable frame, a rotatable geared plate, supporting a series of stands and bristle-forms, a series of bristle-compressors, a cement-pot, a flexible-faced supply-wheel, a cementing-wheel formed of a series of disks, a pair of brackets affixed to cement-pot, to support means to supply motion to cement-wheels and impart motion to eccentric-operating reciprocating shaft.

12. In an organized machine, for forming half brush-knots, in combination, with a series of binding instrumentalities, a rotatable geared plate, a series of stands, and forms, with bristle-compressors, a fixed supporting-plate, a reel to carry a strip of sheet metal, a pair of tension-rollers, adapted to guide said metal strip, a slitting and forming die, a slitting-punch, to slit and form tongues in said metal strip, and means to actuate same, substantially as set forth.

13. In a machine, for forming half brush-knots, in combination, with a series of binding instrumentalities, a fixed supporting-plate, a reel to carry a strip of sheet metal, a pair of tension-rollers, adapted to guide said metal strip, a slitting and forming die, a slitting-punch, to slit and form tongues, in said metal strip, means to actuate the same, a forming-wheel, having recesses cut at intervals, in the face thereof, said recesses, being adapted to receive said metal strip from said forming-die, substantially as set forth.

14. In a machine, for forming half brush-knots, in combination, with binding instrumentalities, a fixed plate, a reel to carry a strip of sheet metal, a pair of tension-rollers, to guide said metal strip, a splitting and forming die, a slitting-punch, to slit and form tongues, in said metal strip, means to actuate the same, a forming-wheel, having recesses cut at intervals, in the face thereof, said recesses being adapted to receive said metal strip, from said forming-die, a curved projection, between said recesses, said projection, being adapted to force outwardly, the tongues in said metal strip, a pair of recessed tangential jaws, adapted to contact with said tongues, and means to operate the same, substantially as set forth.

15. In a machine, for forming half brush-knots, in combination, with binding instrumentalities, a pair of tangential jaws, recessed in the meeting ends thereof, said jaws adapted to turn and upset aforesaid tongues, a cam adapted to encounter a bar, said bar actuating aforesaid jaws, a frame, supporting means, to impart motion, to said binding instrumentalities, substantially as set forth.

16. In an organized machine, for forming half brush-knots, in combination, with a device for supporting a series of stands, and bristle-forms, and compressors, and presenting them in succession, to the piercing and wiring instrumentalities, and upright bar, and bar-head, means to move same axially, a punch secured to said bar-head, and means to move same, substantially as set forth.

17. In a machine, for forming half brush-knots, in combination, with piercing and wiring instrumentalities, an upright bar, and bar-

head, means to move same axially, a punch secured to said bar-head, and means to move same, a fixed jaw in bar-head, a movable jaw, working on a stud in said bar-head, and adapted to member with said fixed jaw.

18. In a machine, for forming half brush-knots, in combination, with piercing and wiring, instrumentalities, a bar and bar-head, means to move same axially, a punch secured to said bar-head, a fixed jaw, in said bar-head, a movable jaw, working on a stud, in said bar-head, and adapted to member with said fixed jaw, and means to move same, a wire-cutting shear, overlapping said fixed jaw, and means to move same, substantially as set forth.

19. In a machine, for forming half brush-knots, in combination, with piercing and wiring, instrumentalities, and upright bar, and bar-head, means to move same axially, a punch secured to said bar-head, a fixed jaw in said bar-head, a movable jaw working on a stud, in said bar-head, and adapted to member with said fixed jaw, means to move same, a wire-cutting shear, overlapping said fixed jaw, and adapted to cut a piece of wire therefrom, means to move same, a curved pipe, adapted to pass, or retain said wire, means to move said wire, means to support, and hold said curved pipe, a wire-reel, and means to support same, substantially as set forth.

20. In a machine, for forming half brush-knots, in combination with piercing and wiring instrumentalities, and upright bar, and bar-head, means to move same axially, a punch secured to said bar-head, a fixed jaw in said bar-head, a movable jaw, working on a stud in said bar-head, and adapted to member with said fixed jaw, means to move same, a wire-cutting shear, overlapping said fixed jaw, and adapted to cut a piece of wire therefrom, means to move same, a curved pipe adapted to pass or retain said wire, means to support and hold said curved pipe, a reciprocating lever, a lever-bar, an end of which is slotted, a pin affixed to said bar, and adapted to contact with a cam, a frame to support said lever, a grooved shaft, supporting means to operate bar and bar-head, and devices thereon, said shaft adapted to be reciprocated by aforesaid lever, substantially as set forth.

21. In an organized machine, for making half brush-knots, in combination, a suitable frame, a reciprocating bar, working in a fixed guide and controlled by a spring, a curved clenching-plate, a curved apron, to hold and guide bristles in forms, means to support said apron, substantially as set forth.

In testimony that I claim the foregoing as my invention I have hereunto signed my name this 16th day of August, A. D. 1900.

JOSEPH F. MUMFORD.

In presence of—

HARRY C. BLACK,

WILLIAM C. JONES.