(No Model.) 5 Sheets—Sheet 1.

A. C. ESTABROOK.

MACHINE FOR BORING BRUSH HEADS.

No. 390,956. Patented Oct. 9, 1888.

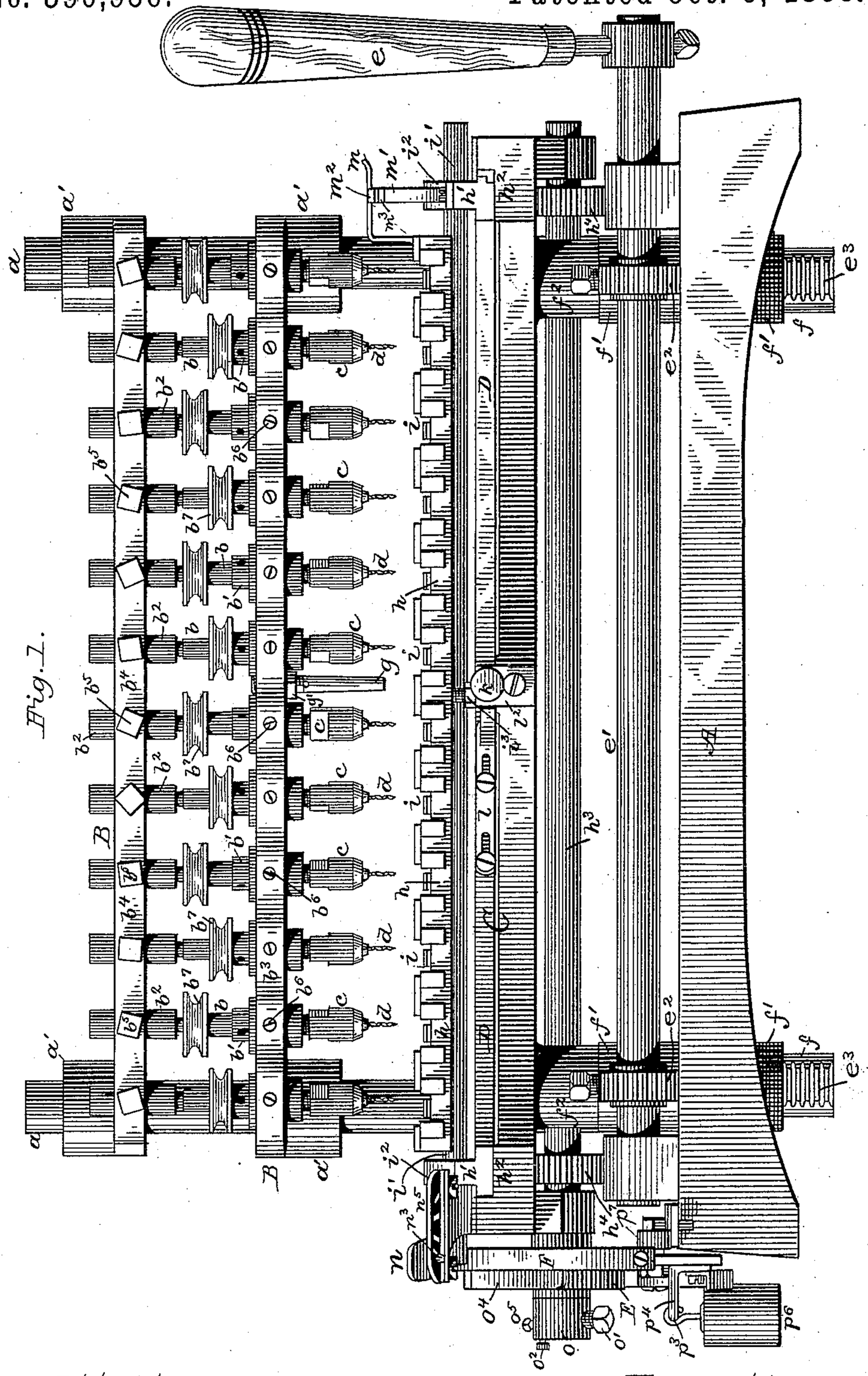

Fig. 1.

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Lowell Bartle

Inventor:
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By Wm. C. Wood & Co. Attorney.

(No Model.) 5 Sheets—Sheet 2.

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MACHINE FOR BORING BRUSH HEADS.

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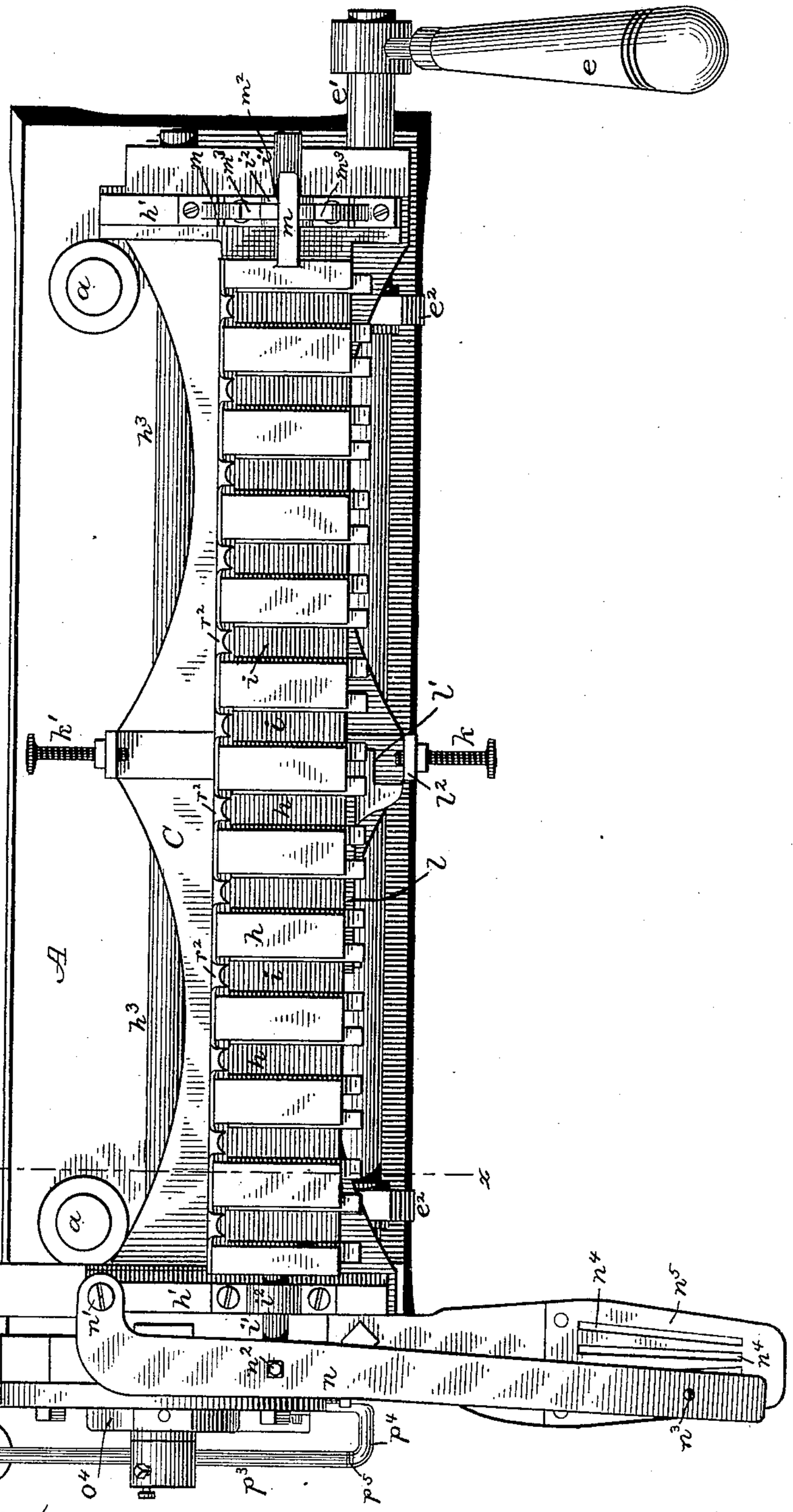

Fig. 2.

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A. C. ESTABROOK.

MACHINE FOR BORING BRUSH HEADS.

No. 390,956. Patented Oct. 9, 1888.

Fig. 3.

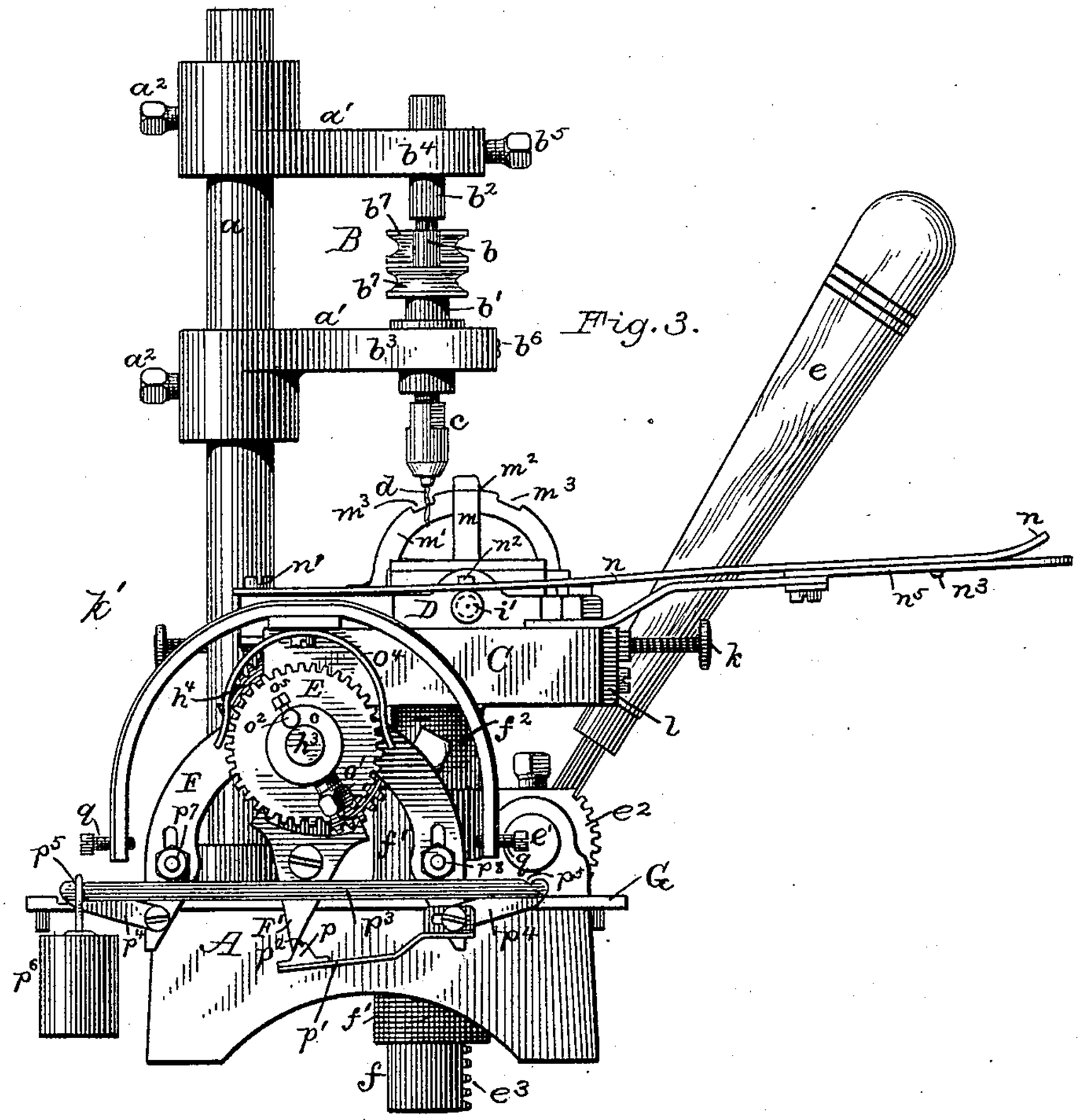
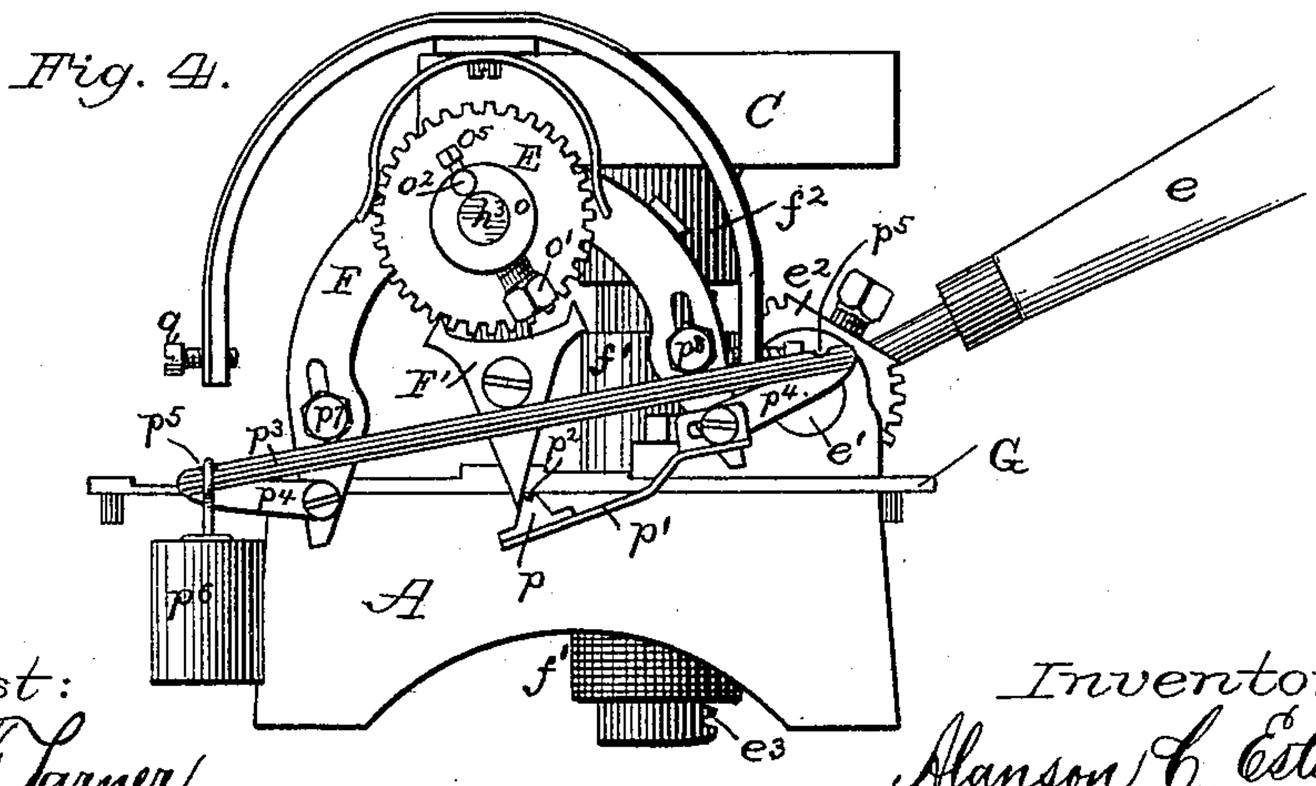


Fig. 4.



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A. C. ESTABROOK.

MACHINE FOR BORING BRUSH HEADS.

No. 390,956. Patented Oct. 9, 1888.

Fig. 5.

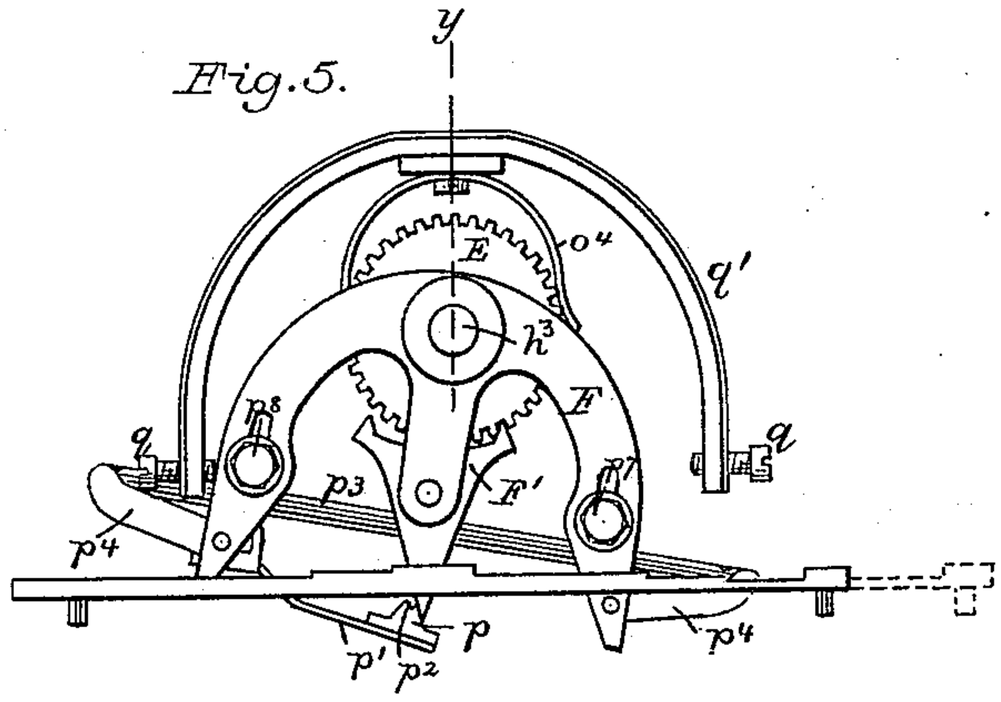


Fig. 6.

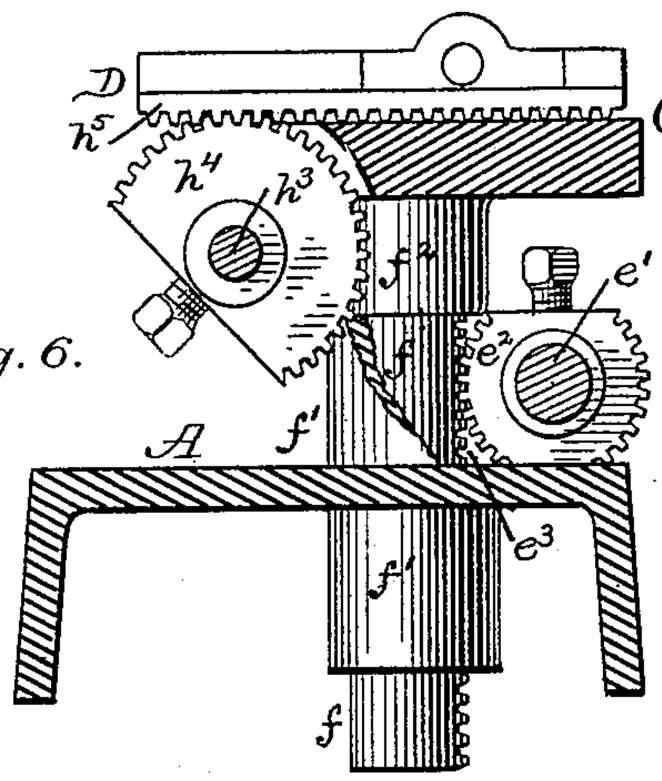


Fig. 8.

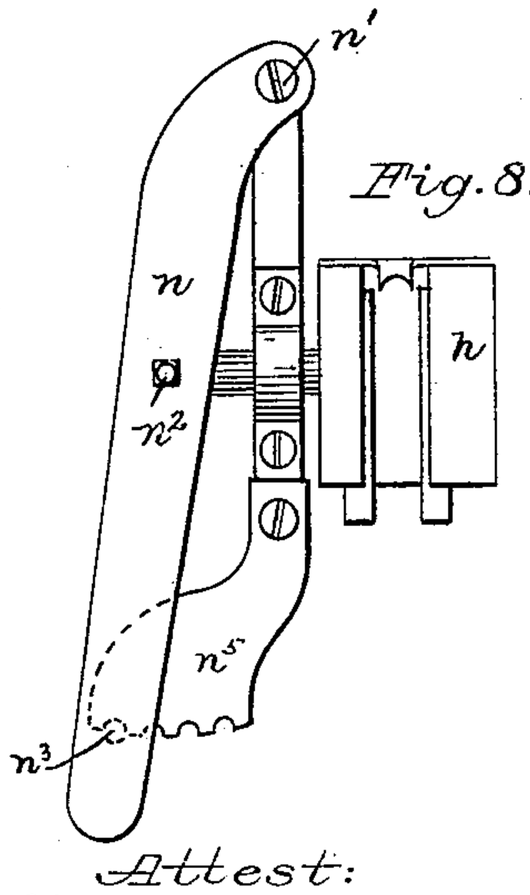
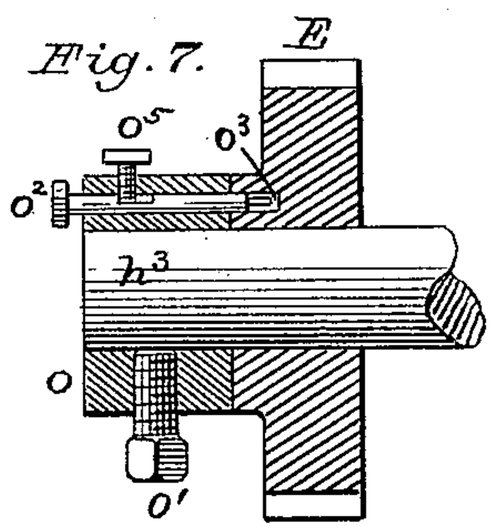


Fig. 7.



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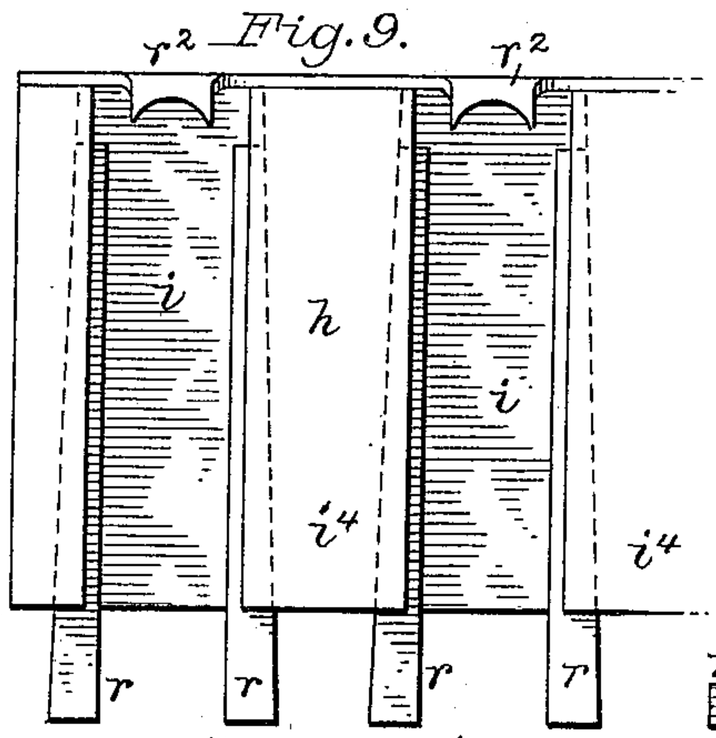
A. C. ESTABROOK.

MACHINE FOR BORING BRUSH HEADS.

No. 390,956. Patented Oct. 9, 1888.

Fig. 9.



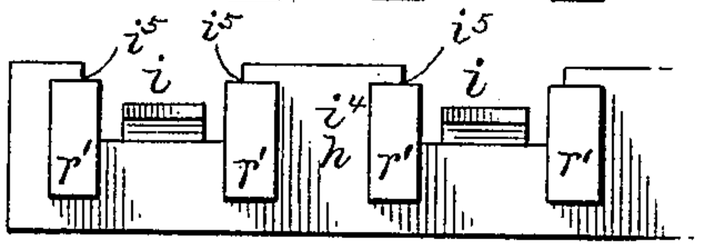


Fig. 10.

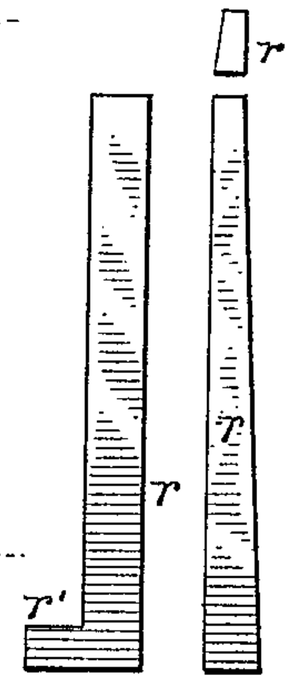


Fig. 11.

Fig. 12.

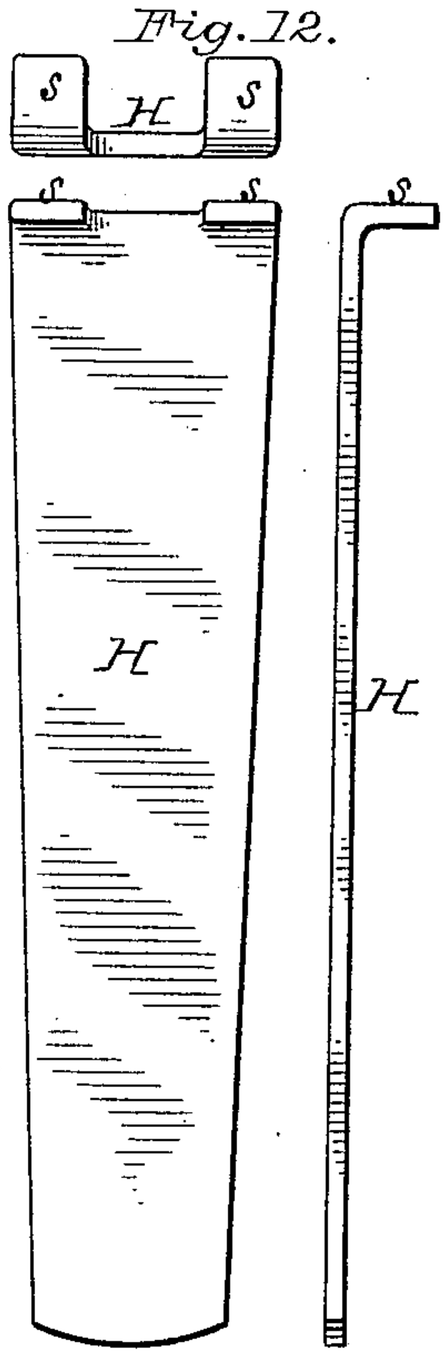
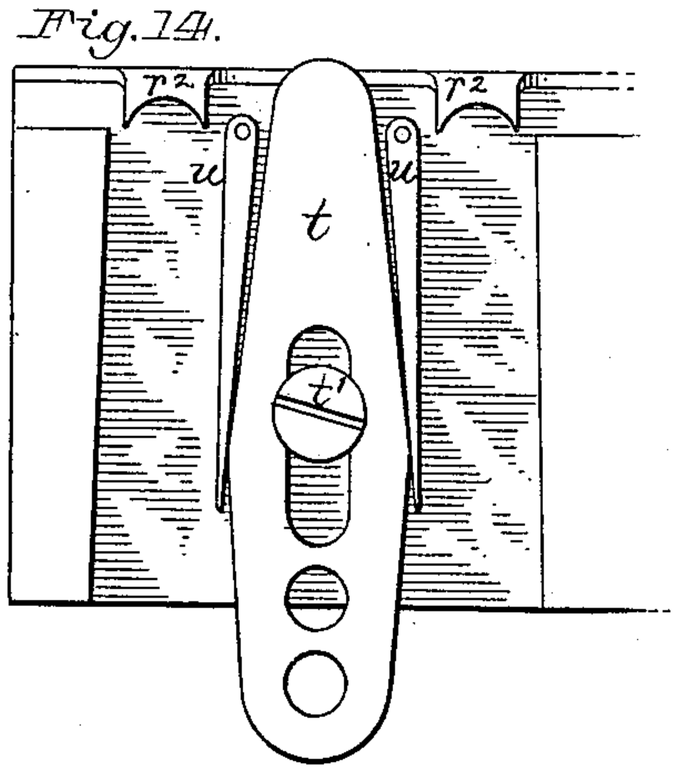


Fig. 14.



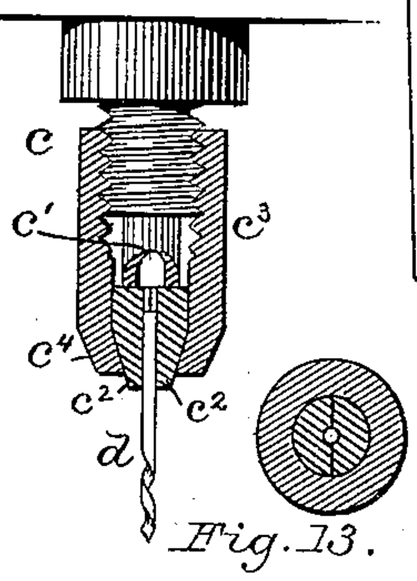


Fig. 13.

Fig. 15.

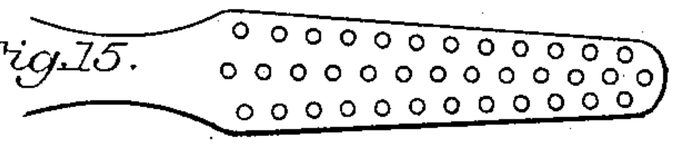


Fig. 16.

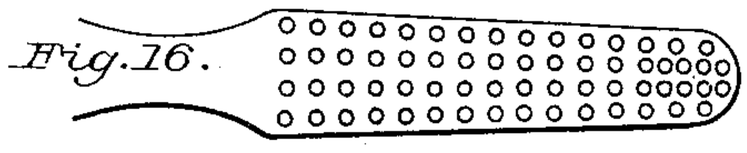


Fig. 17.

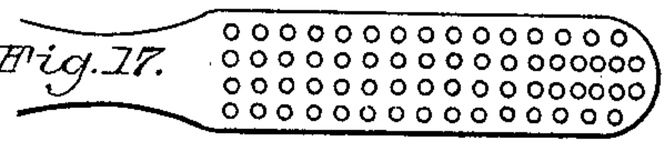


Fig. 18.

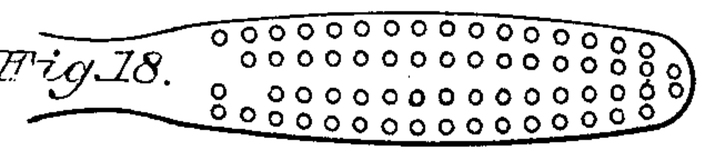


Fig. 19.

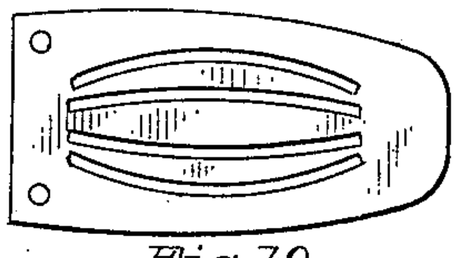
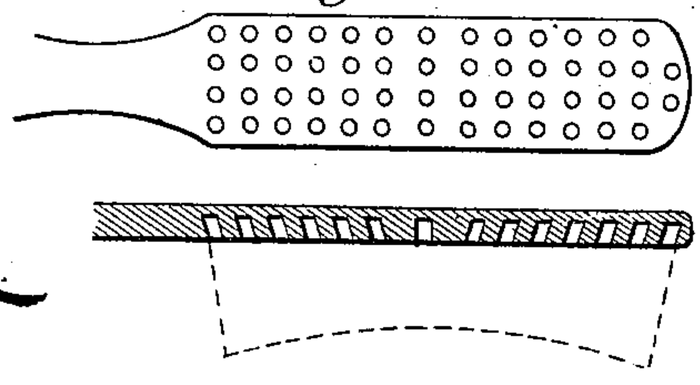


Fig. 20.



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Inventor:
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UNITED STATES PATENT OFFICE.

ALANSON C. ESTABROOK, OF NORTHAMPTON, ASSIGNOR TO THE FLORENCE MANUFACTURING COMPANY, OF FLORENCE, MASSACHUSETTS.

MACHINE FOR BORING BRUSH-HEADS.

SPECIFICATION forming part of Letters Patent No. 390,956, dated October 9, 1888.

Application filed August 23, 1886. Serial No. 211,588. (No model.)

To all whom it may concern:

Be it known that I, ALANSON C. ESTABROOK, of Florence, in the city of Northampton, county of Hampshire, and State of Massachusetts, have invented certain new and useful Improvements in Machines for Boring Brush-Handles; and I do hereby declare that the following specification, taken in connection with the drawings furnished and forming a part of the same, is a clear, true, and complete description of the several features of my invention.

Although machines embodying the whole or a part of my said improvements may be employed in various branches of brush-making, they have been devised by me with special reference to their use in connection with the manufacture of tooth-brushes having bone or ivory handles. So far as my knowledge extends, I am the first to devise, organize, and use machines adapted to this specific service by means of which unskilled labor can be relied upon, and said machines were disclosed in my Letters Patent No. 260,377, dated July 4, 1882. I employ in my present organization several of the features of invention disclosed and claimed in said Letters Patent, to which reference may be had for a comparison herewith if need be.

The main object of my present invention is to still further reduce the cost of drilling, and this is accomplished in part by grouping the drills and arranging for the simultaneous presentation thereto of a corresponding number of brush-heads, each in its precise position, so that any desired number of heads may be commenced together, the drilling progressively carried on with all, and the whole finished at the same time. As a rule, I deem it best to operate on twelve heads simultaneously, although my machines can be constructed to operate on a greater number, or any lesser number down to one, without substantial departure from certain portions of my invention.

In my said prior Letters Patent I disclosed the use of more than one drill at a time; but in that case two drills operated for simultaneously drilling two holes in the same row, and I did not provide for operating upon more than one brush-head at a time. In multiple work in this art, as now for the first time provided for by me, I deem it unadvisable to have more than one drill for operating upon each head and more than twelve drills in any one machine.

In this connection I should have it understood that machines for boring heads for larger brushes of the ordinary varieties have had grouped drills, so that an entire brush-head, or considerable portions thereof, could be drilled at one presentation of the head to the drills; but it will be obvious that the accuracy involved in tooth-brush making and the minute spacing of the drills render that mode of boring practically impossible, because of mechanical difficulties wholly distinct from the mere matter of relative proportions in the dimensions respectively involved.

In my present machines I have for the first time so organized the co-operative elements as to enable irregular spacing between the holes in any one longitudinal line, thus providing for what is known as "gathering," and enabling the compacting of the bristles at certain portions of the brush more than at others. This variation of adjustment in the matter of spacing holes in any one row is promptly effected by the movement of a sliding change-plate to and fro, and in one of its forms said plate serves as a "spreader" for increasing spaces between two or more holes in any one row. Thus when said change-plate is used as a "gatherer" it will be obvious that in shifting back to regular spacing it will operate as a spreader, and so in shifting from spreading to regular spacing it operates as a gatherer, the only difference between the two plates being that one is specially designed for gathering and the other for "spreading" in changing in either case from the regular or usual spacing desired in any one particular kind of brush.

I have also provided for drilling the holes at required angles—as, for instance, for producing tooth-brushes having a longitudinally-concave brush face, and also for brushes having inclined tufts of bristles at the end of the head; also for varying the lengths of the longitudinal rows in each head, thus enabling a symmetrical and desirable arrangement of the bristles at either end of a head. I have also, for the first time, provided for maintaining equal and regular spacing between the holes

in two or more rows, and at the same time enabled the holes of one row to be located opposite the spaces in the rows on either or both sides.

I have also devised certain combinations of mechanism by which the presentation of the brush-heads to the drills is effected in connection with actual drilling, and also in adjusting preparatory to each drilling movement; also in means for conveniently and securely clamping the brush-heads, regardless of their variable contour. All of my said features of invention are of value in machines having groups of drills and a corresponding number of brush-head clamps, and many of them are of value in a machine wherein a single drill or several drills are organized to co-operate with a single head-clamp.

Certain other novel features of minor importance have been devised by me, and, after fully describing a machine embodying my complete invention, the features deemed novel will be specified in the several clauses of claim hereunto annexed.

Referring to the five sheets of drawings, Figure 1, Sheet 1, illustrates one of my machines in front elevation. Fig. 2, Sheet 2, illustrates a portion of the same in plan view, the drills and the framing in which they are mounted being removed. Fig. 3, Sheet 3, is an end view of the machine. Fig. 4 is a similar view of a portion of the machine shown in Fig. 3, but with the working parts in different position. Fig. 5, Sheet 4, is a similar view to Fig. 4, but with the working parts in still another position. Fig. 6 is a lateral sectional view of a portion of the machine on line x, Fig. 2. Fig. 7 is a sectional view of a portion of the machine on line y, Fig. 5. Fig. 8 is a plan view of a portion of the clamp-plate, adjusting, and guiding mechanism in a modified form. Fig. 9 is an enlarged plan view of a portion of the clamp-plate and a preferred form of brush-head clamp. Fig. 10 is a front or edge view of the same. Fig. 11, in side and top view, illustrates a clamping-wedge detached from the clamp-plate. Fig. 12, in several views, illustrates a hand-plate or wedge-key devised for moving the wedges. Fig. 13, in two sectional views, illustrates one of the drill-chucks as devised by me. Fig. 14, in plan view, illustrates another form of brush-head clamp. Fig. 15 illustrates a brush-head bored in three angular rows. Fig. 16 illustrates a brush-head bored in four angular rows. Fig. 17 illustrates a head bored in straight rows. Fig. 18 illustrates a head bored in curved lines. Fig. 19 illustrates a guide-plate for curved-line boring. Fig. 20, in plan and longitudinal section, illustrates a brush-head with inclined holes.

It will be obvious that the frame-work of the machine may be largely varied so long as due provision be made for the bearings of moving parts and requisite strength afforded for the different members of the frame to secure freedom from vibration when in service.

As here shown, the bed-plate A is adapted to be mounted upon and secured to the top of a work bench or table cut away to afford room for certain pendent parts.

Although it would be mechanically possible to mount the drills in a frame, B, which is vertically movable or reciprocatory, it is deemed best that said frame be as rigidly held as possible in view of the high speed at which the drills are driven and the accuracy with which they should operate, and therefore the drill-frame B is mounted on vertical standards a, rigidly projecting upward from the bed-plate by means of arms or brackets a', each provided with a clamp-screw, a^2, as shown in Fig. 3. Each drill arbor b is provided with a bolster-bearing, b', and an adjustable center bearing, b^2, both being mounted in the frame B, which is constructed in two parts, respectively operating as a bolster-rail, b^3, and a center-bearing rail, b^4, the latter having a series of clamp-screws, b^5, one for each center bearing, and the rail b^3 having a screw, b^6, for each bolster. Each drill-arbor has a whirl, b^7, for receiving a driving-cord, and these whirls alternately occupy different planes because of their close proximity to each other. Each arbor is radially bored above its bolster for the reception of a holding-pin during the tightening and loosening of the drill-chucks c, which are each squared up on two sides for affording a seat for a wrench. The importance of having the tips of all the drills d in a certain precise horizontal plane renders it imperative that the chucks c be capable of being tightened for clamping a drill without any liability of varying the position of the latter, and also so that all of the drills may be accurately adjusted prior to tightening by permitting them to drop and rest their tips upon any flat plate which may be used for the purpose. So far as I know, the chuck here shown in Fig. 13 is the first involving a screw threaded arbor having a hollow cylindrical non-threaded end, c', a pair of conical wedges, c^2, and a sleeve, c^3, threaded to the arbor and provided with a cylindrical tapering nose, c^4, the whole being so organized that the drill may be freely adjusted longitudinally when the sleeve is loosened, and then firmly clamped by rotating the sleeve without in any manner affecting the adjustment of the drill.

It will be seen that before any clamping effect can occur on the part of the wedges the butts of the latter must engage against the coincident end of the arbor, and therefore up to that time the drill will rest freely on its adjusting-plate, and that after the sleeve begins to close the wedges into clamping contact with the drill the wedges cannot possibly rise, and therefore the drill will maintain its precisely proper position as to the vertical adjustment of its tip.

Beneath the drill-frame is the clamp-frame C, on which the clamp-carriage D is mounted. The clamp-frame C requires only a capacity for vertical reciprocation within certain care-

fully-prescribed limits, and this movement is imparted by the hand of an operator. Various kinds of mechanism may intervene between the handle *e* and the clamp-bed—as, for instance, in my prior patented machines I used a rock-shaft and a lifting-cam, and I have also used jointed arms; but I prefer to employ the rock-shaft *e'*, provided with segmental gears e^2, which mesh with rack-teeth e^3 on one side of the guiding-legs *f*, which project downward from the under side of the clamp-frame and are accurately fitted to slide in vertical tubular bearings *f''* in the bed-plate. When the clamp-frame is in its lowest position, the hubs f^2, in which the legs *f* are mounted, rest upon the tops of the bearings *f''*, as clearly indicated in Fig. 1. For accurately limiting the upward movement of the clamp-frame and its carriage, a stop, *g*, is provided at the center of the overhanging drill-frame B. This stop *g* is in the form of a pendent stud tapped into the bolster-rail and provided with a clamp-nut, *g'*, by which it may be secured at any desired adjustment, which must obviously be very fine in view of the fact that a tooth-brush head has little thickness, and the drilled holes do not pass through the head, but must coincide with and merge into the shallow graved lines cut from the opposite side of the head.

The clamp-carriage D carries the clamp-plate *h*, having a series of recesses, *i*, for receiving brush-heads. The carriage at each end is provided with a rail, *h'*, and these are fitted to slide-bearings h^2 on the clamp frame and so arranged that it can slide laterally to and fro on said frame without any endwise or any twisting movement. This movement is performed in a step by-step motion and as a result of the vertical movement of the clamp-frame, as will be hereinafter fully described; but I will now refer to the immediate mechanism involved, which consists of a shaft, h^3, mounted in bearings upon and at the rear of the clamp-frame and below the carriage, as clearly shown in Figs. 1 and 6, and carrying gears h^4, which mesh with rack-gears h^5 on the under side of each end of the carriage, so that when said shaft is intermittingly rotated in one direction the carriage is moved rearward step by step, and it is moved forward in like manner when said shaft is rotated in the opposite direction. Now, for nicely limiting the forward and backward movements of the clamp-carriage, and thus defining the lengths of some of the rows of holes to be drilled, the clamp-bed, at its front and rear sides, has adjusting stop-screws *k* and *k'*, which are abutted at their inner ends by the coincident front and rear edges of the carriage. On the front edge of the carriage there is a sliding bar, *l*, having an abutting face, *l'*, which can be moved inward, so as to be in line with and abutted by the screw *k*, and also so moved as to only permit said face *l'* to abut against the inner face of the block l^2, on which said screw is tapped, and also so moved still farther to the left as to allow the screw to be abutted by the edge of the carriage, all for special purposes, which will be hereinafter explained.

The clamp-plate *h* is axially mounted upon the carriage D, so that it can be laterally rocked into certain desirable adjustments, and it is also mounted so as to be capable of longitudinal movements in exact harmony with the lateral movements of the carriage or independently thereof.

The clamp plate *h* has secured to its under side a rock-shaft, *i'*, which extends beyond both ends of said plate and occupies bearings i^2 on the carriage, which permit said shaft to semi-rotate and also to slide therein. At one end the clamp-plate has a spring-arm, *m*, and opposite this, on the carriage, is a notched arched keeper, *m'*, as clearly shown in Figs. 1, 2, and 3, these being so arranged that the clamp-plate will be held in a laterally-horizontal position when the arm is located in the central notch, m^2, of the keeper, or inclined toward the front or toward the rear, according to which of the side notches, m^3, said arm may be engaged by. For certain kinds of service the clamp-plate should not be moved laterally from a truly horizontal position, and in such cases the spring-arm is relieved from actual duty by the screws i^3, which are tapped into the under side of the plate centrally at its front and rear, so that their heads may abut upon the top of the carriage, and thus firmly block the plate against axial movement.

It has already been stated that the lateral to-and-fro movement of the clamp carriage was derived through its vertical movement, and now it is to be understood that the longitudinal movement of the clamp-plate is derived from the said lateral movement, and this is accomplished as follows:

A lever, *n*, is pivoted at its rear end to a vertical pivot. *n'*, on the carriage, and at the rear portion of one end thereof, as clearly shown in Figs. 1 and 2. This lever has a pendent pin, n^2, which occupies snugly an annular groove in the rock-shaft *i'* near its outer end. Near the outer or free end of this lever, which is composed of thin spring metal, there is a guiding-stud, n^3, projecting downwardly from its under side and occupying a slot, n^4, in a pattern or gage plate, n^5, which is firmly mounted on the clamp-frame C and projects forwardly therefrom. A gage or pattern plate of this type is essential for boring holes in lines which are not parallel, there being as many slots n^4 as there are rows of holes to be drilled, and also for drilling rows of holes in curved lines, and a plate with parallel slots may also be used for drilling holes in parallel rows, or the latter may be gaged by means of a notched plate which is mounted upon the carriage and moves to and fro laterally with it and with said lever, as will be hereinafter more fully described in connection with Fig. 8.

I will next describe how the vertical reciprocation of the clamp-bed imparts a step-by-step rotation to the shaft h^3, and the conse-

quent step-by-step lateral movement of the clamp-frame, and the gradual longitudinal movement of the clamp-plate when that is desired.

On referring to Figs. 1 to 7, inclusive, it will be readily seen that the shaft h^3 has at one end a square toothed gear, E, which operates as a pawl gear, and this is peculiarly mounted upon and coupled to said shaft, as illustrated in Figs. 3, 4, and 7. The gear itself is loosely mounted on said shaft, but it is rotatively coupled thereto, as shown in Fig. 7, by means of the collar *o*, (secured to said shaft by a clamp-screw, *o'*,) and a sliding dowel-pin, o^2, in said collar, which at its inner end occupies a hole o^3, in the side of the gear, thus locking the gear to the shaft. The inner end of the dowel-pin has two diameters, one of which accurately fills the hole o^3 and the other only partially fills said hole. In order that the gear may not move too freely on its shaft, a friction-pad is applied thereto in the form of a bow-spring, o^4, mounted at its center to a bracket on the clamp-frame, so as to depend therefrom and pinch or embrace said gear at one or more points at its periphery. Said pin o^2 is longitudinally adjustable, and is provided with a clamp-screw, o^5, so that said pin may be set for duty in either, causing the shaft to be promptly rotated upon the rotation of the gear, or causing said shaft to delay in rotation until after the gear has been moved a little on its axis, thus providing for a desirable lost motion under certain circumstances, as will hereinafter be further described.

Now, referring especially to Figs. 3, 4, and 5, I will explain how the vertical motion of the clamp-frame is converted into intermitting rotary motion in the shaft h^3 and gear E. On said shaft, and at the inner side of said gear, a pawl-frame, F, is loosely mounted, so that it can rock freely thereon. This frame is bow-shaped and has three pendent arms. The central pendent arm carries a double-toothed triangular pawl, F', and at the foot of one of the side arms there is a pawl-keeper, *p*, mounted on a spring, *p'*. This pawl-keeper has a central notch at p^2 for receiving the tip of the pawl when the latter is to have neither of its teeth engaged with the gear E; but at each side of said notch there is an angular face, against one of which said tip will bear, according to which of the two pawl-teeth is desired for service.

As thus far described it will be readily seen that if the pawl-frame be rocked on the shaft the latter will be revolved step by step or tooth by tooth in either direction, according to which of the two pawl-teeth may be on duty.

The two outer pendent arms of the pawl-frame are coupled together at their lower ends by a straight bar or rail, p^3, provided with bent arms p^4, and at each end, on its upper surface, having a notch, p^5. On this rail a weight, p^6, is suspended by means of a ring or hook, which occupies one or the other of the said notches p^5. An expansive spiral spring, sliding upon a similar stationary rod below, can be relied upon in lieu of the weight.

In Fig. 3 the clamp-frame is shown in its lowest position, and in Fig. 4 it is shown in its highest position, and it will be seen that when elevated the weight causes the pawl-frame F to tilt toward the weight, and as the clamp-frame rises from the position shown in Fig. 3 the left-hand end of the pawl-frame remains depressed, as shown in Fig. 4, wherein the pawl finger or tooth nearest the weight is shown to be engaged with the teeth of the gear E, and therefore when the clamp-frame is next lowered the shaft h^3 will be rotated toward the right hand, because each of the outer pendent arms of the pawl-frame has a roller-stud, p^7 p^8, and the stud p^7 now rests upon the abutment afforded by the upper surface of the adjacent end of the bed-plate, as shown in Fig. 1, or upon a change-plate resting upon the bed-plate, as will be hereinafter described. Now, referring to Fig. 3, let it be supposed that the weight has been shifted into the notch p^5 at the right-hand end of the rail p^3, and the tip of the pawl then shifted over to the corresponding angular face of the pawl-keeper *p*, then the roller-stud p^8 will be depressed and the stud p^7 elevated, so that if the clamp-frame were then lowered the pawl would rotate the gear E and its shaft in the opposite direction to that previously indicated. The roller-studs p^7 p^8 are made adjustable on the pawl-frame by means of slots in said arms and clamp-nuts on the studs, thus providing for variations in regular spacing between holes in a row.

For restricting the deflecting action of the weight so that the pawl-teeth will pass over or skip just the required number of gear-teeth in each case, two stops, *q*, are employed in the form of screws in the lower end of a rigid bow-shaped frame, *q'*, which is rigidly mounted upon and carried by the clamp-frame, it being obvious that either arm of the pawl-frame will abut against the inner end of the screw *q*, which is at the side of the pawl farthest from the weight, and thus control or limit the range of movement by the pawl. It is to be understood that the entire lifting movement of the clamp-plate by the handle *e* is not essential for operating the hole-spacing feed, and hence without causing the contact of the drill with a brush-head the clamp-plate may with care be moved as well without drilling as with it.

I have now to describe how on occasion the pawl can be made to variably operate for causing holes to be bored at varied distances from each other by varying the height of the abutment on which the roller-studs p^7 and p^8 strike or rest when the clamp-frame is lowered.

On top of the bed-plate, at its left-hand end, there is a detachable sliding change-plate, G, (clearly indicated in Figs. 3 and 4,) having at each end a pendent stud for preventing it from being drawn or pushed out of place longitudinally. This change-plate has its upper surface

in several steps or flat horizontal planes, so that by moving it endwise the roller-studs will be made to abut and rest upon whichever plane may be desired. Without this plate the distances between the holes drilled are varied, as hereinbefore stated, by adjusting the screws *q* or the roller-studs, as for regular spacing; but this change-plate G enables certain precise variations to be promptly made by merely sliding the plate. If the change-plate be removed, the holes bored would, without readjusting the screws *q* or the roller-studs, be always the same distance apart, and the same is true when the plate G is not moved longitudinally. In many cases the holes bored near the outer end of a tooth-brush head are closer together than others in the same row, and this is called "gathering;" and hence I term this change-plate G a "gathering-plate" when so constructed as to enable me to gather at any time and to at once resume regular spacing. Now, it will be obvious that if the lifting-steps of the change-plate G be reversed, so that the abutment or bearing-points for the roller-studs will be progressively lowered, (instead of raised, as in gathering,) the effect will also be reversed, and the holes "spread" instead of "gathered;" and hence, although said plate in either form is a change-plate for effecting prompt variations in spacing holes in a row, it is sometimes a gathering-plate and at other times a "spreading plate."

I will now describe the clamps by which the tooth-brush heads and handles are secured upon the clamp-plate.

It will of course be obvious that whatever has been already described is in no manner dependent upon the character of clamp employed, so long as the clamp-plate is thereby enabled to carry a brush-head below each drill and to firmly hold said head during the various movements of the clamp-plate in drilling. I show two forms of clamps which have been devised by me, but will first describe the preferred form illustrated specially in Figs. 9, 10, and 11.

The clamp-plate *h* has on its upper surface the recesses *i*, formed by a series of transverse stationary wedge-shaped bars, i^4, having at each edge a longitudinal recess at i^5, and these bars are regularly spaced to correspond with the intervals between the overhanging drill-chucks, and they may be integral with said plate or separately applied thereto. Into each of these recesses a wedge, *r*, is inserted, and each wedge has a pendent head, *r'*. At the rear edge of the clamp-plate, midway between each two of the bars i^4, there is an end gage, r^2, the top of which slightly projects toward the front, and the whole conforms generally to the end of a tooth-brush head, so that when a head is placed between the wedges and in end contact with said gage r^2 it will be longitudinally adjusted in a proper position for presentation to the drills, and by forcing the wedges inward evenly the head will be firmly clamped and laterally adjusted in a proper position.

For preventing a head from rising while being wedged, the wedges on their inner sides are inclined, being wider on the top than on the bottom, so that when forced into contact with a head they bind it down upon the plate, as well as confine it laterally.

For conveniently and accurately controlling a pair of wedges, I have devised the hand-plate H, Fig. 12, which constitutes a wedge-key of special value for this purpose. In its best form this hand-plate is a strip of heavy sheet-steel bent at right angles at one end and cut away centrally to afford two fingers, *s*, and an intervening space greater than the width of the widest tooth-brush handle at or near its head. Looking now at Figs. 9 and 10, let it be supposed that a brush-head has been inserted endwise with its end against the gage and that the wedges are both loose. Now the hand-plate is placed with its fingers straddling the brush-head and each finger in contact with the head of a wedge, whereupon endwise pressure is applied and both wedges are forced home with uniformity, and when the head is to be removed from the clamp the hand-plate is turned bottom up, its fingers placed against the rear of the pendent wedge-heads *r'* for pulling them outwardly, and with wedges of proper length the hand-plate can be used with leverage, because then the fingers will at one side engage with the wedge-heads and at the other side with the coincident front edge of the clamp-plate *h*. In the form of clamp shown in Fig. 14 one side of each head-seat or recess is slightly inclined, and between each two seats there is a sliding wedge-block, *t*, provided with a central slot and a clamp-screw, *t'*, and said block slides between two wedges, *u*, pivoted at their front ends on the clamp-plate. Two brush-heads having been placed in the seats with their ends in contact with the gages, the wedge-block is driven inward and secured. I prefer the other simpler form of clamp, and shall make special claim thereto in appropriate combinations; but this more complex form may be used, as well as many others, without departure from the main features of my invention.

As thus far described, I believe I have clearly indicated the capacities for movement of the several parts of the machine and the several capacities for variation in operation; but to render them and their value more clearly apparent I will now describe the operation of boring heads like that illustrated in Fig. 15, which has a straight central line or row of holes and a row at each side thereof, but angular thereto.

The holes being all of the same depth, it will be assumed that the drills have been set and the pendent stop *g* properly adjusted to secure the desired depth of boring; also that the pawl-frame has been set to produce the proper spacing between the holes in each row. As but

three rows are to be drilled, the four-row pattern-plate n^5 is removed and one put in its place having three slots, n^4. The lever n is then set with its guiding-stud in one of the outer slots. The clamp-carriage is then drawn fully forward and the brush-heads clamped thereon, the pawl meantime occupying the notch of the keeper. The carriage is then moved backward until the sliding bar l can be moved to the right and in contact with the inner end of the screw k, which will properly locate the brush-head to receive the first hole at the outer end of one of the side rows. The weight is then set toward the front, and the pawl set to rotate the gear E in the proper direction, whereupon, the drills being in motion, the clamp-frame is lifted, the first hole bored, then lowered and lifted again, and so on until all the holes in an outer row are bored.

In drilling this style of brush, the rear stop-screw, k', need not be used, the operator determining by observation the location of the rearmost hole in the outer row. Having thus drilled one outer row, the clamp-plate is moved and properly located for drilling the other outer row, commencing to drill at the rear end of the head. The pawl is then shifted and the clamp-bed vertically reciprocated, as before, until the end hole has been bored in the second outer row. After drilling the last-named hole, the clamp-bed is again partially reciprocated once or twice, which locates the path of the drill beyond the end of the head. The clamp-plate is then moved longitudinally and properly set for locating the center row of holes. The dowel-pin o^2 is then slightly withdrawn from the pawl-gear E, so that when the pawl is next shifted for drilling backward on the center row and the clamp-bed reciprocated there will be a lost motion by the pawl-gear equal to one-half of a regular space, and therefore, after drilling the outer end hole of the center row, located by shifting the sliding bar l, the others will be not only regularly spaced, but each hole will be located substantially opposite the center of the spaces between the adjacent holes of the side rows, the last or rear hole of the center row being located a half-space at the rear of the side rows.

In drilling the head shown in Fig. 16 the guide-plate shown in Fig. 2 is used, having four angular lines, and the dowel-pin o^2 is set into the pawl-gear, so as to afford no lost motion. The outer hole of one of the side rows is first drilled, and then the others of that row with regular spacing, as before described. The clamp-plate is then moved longitudinally and set so as to locate the clamps and drills for the next adjacent inner row, and the pawl is shifted for reversing the movement of the clamp-carriage. Then the drilling proceeds as before described, until that point is reached at which the gathering should begin, and then the gathering change-plate is drawn outward partially, thus narrowing the space between two or more holes, and then again said plate may be pulled out farther if still less spacing is required. After drilling the outer end hole of this row, the clamp-plate is moved longitudinally for locating the next inner row and the first hole drilled without changing the position of the gathering-plate; but before drilling the next hole of that row the gathering-plate is moved inward to the extent of its outward movements, so as to afford the same spacing as in the row last drilled, and so on until the gathering-plate, having been forced fully inward, then causes regular spacing, as in the two rows already drilled. Having finished the second inner row, the clamp-plate is again moved longitudinally for locating the second outer row, and the pawl is again shifted, and the drilling proceeds, as before, without moving the gathering-plate.

In drilling the head shown in Fig. 17 another pattern or gage plate with four straight slots, or the notched plate shown in Fig. 8, is used; but the procedure in drilling and in the use of the gathering-plate is the same as last described.

In drilling the head shown in Fig. 18 still another guide-plate is used having curved slots, as shown in Fig. 19; but the gathering-plate is not used, because the outer end of the head is narrow, and the curved-line arrangement naturally groups the holes sufficiently at that point. At the rear end, however, the curved-line arrangement would, with uniform spacing, cause such a close grouping of the holes as to weaken the head too much, and hence some of the holes are omitted from one of the central rows, as is clearly indicated in Fig. 18. This is accomplished by the use of a sliding change-plate having a bearing-surface reversely stepped as compared with the gathering change-plate, as hereinbefore indicated, and hence the change-plate is made to serve as a spreading-plate instead of a gathering-plate.

In Fig. 20 a well-known type of brush-head is shown, in which all the holes between the end of the brush-head and a cross-row at the the middle thereof are drilled angularly and pitching toward the handle, and all the holes between the middle of the head and the handle or neck are drilled at an opposite angle and pitching toward the outer end of the head, as fully indicated in the sectional view of this figure. In drilling this head the clamp-plate is tilted or rocked toward the front of the machine, and the drilling of the rear portion of the holes proceeded with as in straight-line drilling, and when these holes are all finished the clamp-plate is reversely tilted, and then the drilling is proceeded with as before. The wide blank spaces near the middle of the head are due to the changes in the angles; but when the bristles have been inserted they are massed at their outer ends over said spaces.

With these descriptions of the modes of procedure in boring the heads of several kinds of brushes I do not deem it necessary to go farther in this direction, believing that persons skilled in the art will be readily able to adjust

and operate the machine for the proper performance of all of the various kinds of work involved in the production of fine brushes.

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

1. In a machine for boring brush heads, the combination, substantially as hereinbefore described, of a clamp provided with a gage for longitudinally adjusting a brush-head therein, a rocking clamp-plate carrying said clamp and free to slide transversely and longitudinally in a horizontal plane, a drill opposite said clamp and plate, and means for placing said drill and clamp into various co-operative positions, whereby holes may be bored in rows and at various inclinations.

2. In a machine for boring brush-heads, the combination, substantially as hereinbefore described, of a series of drills, a brush-clamp opposite each drill, a longitudinally and transversely sliding clamp-plate carrying said clamps in a plane at right angles to the drills, and means for placing said drills and the clamps into various co-operative positions, whereby several brush-heads carried on said clamp-plate may be simultaneously provided with holes arranged in several rows.

3. In a machine for boring brush-heads, the combination, substantially as hereinbefore described, of the vertically-movable clamp-frame, the sliding carriage thereon, the shaft and gear thereon carried by said frame, a rack on said carriage meshing with said gear, a double-toothed pawl on a pendent pawl-frame having wide-spread arms and mounted loosely on said shaft, a shifting weight on said pawl-frame, a pawl-gear on said shaft engageable by either tooth of said pawl, and an abutment beneath the arms of said pawl-frame, whereby, as a result of the vertical movements of said clamp-frame, said carriage is intermittingly moved regularly step by step in either direction, according to which of the arms of said pawl-frame engages with said abutment.

4. In a machine for boring brush-heads, the combination, substantially as hereinbefore described, of the vertically-reciprocative clamp-frame, the clamp carriage and its shaft, the pawl and its vibrating weighted frame loosely mounted on said shaft, the abutment below said frame, and a pawl-gear loosely mounted on said shaft and provided with means for rigidly locking it thereto, for causing said pawl and frame to promptly partially rotate said shaft, and also provided with means for loosely locking said gear on said shaft for affording lost motion as between said gear and shaft, whereby holes in any one row may be bored opposite the spaces in an adjacent row, but equally spaced in both rows.

5. In a machine for boring brush-heads, the combination, substantially as hereinbefore described, of the clamp-carriage, the drill, the vertically-movable shaft by which the clamp-carriage is moved step by step, the pawl and its swinging frame having wide-spread pendent arms, the pawl-gear on said shaft, and the change-plate below said arms and serving as a promptly-adjustable abutment for contact by either of said arms and enabling the spaces between holes to be drilled in any one row to be promptly varied.

6. In a machine for boring brush-heads, the combination, substantially as hereinbefore described, of a drill, a brush-head clamp, and the clamp-plate, adjustable in a fixed position as to inclination, and also movable longitudinally on a laterally-movable carriage in a plane at right angles to the drill, and a pattern or gage plate for controlling said clamp-plate while moving to and fro in an inclined position and guiding it in all its movements while boring rows of inclined holes in a brush-head.

7. In a machine for boring brush-heads, the combination, substantially as hereinbefore described, of a drill, the vertically-movable clamp-carriage shaft and its pawl-gear, the pawl-frame provided with a double-toothed pawl and with two wide-spread arms, each having an adjustable contact-stud and an underlying abutment in intermittent contact with said studs, whereby regular or uniform spacing between the holes in any one row can be accurately and readily provided for.

8. In a machine for boring brush-heads, the combination, substantially as hereinbefore described, with the drill and a vertically-movable shaft through which spacing of holes in a row is controlled, of a pawl-gear on said shaft, a pawl, a pawl-frame loosely pivoted on said shaft and having bow-shaped arms, a shifting weight on said frame, an abutment with which one or the other of said arms engages during the downward movement of said shaft, and adjusting stop-screws for limiting the extent of vibration of said frame and varying the engagement of said pawl with the teeth of the pawl-gear.

9. In a machine for boring brush-heads, the combination, with the clamp-plate and a drill-arbor having a neck which is both screw-threaded and plain and axially bored to freely receive the shank of a drill, of a pair of conical wedges abutting against the neck of the arbor for embracing the shank of a drill and a conical-tipped sleeve surrounding said wedges and internally threaded to receive the threaded portion of the arbor, substantially as described, whereby the tip of the drill may be accurately located with relation to the surface of the clamp-plate and securely tightened without liability of changing the relations of said drill and clamp-plate.

10. In a machine for boring brush-heads, the combination of the drills, the sliding clamp-carriage, the sliding bar *l*, and the stationary adjustable stop-screw *k*, substantially as described, for promptly varying the rearward limit of movement by said carriage without changing the adjustment of the stop-screw, and thereby providing for holes in rows of different lengths.

11. The combination, with a drill, of the

brush-head clamp provided with a head-receiving recess, an end gage, and two sliding wedges occupying grooves at the sides of the recess and between which a brush-head is clamped and centrally located in said recess, substantially as described.

12. The combination, with a sliding clamp-frame, the clamps and drills, the pawl, and the pawl-frame, of the pawl gear for intermittingly moving said clamp-frame, said gear being loosely mounted on its shaft and capable of a partial rotation thereon independently of said shaft, and a friction-pad, o^1, engaging with said gear, substantially as described, whereby said gear is prevented from rotation except when properly engaged by said pawl for moving the clamp-frame.

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Witnesses:
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