Dec. 17, 1940. P. R. ARONSON 2,225,426

DRILLING FIXTURE

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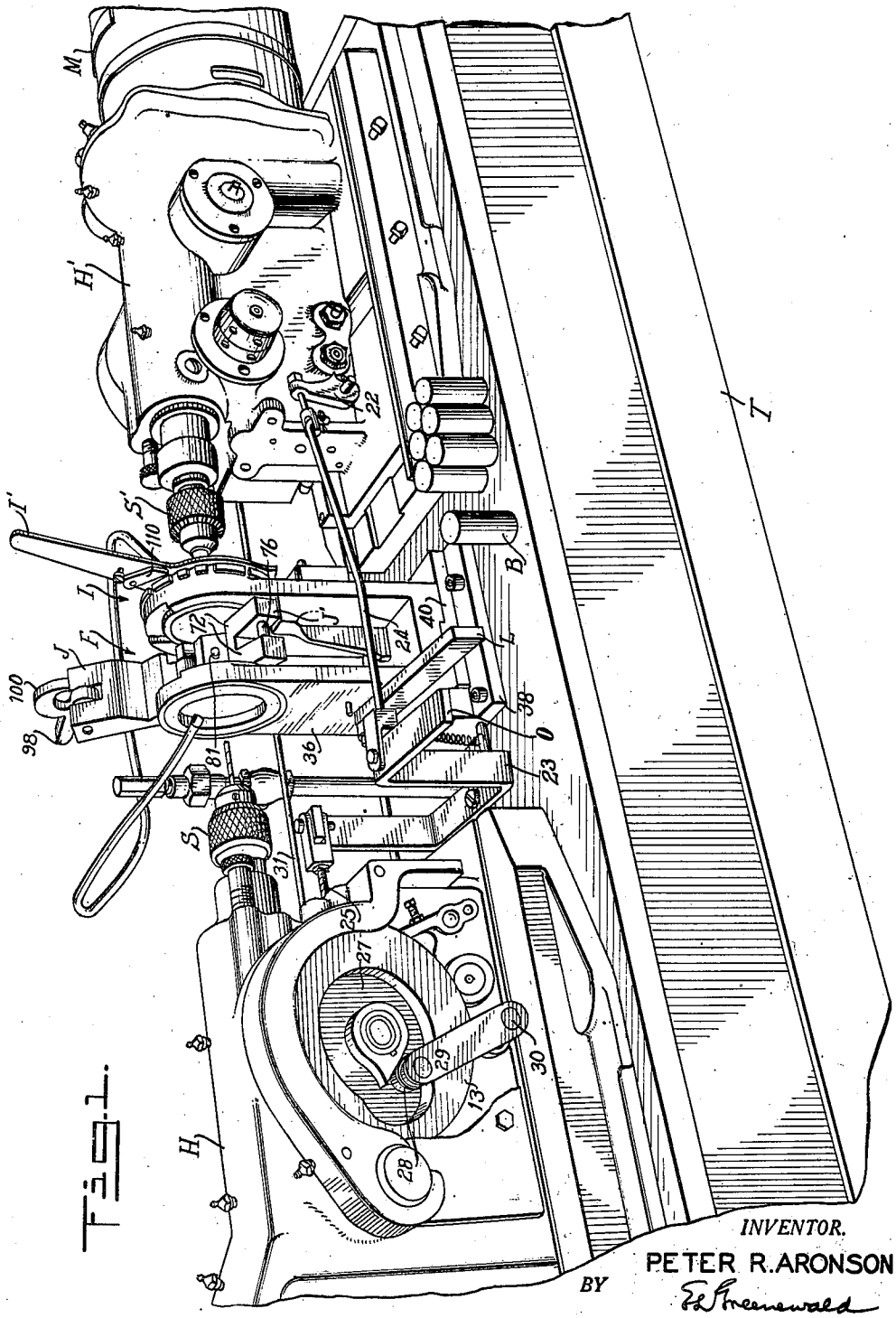


Fig. 1.

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DRILLING FIXTURE

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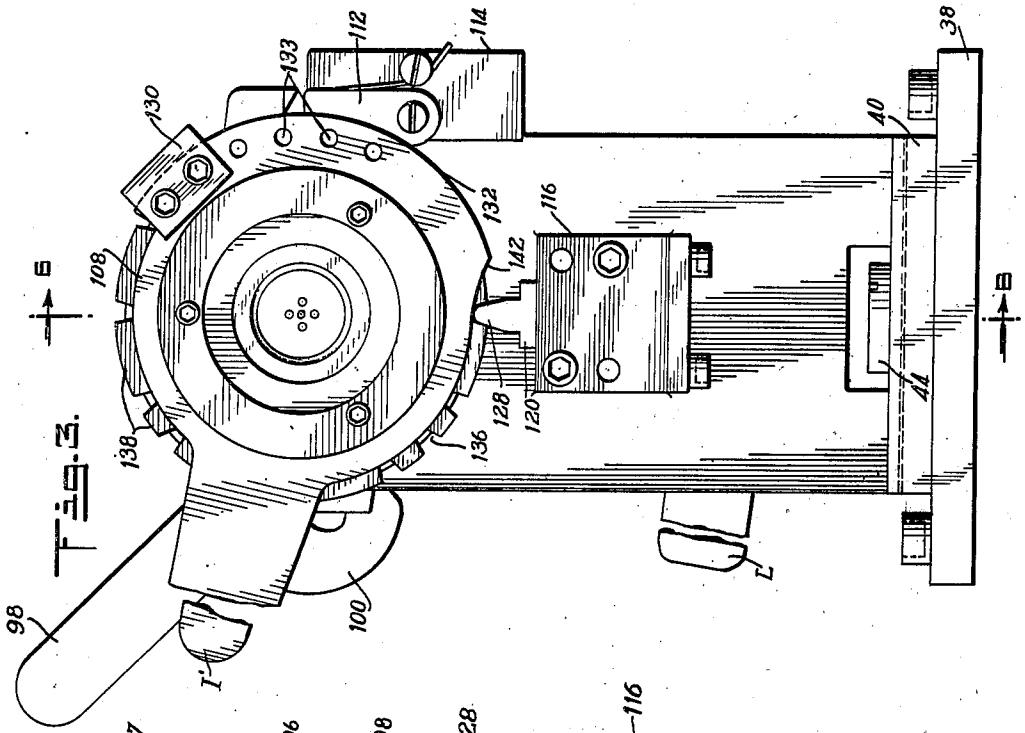


Fig. 3.

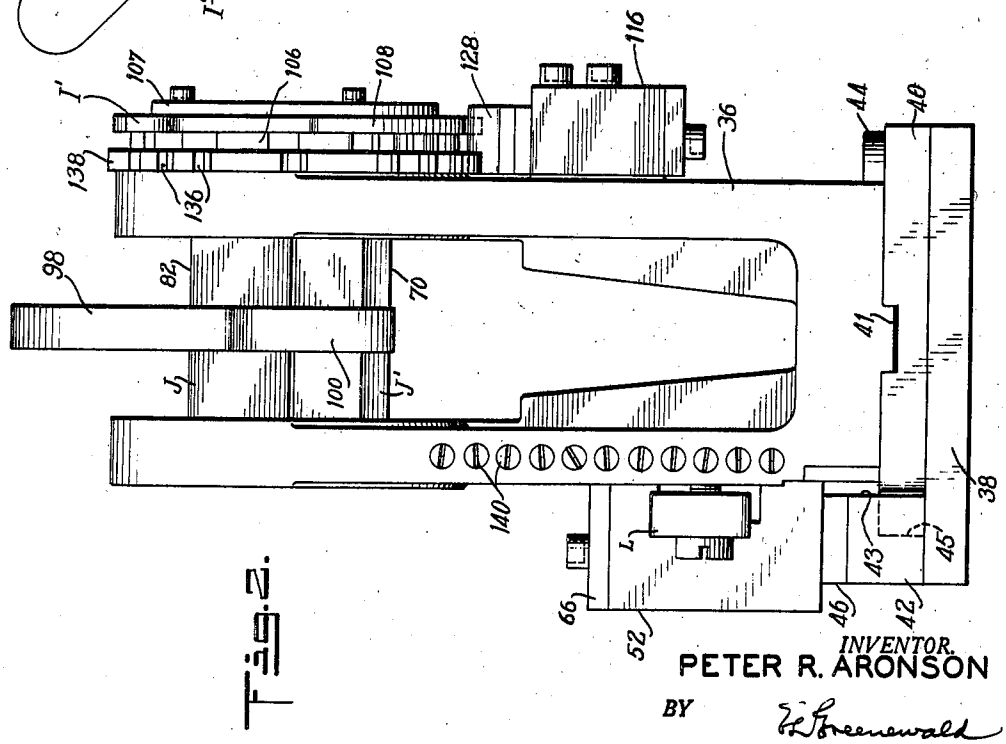


Fig. 2.

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DRILLING FIXTURE

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Fig. 5.

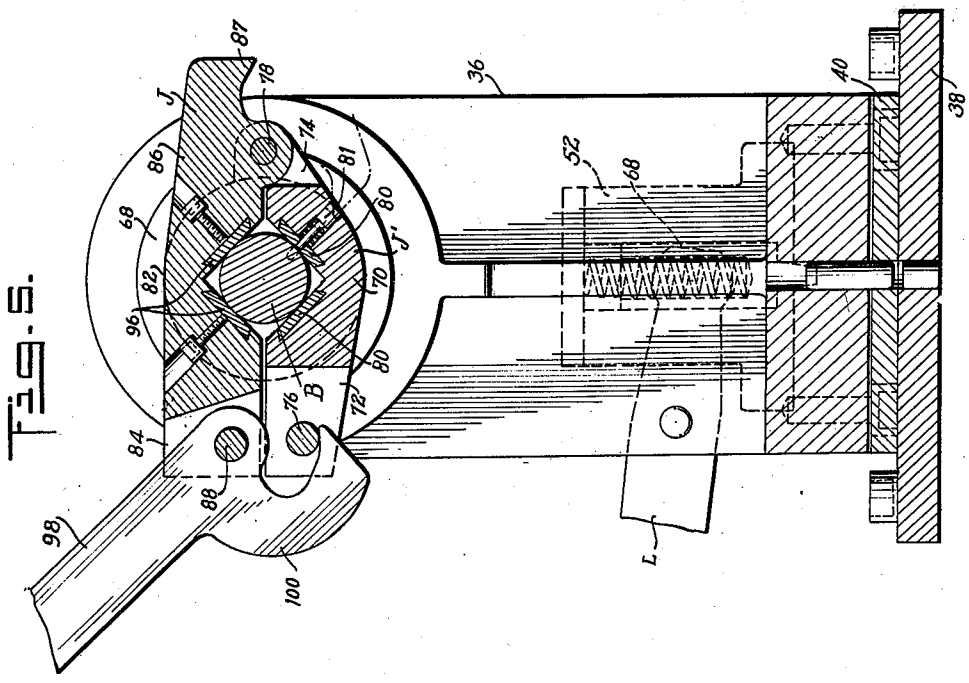
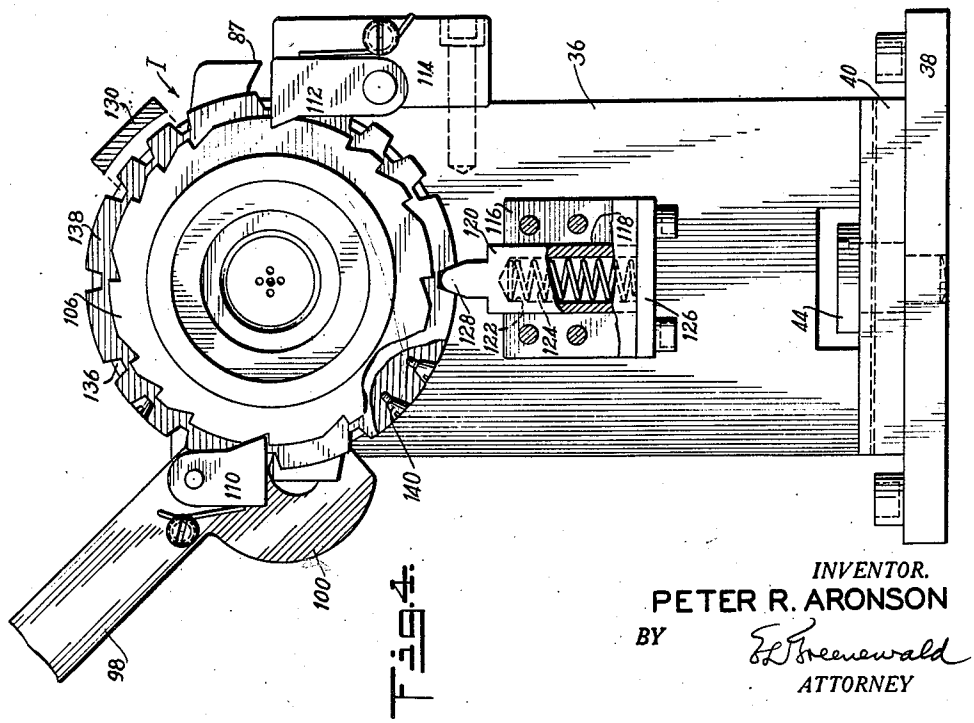


Fig. 4.



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DRILLING FIXTURE

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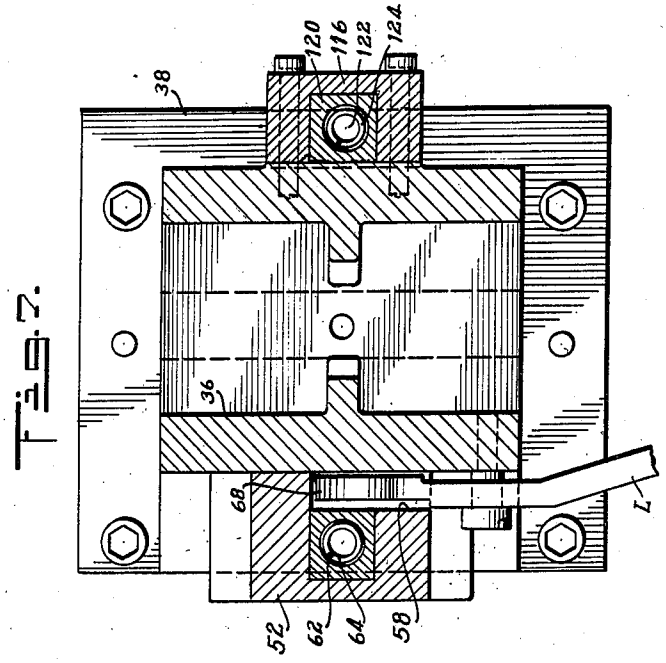


Fig. 7.

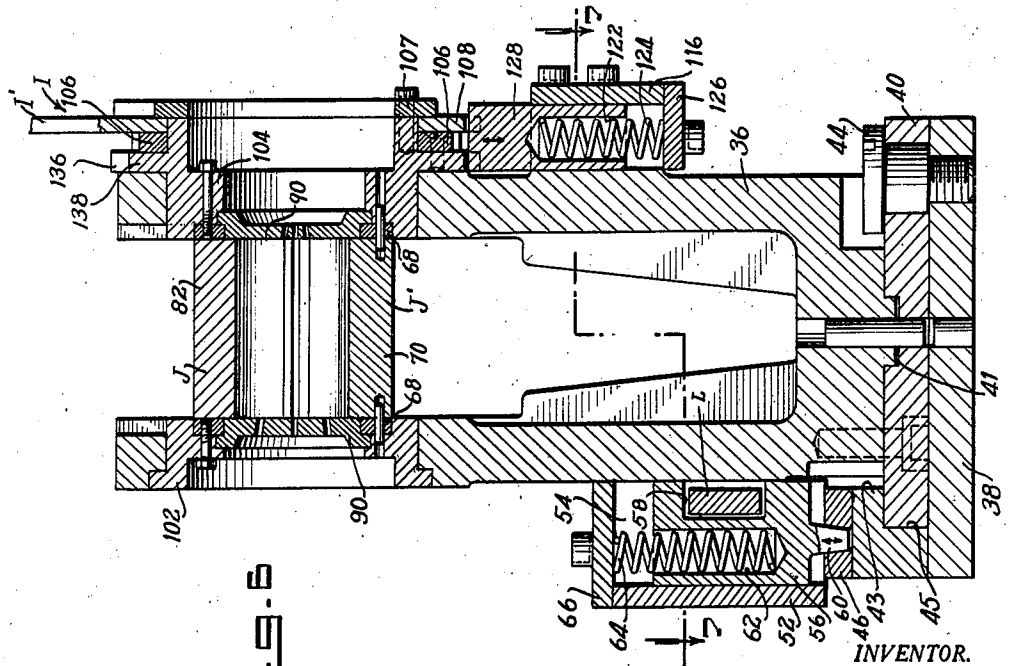


Fig. 6.

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DRILLING FIXTURE

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Fig. 9.

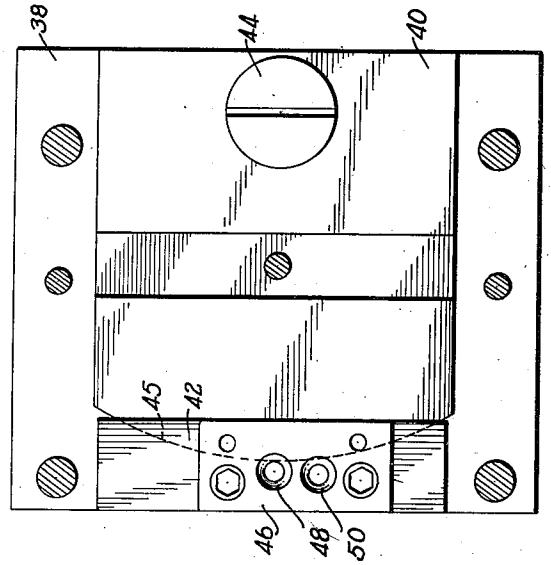


Fig. 12.

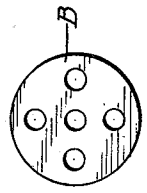


Fig. 11.

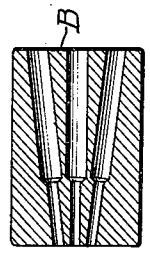


Fig. 10

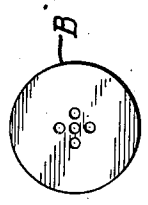
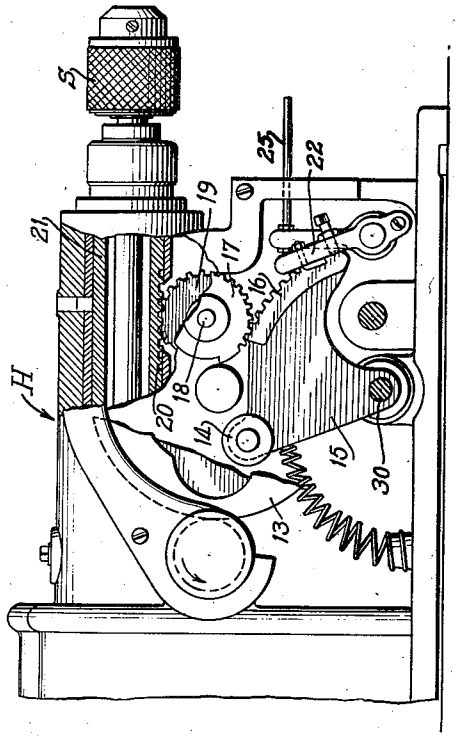


Fig. 8.



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UNITED STATES PATENT OFFICE

2,225,426

DRILLING FIXTURE

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Application August 18, 1937, Serial No. 159,659

11 Claims. (Cl. 77—21)

This invention relates to the art of drilling, and particularly to apparatus for drilling metal blanks preparatory to a metal-working operation for producing blowpipe nozzles and the like.

In accordance with known methods of manufacturing one-piece blowpipe nozzles from metal blanks, the blanks are drilled from one end to form a series of longitudinal passages of constant diameter, including a central passage and a series of parallel passages disposed about the central passage. Mandrels in the form of music wire are inserted within the passages, and the blanks are subjected to a metal-working operation in order to reduce the drilled passages to a diameter conforming with that of the music wire.

In these prior known methods a blank is drilled from one end, and although these drills are started accurately, they are, nevertheless, subjected to movement known as "walking" during the drilling operation, so that although the plurality of holes entering the blank are symmetrically located with respect to each other, their points of exit are invariably anything but symmetrical. If the passages surrounding the central oxygen passage are not accurately and symmetrically located, a preheat flame of inferior quality will result. In some instances, this will affect the rate of preheat as much as 5%. Likewise, these passages at the rear end of the nozzle must be accurately located, otherwise they will interfere with the formation of a gas-tight seat about the same, and about the central passage.

Furthermore, it is practically impossible accurately to drill a large number of angularly related passages in a metal blank so as to form relatively small and large hole circles at the respective ends of the blank, and to maintain the ratio between the passage diameters and the wall thickness dividing the passages of such a proportion that no folding of the metal between the same will occur during the metal-working operation.

The objects of this invention include, providing apparatus for preparing metal blanks preparatory to a metal-working operation so that they will contain a series of small diameter passages arranged in a relatively small hole circle at one end; and the provision of such an apparatus including a hand-operated indexing unit adapted to rigidly hold the blanks during the drilling operation, capable of being moved to the proper angle, and provided with means for rotating the blanks about their longitudinal central axis, so that a circular arrangement of a series of converging passages can be drilled in said blanks.

The above and other objects of the apparatus to be described will become apparent from the following specification and the drawings, in which:

Fig. 1 is a perspective view of one form of apparatus embodying the principles of the invention and showing opposed drilling heads with a hand-indexing fixture located between the same;

Fig. 2 is a front elevational view of the drilling fixture of Fig. 1;

Fig. 3 is a side elevational view of the unit shown in Fig. 2;

Figs. 4 and 5 are views partly in section and partly in elevation, showing certain details of the indexing fixture;

Fig. 6 is a vertical sectional view taken along in line 6—6 of Fig. 3;

Fig. 7 is a horizontal sectional view taken along line 7—7 of Fig. 6;

Fig. 8 is a detail view, partly in elevation and partly in section of a portion of one of the drilling heads shown in Fig. 1;

Fig. 9 is a detail plan view of the base of the indexing unit shown in Fig. 2; and

Figs. 10, 11, and 12 show the flame end, a section, and the entrance end respectively of a blank drilled while held by the apparatus of the invention.

Oxy-acetylene blowpipe nozzles, especially cutting nozzles, are usually provided with a central longitudinal oxygen passage, and a series of longitudinal preheat passages arranged in a circle about the oxygen passage and in such relation thereto that they are capable of delivering substantially a ring of preheating flames about the oxygen passage. The preheat passages at the exit or flame end of such nozzles should be located as accurately as possible about the central oxygen passage, and in some instances a great number of these passages is necessary in order to give the proper preheat for a cutting operation.

With the apparatus of this invention oversize passages may be formed within a metal blank by simultaneously drilling from opposite ends thereof with drills of relatively small diameter for penetrating the flame end, and drills of relatively larger diameter for penetrating the entrance end of the blank. Thus a large number of preheat passages arranged in a relatively small preheat circle at the flame end of the nozzle blank may be formed; and the accuracy of drilling afforded thereby makes it possible to

maintain the ratio between the passage diameters and the wall thicknesses dividing the passages of such proportion as to avoid folding of the metal between said passages during the metal-working operation. In order to eliminate the inaccuracies incident to the drilling of long passages with the relatively small diameter drills, their degree of penetration has been minimized and drills of larger diameter are employed for drilling from the entrance end of the blank to a point substantially beyond the center thereof. It is possible to use larger drills at the entrance end of the blank because this end is subsequently provided with seating surfaces requiring the disposition of the preheat passage-entrances in a relatively large circle thereby affording greater wall thickness between the passages.

A pair of substantially axially aligned, oppositely disposed drills are adapted to be fed along the central longitudinal axis of the metal blank. These drills are fed in such a relation that the larger drill completes its work before the smaller. It is fed to a point substantially beyond the center of the blank, and due to synchronization begins to recede before the smaller drill penetrates to, and breaks through the bottom of the passage formed by the larger drill. The metal blank is then moved to a position where the axes of the aligned drills define a line extending longitudinally through the blank but spaced from the longitudinal central passage. The drills are then simultaneously fed from opposite ends of the blank along this newly defined line similarly to the manner in which they were fed along the longitudinal central axis of the blank. The metal blank is then rotated about its central longitudinal axis and similar passages are formed at regular intervals, thus providing a series of passages which are arranged about the central longitudinal passage. The series of passages may be parallel with the central axis, or they may converge toward said central passage. In the present embodiment of the invention these passages converge toward the central passage, and the movement of the metal blank after the drilling of the central passage is such that the axes of the aligned drills define a line through the metal blank which converges toward the central axis of said blank.

One form of apparatus is shown in the drawings and comprises a drill assembly including a table T adapted to support a pair of aligned oppositely disposed drill-heads H, H', respectively operated by motors M (only one of which is shown) which are adapted to rotate as well as reciprocate drill spindles S and S'. Simultaneous reciprocative movement of the spindles S and S' may be effected by movement of a lever O when the motors M are operating. The timing of the movement of spindles S and S' is such that the former begins to recede from the point of its maximum inward displacement prior to the arrival of spindle S' at said point.

A drilling fixture F, having a pair of gripping jaws J, J' for rigidly securing a blank B during the drilling operation, is mounted on the supporting table T between the drill-heads H, H'. The fixture F is provided with means operated by a lever L for turning it to a position such that the axes of the drills in spindles S, S' define a line spaced from and converging toward the central axis of the blank B. The drilling fixture F is further provided with a hand-indexing unit I adapted to selectively rotate the blank B and the gripping jaws J, J' intermittently about the longitudinal central axis of the blank.

In accordance with the present invention, round hard-drawn copper rod-stock is cut to the desired length, and a forming tool is used to round the corners of the resulting blank during the cutting operation. The blank is inserted within the jaws J, J' which are clamped so as to maintain the blank in fixed position. The fixture F is positioned so that the axes of the drills within the spindles S, S' coincide with the central longitudinal axis of the blank B. The lever O is moved to the left thereby causing the drills within spindles S, S' to form a central longitudinal passage within the blank B.

After the central longitudinal passage has been formed, the operator turns the fixture F eccentrically about a vertical pivot by operating the hand-lever L so that the axes of the drills define a line through the blank, spaced from and converging toward the longitudinal central passage. The hand-lever O is again moved to the left, and the drills within spindles S, S' operate to form a passage within the blank which converges toward the central passage. Upon the completion of the formation of this last passage, the operator actuates the indexing unit I by moving the handle I' first upwardly and then downwardly thus effecting a predetermined rotative movement of the blank B about its longitudinal central axis, and similar drilling operations may be performed at spaced points about the central passage thus forming a ring of converging accurately-formed passages surrounding the longitudinal central passage. The jaws, J, J' are then opened, the blank removed, another blank inserted, and the drilling operations are repeated.

The automatic drill-heads H, H' are identical in construction, and are substantially the same as the Automatic sensitive drilling heads No. 18 manufactured by The Kingsbury Machine Tool Corporation. Since the specific drill-head construction forms no part of the present invention, only that portion of the same will be described which is necessary for a clear understanding of their relation with the apparatus of this invention; a specific description of their construction and operation may be had from Bulletin No. 1—35 entitled "Kingsbury Production Units" published by the above-referred to corporation.

The drill-heads H, H' are oppositely disposed on the table T in aligned relation. Referring to Figs. 1 and 8 of the drawings, the drill-head H is provided with a motor (not shown) geared to, and adapted to rotate, the spindle S. The spindle S is adapted to be reciprocated automatically by a friction drive, including a friction-wheel 13. This friction-wheel 13 is provided with a face cam (not shown) on the opposite face from that disclosed in Fig. 1, which controls the oscillation of a cam-follower 14 and a pivotally mounted supporting plate-segment 15 upon which a rack 16 is fixed (see Fig. 3), which latter is adapted to mesh with a gear-segment 17 on a shaft 18. The shaft 18 also fixedly supports a gear 19 which meshes with a rack 20 on a sleeve 21 within which the spindle S is keyed. Rotation of the friction-wheel 13 imparts an oscillatory movement of the rack 16, the gear-segment 17, the gear 19 and the rack 20, and consequently a reciprocating motion to the spindle S. A latch lever 22 is adapted to lock the rack 16 in a position preventing the reciprocation of the spindle S, and it is automatically engaged with the rack 16 when the segmental plate 15 is moved

to its maximum extent by the action of the cam surfaces on the reverse face of friction-wheel 13. Thus it is seen that by tripping the lever 22, the rotation of the friction-wheel 13 will begin and upon completion of one revolution thereof, the lever 22 will automatically re-engage and lock the rack 16 when the spindle S is withdrawn from the work. The cam surfaces on the reverse face of wheel 13, which coact with follower 14, may be designed so that the spindle S will recede slightly one or more times during the forward motion of the spindle S in order to clear the drill of chips, and so that latch 22 will engage the rack 16 at the end of each revolution of the wheel 13.

The drill-head H' is substantially identical with the drill-head H and its lever 22 is simultaneously tripped with that of head H. For this purpose, a U-shaped bracket 23, pivotally mounted on the top of table T between the drill-heads H, H', is adapted to be connected to drawbars 24 and 25 respectively attached to the trip levers 22 of the respective heads H' and H. The bracket 23 is further provided with an operating handle O for manually moving bracket 23 about its pivot on table T, thus effecting the tripping of the latch levers 22. The timing of the reciprocative movement of spindle S with respect to that of spindle S' is such that the feeding of the drill, supported by the latter, is interrupted before it reaches its maximum degree of penetration and locked against further penetration until the drill in spindle S reaches its maximum degree of penetration and begins to recede therefrom, thus preventing interference of the respective drills within the blank B.

The friction-wheel of head H' is provided with an automatic locking mechanism adapted to interrupt the reciprocative movement of spindle S' when the friction-wheel of head H' reaches a predetermined angular position. Completion of the penetration of the drill supported in spindle S' is effected by the release of this locking mechanism, which release is controlled by the head H. Referring to Fig. 1, a face-cam 27 is formed on the outer face of the friction-wheel 13 and is adapted to oscillate a cam-follower 28 journalled on a pin in one end of an oscillatable lever 29. A pivot shaft 30, extending through the head H, and upon which pivotal plate-segment 15 is journalled, is adapted to fixedly support the lever 29, on its one end, and a similar oscillatable lever (not shown) on its other end. This latter lever is connected to a draw-bar 31, which engages a tripping device adapted to release the locking mechanism associated with the friction-wheel of head H'. The low point of cam 27 causes lever 29 to oscillate once during each revolution of friction-wheel 13, and this low point is so located that release of the locking mechanism associated with the friction-wheel of head H' occurs after the drill in spindle S begins to recede from its maximum degree of penetration.

Drilling fixture F comprises a U-shaped standard 36 mounted for slight pivotal movement on the table T between the drill-heads H and H'. Referring to Figs. 2 and 9, a base-plate 38 is rigidly secured to the top of table T between the drill-heads H and H', and is adapted to receive a plate 40 pivoted thereto by pin 44, about which the standard may swing eccentrically with respect to the jaws J and J'. The plate 40 is provided with an arcuate edge-surface 45 adapted to cooperate with, and to be guided by a guide 42 mounted along one side of the plate 38. The guide 42 is provided with a mating arcuate surface and a portion 43 adapted to overlie the arcuate edge of plate 40. The U-shaped standard 36 is adapted to be removably positioned in fixed relation with respect to the plate 40, and is mounted thereon by a cooperating tongue and groove connection 41 and a dowel pin passing between the bottom of standard 36 and into the plate 40.

Standard 36 is adapted to be adjustably secured in two or more positions with respect to the plate 38. One position of the standard 36 is such that it will support the blank B with its longitudinal central axis coincident with the axes of the drills within spindles S and S'. Another position of the standard 36 with respect to the base-plate 38 is such that the axes of the drills define a line extending longitudinally through the blank B but spaced from, and converging toward the central longitudinal axis. The plate 40, and consequently the standard 36, is releasably held in adjusted position by a spring detent device, adapted to cooperate with a positioning plate 46 rigidly secured to the guide 42. The positioning plate 46 is provided with a recess 48 located on the center line of plate 40 that passes through the center of pivot pin 44, and a similar recess 50 is positioned a predetermined arcuate distance from the recess 48. A series of interchangeable plates 46 may be provided having different arcuately positioned recesses 48 and 50 so that converging passages of varying degrees may be drilled about the central longitudinal passage within the blank B. The spring-detent device comprises a housing 52 rigidly secured to one of the legs of the standard 36, and it is provided with a guide slot 54 (see Fig. 6) adapted to receive and slidingly engage a detent 56. The detent 56 is provided with a handle recess 58 in one side thereof, and a tooth 60 adapted to cooperate with the recesses 48 and 50 of the positioning plate 46. The detent 56 is further provided with a recess 62 in which a spring 64 is adapted to be positioned for cooperation with a cover-plate 66 forming the top of housing 52. A hand-operated lever L is pivotally mounted at a point intermediate its ends to the leg of standard 36 (see Fig. 5) to which housing 52 is attached, and its one end is provided with a curved portion 68 adapted to cooperate with the handle aperture 58 within the detent 56. It is thus apparent that the U-shaped standard 36 may be adjusted from one position to another by simply operating handle L so as to raise the detent 56 against the action of coil-spring 64 to a point where tooth 60 disengages the recesses 48 and 50, and moving the standard to an adjusted position. Upon releasing the handle L, spring 64 causes the detent 56 and consequently tooth 60 to move downwardly and to engage the selected recesses 48 and 50.

Gripping jaws J and J' which rigidly hold the blank B in position to be operated upon by the drills in spindles S and S', are adapted to be rotatively supported by the legs of standard 36. Referring to Figs. 5 and 6, the gripping jaw J' comprises a body-portion 70, to which a pair of rings 68 are doweled at its central portion. These rings are adapted to be mounted for rotation within the upper portion of the legs of standard 36. The body-portion 70 further comprises extended bifurcated portions forming legs 72 and 74 extending in opposite directions from the central portion thereof. Each pair of these extend-

ed legs is provided with aligned pivot apertures adapted to receive pins 76 and 78 respectively. A pair of right-angularly arranged gripping surfaces 80 are positioned within the body-portion 70. A plunger 81, to be described later, is mounted in one of the surfaces 80 for expelling the blank B when the jaws are opened. The other gripping jaw J comprises a body-portion 82 having a bifurcated extension forming legs 84 and a tongue-portion 86, extending in opposite directions from said body-portion. The legs 84 and the tongue 86 of the body-portion 82 are provided with pivot apertures, for a purpose to be described later. The body-portion 82 of the jaw J is adapted to freely pass within the space between the rings 68 of the jaw J', and the tongue-portion 86 is adapted to be mounted on the pivot-pin 78. A pin 88 is positioned between the legs 84, and it is adapted to support a latch-lever 98 having a hook-portion 100 adapted to engage the pin 76 in the legs 72. The body-portion 82 of the jaw J is further provided with a pair of right-angularly arranged gripping surfaces 96 so arranged that they, together with gripping surfaces 80, rigidly secure the blank B between the same when the jaws are locked in clamped relation. The tongue 86 of the body-portion 82 is provided with a tail 87 which is adapted to engage and actuate the ejecting plunger 81 when jaw J is swung to open position. Drill-guides 90 having the correct number and position of holes corresponding to the passages to be drilled within the blank B are positioned in recesses formed within the rings 68, and they are adapted to guide the drills during their movement toward the blank B.

The jaws J and J' are rotatably supported by the U-shaped standard 36 by rigidly mounting the jaw assembly between a pair of bushings 102 and 104 journalled in the legs of the standard 36.

The indexing unit I is adapted to be associated with the bushing 104, and comprises an adjustable rotating mechanism and detent-locking device capable of accurately locating and indexing the blank B about its longitudinal central axis so that as many passages as desired may be formed about the central longitudinal passage. Referring to Figs. 3, 4 and 6, the indexing unit I comprises a ratchet wheel 106 mounted on an extension of the bushing 104 and rigidly secured thereto. The handle I' is provided at its one end with an annular portion 108 adapted to slidingly engage the extension of bushing 104 and is positioned adjacent to the ratchet-wheel 106. An end-plate 107 is adapted to overlie the annular portion 108, and is fixed to the end of bushing 104 by screws extending within the inner circumference of the annular portion 108 of the handle I' so as not to interfere with the free movement of said handle. A pawl 110 (Fig. 4) is pivotally mounted on the handle I' in position to overlie the ratchet-wheel 106 and it is so arranged that clockwise movement of the handle I' will cause the pawl to freely slide over the ratchet-teeth on the ratchet-wheel 106, and counter-clockwise movement of the handle I' will effect rotation of the wheel 106, and of the bushing 104 together with the gripping jaws J and J'. In order to prevent clockwise movement of the ratchet-wheel 106 when the handle I' is moved in that direction, another pawl 112, adapted to overlie and engage the teeth of the same, is pivotally mounted on a boss 114 fixed to one of the legs of the standard 36.

A controlled degree of rotative movement may be imparted to the blank B by locking and abutting devices respectively associated with the ratchet-wheel 106 and the handle I', and a spring-pressed detent mounted on one leg of standard 36. This limiting mechanism includes a device somewhat similar to the spring-pressed detent 56 associated with the pivot-plate 40. As shown in Fig. 4, it comprises a guide housing 116 provided with a vertical slot 118, adapted to slidingly receive a detent 120. The detent 120 is provided with a recess 122 within which a coil-spring 124 is adapted to be positioned and to be supported by a bottom cover-plate 126 fixed to the guide housing 116. Spring-pressed detent 120 is further provided wtih a relatively wide tooth 128 adapted to cooperate with the limiting mechanism to be described later.

Clockwise movement of the handle I' may be adjustably controlled by providing an angle abutment 130 (see Fig. 3) on an extended segmental portion 132 of the annular portion 108 of handle I'. One leg of the angle abutment overlies the edge of the segmental portion 132, for a purpose to be described. The extended segmental portion 132 is provided with an arcuately arranged series of threaded apertures 133 adapted to receive the fastening means for the abutment 130. Thus, it is apparent that the angle abutment 130 may be adjustably positioned angularly about the periphery of the annular portion 108. The overlying leg of said abutment 130 will coact with the relatively wide tooth 128 of the detent 120, thereby adjustably limiting the clockwise movement of handle I'. Counter-clockwise movement of the handle I' may be adjustably controlled by the cooperation of the spring-pressed detent 120 with notches 136 circumferentially arranged about an extended flange portion 138 of the bushing 104 (see Figs. 4 and 6). The notches are each provided at their bottoms with screw-threaded openings for receiving plugs 140 adapted to fill up unrequired notches and to eliminate their limiting effect. A number of these plugs 140 may be conveniently mounted along one leg of the standard 36 as shown in Fig. 2.

The extended segmental portion 132 is further provided with a cam-surface 142 (Fig. 3) adapted to depress the detent-tooth 128 and disengage it from the notches of flange 138 during the clockwise motion of the handle I', and to maintain it in disengaged position during the greater portion of the counter-clockwise motion of said handle. During the counter-clockwise motion of handle I', the ratchet wheel 106 together with the flange 138 and the gripping jaws J and J' are rotated in a counter-clockwise direction. Thus, the cam-surface 142 moves to a position where detent 120 is permitted to move upwardly, whereupon its tooth 128 engages the periphery of the flange 138 and seats within the next succeeding open notch 136.

Although the various features of the invention have been shown and described in detail to fully disclose one embodiment of this invention, it will be evident that numerous changes may be made in such details, and certain features may be used without others, without departing from the principles of the invention.

What is claimed is:

1. A drilling fixture for use with spaced oppositely disposed tools such as substantially axially aligned drill-heads, comprising a standard having gripping means adapted to hold a metal blank between said drill-heads for a drilling operation; means for rotating said gripping means to predetermined positions about a central axis extend-

ing through the location of said metal blank, said axis being normally substantially aligned with the axes of said drill-heads; a base plate; said standard being mounted on said base plate to pivot eccentrically about an axis generally perpendicular to said base plate and to the axes of said drill-heads; and means for locking said standard in at least one predetermined pivotal position.

2. A drilling fixture as claimed in claim 1, in which such rotating means includes a movable member adapted to intermittently rotate said gripping means.

3. A drilling fixture as claimed in claim 1, in which such rotating means includes a movable member adapted to intermittently rotate said gripping means, and means for retaining said gripping means in fixed position during the interval between such intermittent rotations.

4. A drilling fixture as claimed in claim 1, in which such rotative means includes an intermittently operable indexing device provided with means adapted to limit the degree of rotative movement imparted to said gripping means.

5. A drilling fixture as claimed in claim 1, in which such rotative means includes an indexing device, and means for retaining said gripping means in said predetermined positions during a drilling operation, and wherein said device comprises means adapted to cooperate with such retaining means for limiting the degree of rotative movement imparted to said gripping means.

6. A drilling fixture as claimed in claim 1, in which such rotative means includes an indexing device, and means including a detent and notched disc for retaining said gripping means in said predetermined positions during a drilling operation, and adjustable means on said device adapted to cooperate with said detent; said notched disc, detent and adjustable means being adapted to limit the rotative movement imparted to said gripping means.

7. A fixture comprising a standard; a clamping device supported by said standard; a base-plate; a supporting plate for said standard pivoted to said base-plate, said supporting plate being provided adjacent to one end with a pivot pin and being provided adjacent to the other end with an arcuate surface; and a guide member having a mating arcuate surface connected to said base-plate and adapted to overlie a portion of said supporting plate adjacent to the arcuate surface thereof.

8. A fixture as claimed in claim 7, in which said clamping device comprises a plurality of jaws adapted to hold a metal blank; and including means for rotating said jaws relatively to said standard about an axis passing through the location of said metal blank; and adjustable limiting means associated with said jaws for limiting their degree of rotation.

9. A fixture comprising a standard having spaced legs adapted to support a pair of clamping jaws; a bearing bushing connected to each side of one of said jaws and journalled in the legs of said standard; a pivotal connection between said one jaw and the other jaw; a hub integral with one of said bushings and extending beyond the side of the leg in which said bushing is journalled; a pair of toothed ratchets integral with said hub; and separate means adapted to cooperate with said toothed ratchets for controlling the degree said jaws may be turned.

10. A fixture as claimed in claim 9, in which said separate means comprises an oscillatable handle journalled on said hub and having a pawl adapted to cooperate with one of said toothed ratchets, and a detent mounted on one of the legs of said standard and adapted to cooperate with the other toothed ratchet.

11. A fixture as claimed in claim 9, in which one of said separate means comprises a spring-pressed detent mounted on a leg of said standard and adapted to engage the teeth of one of said toothed ratchets to hold said ratchet in a fixed position, said other separate means comprises an oscillatable handle having an annular flange journalled on said hub and having a pawl adapted to engage the teeth of said other toothed ratchet and to rotate said jaws during a portion of its oscillatable movement and to ride freely over the teeth of said ratchet during another portion of its oscillatable movement, said annular flange including a cam surface adapted to move said detent out of engagement with the toothed ratchet with which it cooperates during a portion of the oscillatable movement of said handle; and an abutment adjustably mounted on said annular flange adapted to engage said detent and to limit the degree of oscillatable movement of said handle in one direction.

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