July 11, 1950 C. J. BATH 2,514,831

APPARATUS FOR SELECTIVELY WIPE FORMING AND STRETCH FORMING METAL STOCK

Filed May 1, 1950 3 Sheets-Sheet 1

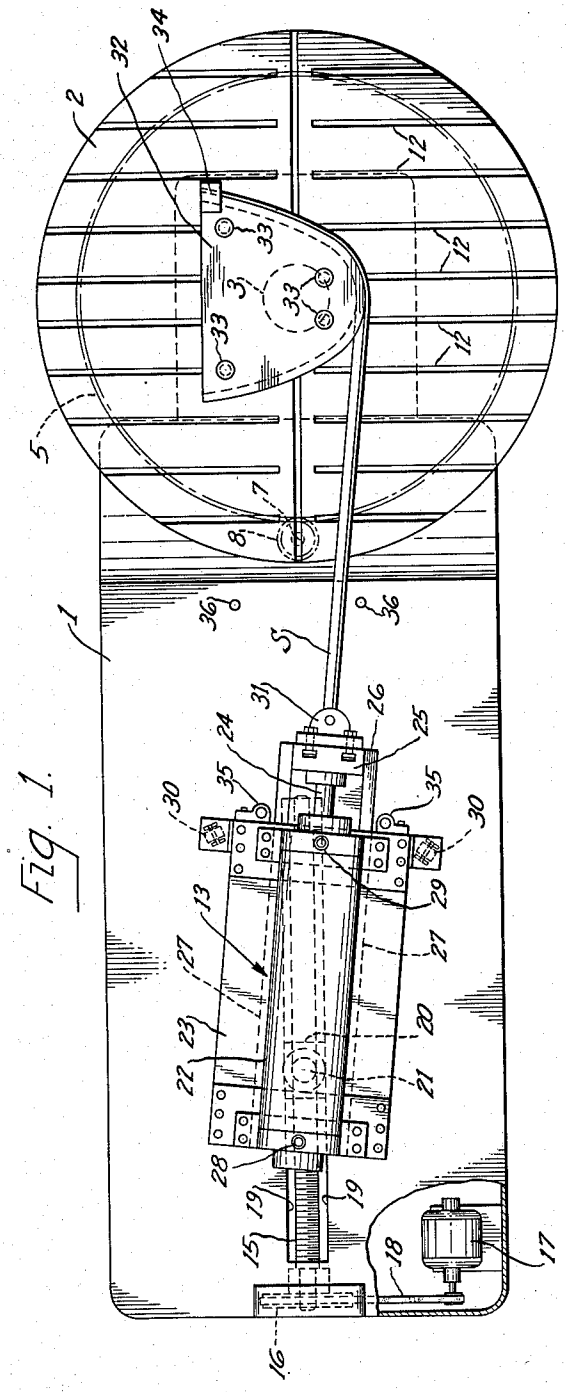


Fig. 1.

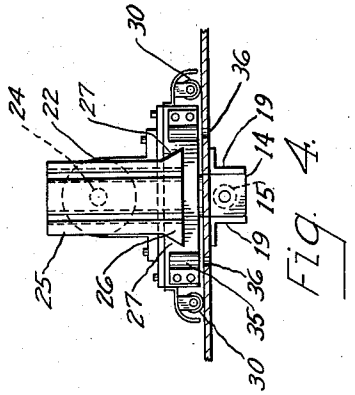


Fig. 4.

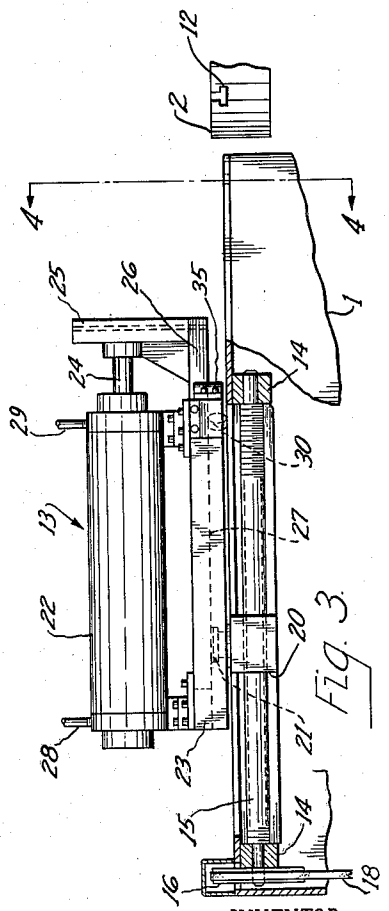


Fig. 3.

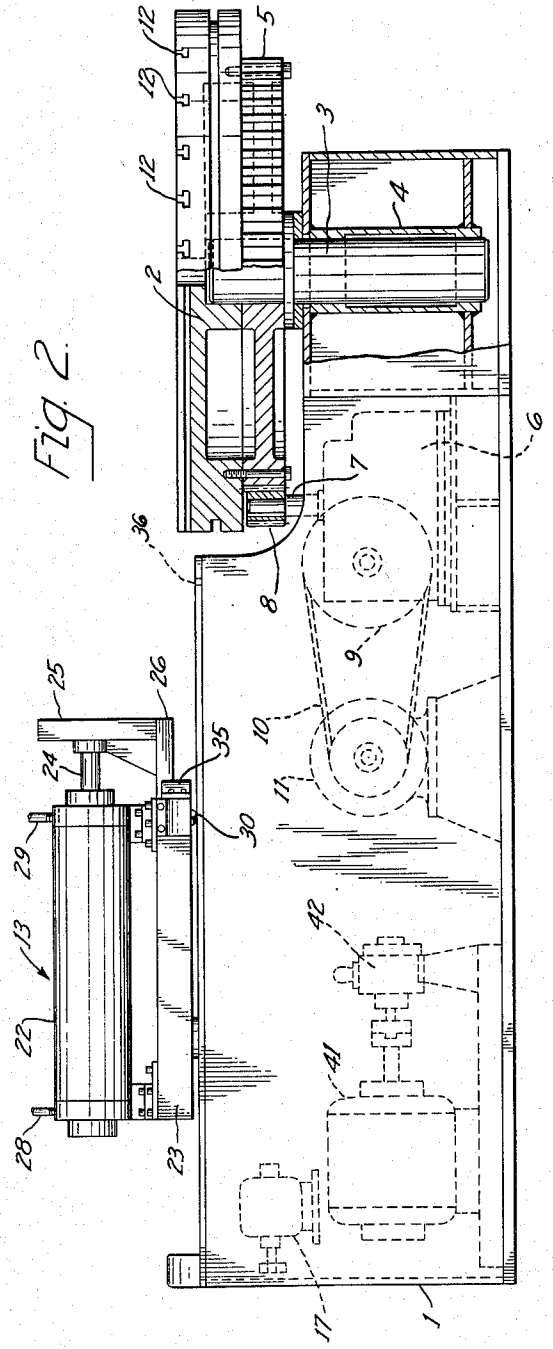
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Fig. 2.



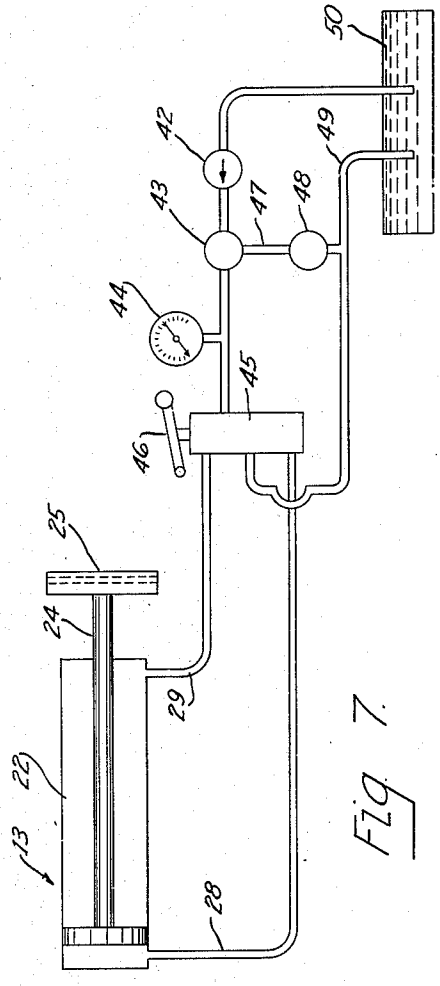


Fig. 7.

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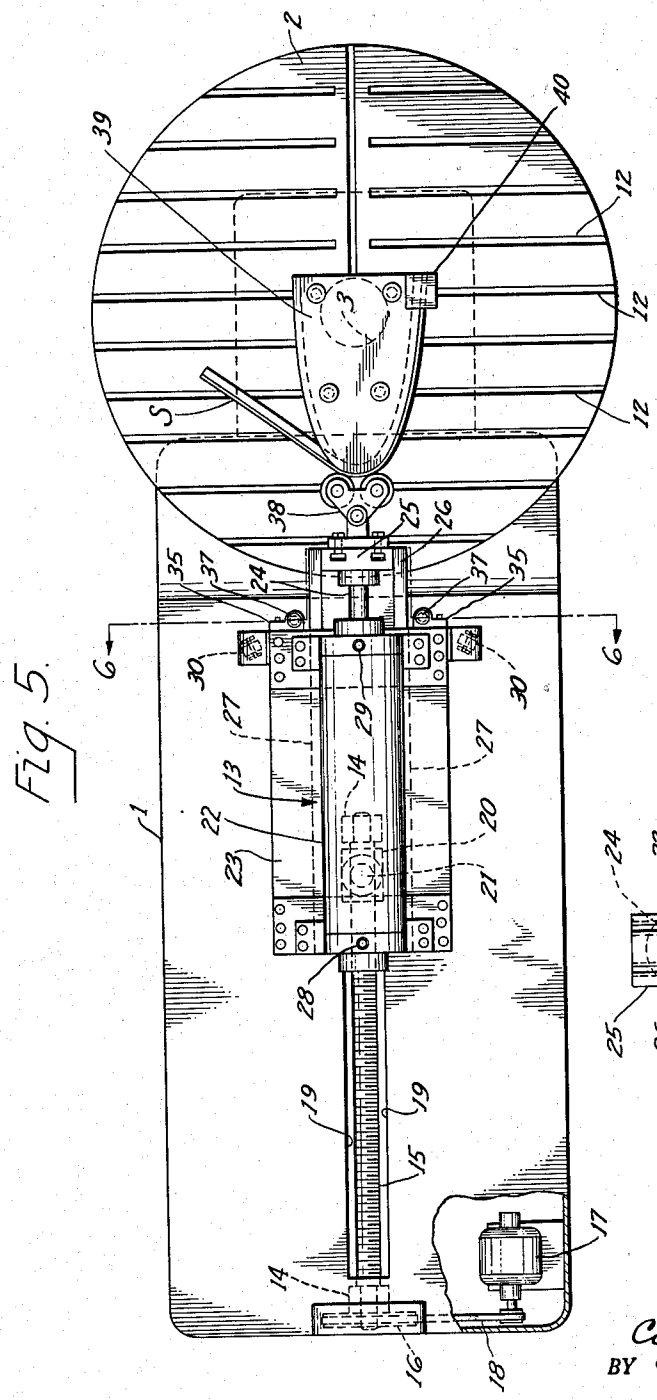


Fig. 5.

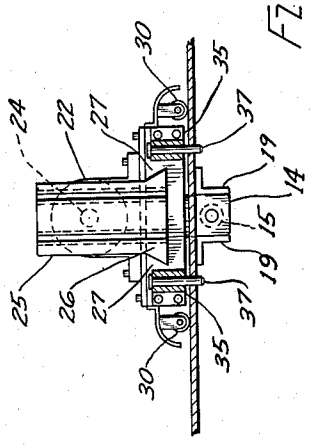


Fig. 6.

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UNITED STATES PATENT OFFICE

2,514,831

APPARATUS FOR SELECTIVELY WIPE FORMING AND STRETCH FORMING METAL STOCK

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Application May 1, 1950, Serial No. 159,347

7 Claims. (Cl. 153—40)

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This invention relates to metal working machines for forming stock pieces such as rods, bars, tubes, strips, sheets, and the like into regularly or irregularly curved or contoured forms and is a continuation-in-part of my co-pending application Serial No. 522,700 filed February 17, 1944.

As more fully set forth in my co-pending application, contour forming machines of the wipe forming type have heretofore been provided. Such machines comprise essentially a base on which is mounted a power driven rotary table which carries a side face die. A piston and cylinder assemblage is mounted on the base and carries a metal forming tool which is adapted to be forced toward the side face of the die by the piston upon admission of pressure fluid to the cylinder and to be held under yielding pressure against a piece of metal which is thereby forced against the side face of the die. One end of the metal is secured for rotation with the die and the other end is left free so that by concurrently rotating the table and yieldably forcing the working tool against the metal in spaced relation from its anchored end the metal is pressed firmly against and wiped or wrapped about the side face of the die and made to conform approximately to the contour of the side face.

In my co-pending application, there is described a contour forming machine of the type now known as the "stretch former." The stretch forming machine comprises essentially a base on which is mounted a rotatable power driven table which, in turn, carries a side face die and suitable means for clamping one end of the length of metal in fixed position relative to the die for rotation therewith. A fluid pressure operated piston and cylinder assemblage is mounted on the base for swinging movement about an upright axis parallel to the table axis and offset therefrom. The piston rod is provided with suitable clamping jaws for engaging the opposite end of the length of metal. Fluid pressure is applied to the cylinder in front of the piston so as to yieldably urge it away from the table so as to stress the strip metal near to its elastic limit. While this stressed condition is maintained, the table is rotated so as to lay or wrap the stressed length of metal onto the side face of the die. Thus the metal is made to conform to the side face of the die and, when released, retains es-

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sentially the contour of the face of the die against which it was laid under tension.

As set forth and described in my co-pending application, there are numerous applications of apparatus of both types, some metals and articles lending themselves to production more efficiently and economically by stretch forming and others by wipe forming. Either machine is rather expensive for small producers who have insufficient production requirements to keep either type of machine in operation for extended periods.

The present divisional application relates to the universal machine disclosed in my said co-pending application and which machine can be used both for stretch forming and for wipe forming, selectively.

The objects and advantages of the present invention will become apparent from the following description wherein reference is made to the drawings, in which:

Fig. 1 is a top plan view of the apparatus shown in condition for operation of stretch forming;

Fig. 2 is a side elevation of the apparatus in Fig. 1, the die, the strip being formed, and the gripping tool being omitted and part thereof being shown in section for clearness in illustration;

Fig. 3 is a fragmentary side elevation of a portion of the base of the apparatus with the piston and cylinder mounted thereon, parts thereof being shown in section for clearness in illustration;

Fig. 4 is a fragmentary cross sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is a top plan view of the apparatus illustrated in Fig. 1 showing it in condition for use in wipe forming;

Fig. 6 is a fragmentary sectional view similar to Fig. 4 but showing the locking means locking the piston and cylinder assemblage against lateral swinging movement; and,

Fig. 7 is a diagrammatic illustration of the fluid pressure system for operating the apparatus illustrated in Figs. 1 through 6.

The present universal machine comprises essentially a rigid hollow base 1 on one end of which is rotatably mounted a suitable die-supporting table 2. As illustrated in Figs. 1 and 2, the table 2 is fixedly mounted on a rotatable post 3 which, in turn, is rotatably mounted in a suitable upright hollow bearing portion 4 which may

be formed integrally with the base. Mounted in fixed position on the under side of the table in co-axial relation with the post 3 is an annular gear 5. Within the base 1 is a suitable speed reduction mechanism 6 having an upright shaft 7 which extends through the top of the base 1 and carries a gear 8 complementary to and permanently in mesh with the gear 5. The speed reduction mechanism may be of any conventional type and is driven through the medium of a pulley 9 and belt 10 by a suitable electric motor 11. The table is provided with the usual locking or mounting channels 12 for receiving the heads of suitable bolts for securing a side face die in the desired fixed position on the table. Mounted on the base 1 in spaced relation to the table 2 and with its axis substantially horizontal or parallel to the plane of the top of the table is a piston and cylinder assemblage, indicated generally at 13. As mentioned, the present machine is to be used for both stretch forming and wipe forming. In the former case, it is desirable that the piston and cylinder assemblage be spaced a considerable distance from the table, whereas in the wipe forming it is desirable that the piston and cylinder assemblage be near to the table 2. Accordingly, the piston and cylinder assemblage 13 is mounted on the base 1 for rapid adjustment toward and away from the table 2. In the illustrative example of a suitable mounting of the piston and cylinder assemblage, the base 1 is provided with suitable aligned stationary bearings 14 which are preferably on the under side of the top and of which the axis intersects the projected axis of the table. Rotatably mounted in the bearings 14 is a feed screw 15 on one end of which is carried a pulley 16 for rotation therewith. A reversible motor 17 is mounted in the hollow base 1 and is connected by a suitable belt 18 to the pulley 16. The top of the base 1 is provided with suitable slideways 19 which extend parallel to the screw 15. A follower 20 is guided by the slide-ways 19 and is in threaded engagement with the screw 15 so as to be moved thereby toward and away from the table depending upon the direction of rotation of the screw 15. The follower 20 is provided at the top an upright pivot 21. The piston and cylinder assemblage comprises essentially a cylinder 22 which is fixedly mounted on a suitable carriage 23. A piston 24 is mounted in the cylinder 22 and is connected at its forward end to an upright tool holder 25. The tool holder is provided at its lower end with a slide 26 which operates in suitable guideways 27 in the carriage 23, so as to relieve the piston from lateral thrusts. Suitable conduits 28 and 29 are connected to the cylinder at opposite ends so as to supply fluid pressure to either end selectively while venting the opposite end to a suitable sump or to the atmosphere in case air is used for the operating fluid. The carriage 23 is connected to the pivot 21 for swinging movement parallel to the plane of the table 2 about the upright axis of the pivot 21. The carriage 23 is provided at its forward ends with suitable rollers 30 so as to reduce the friction and permit as free swinging of the carriage 23, with the piston and cylinder assemblage 13, about the axis of the pivot 21.

When the apparatus is to be used for stretch forming, the screw 15 is operated to move the pivot 21 and with it the carriage 23, toward the left hand end of the base in Fig. 1 so as to allow as much space as possible between the assemblage 13 and the table 2. A suitable metal material

engaging clamp 31 is mounted in the tool carrier 25 and is adapted to engage one end of a piece of a strip of metal S for exerting tension thereon. A side faced die 32 is mounted in fixed position on the table 2 by means of suitable bolts 33. In order to secure the opposite end of the strip of metal in fixed relation to the die 32, a suitable clamp 34 is provided. In the form illustrated in Fig. 1, the clamp 34 is mounted directly on the die 32, although it may be mounted on the table 2 adjacent the die. Thus, upon rotation of the table with one end of the strip S engaged by the clamp 34 and the opposite end engaged by the clamp 31 pressure fluid is admitted to the cylinder 22 in front of the piston 24 and exerts sufficient tension on the strip S to stretch the strip near to its elastic limit. Thereupon, the table is rotated while this stress is maintained and the strip is wrapped around the lateral face of the die 32, the piston compensating for the takeup in the strip. After the strip S is wound around the die 32, the pressure is released from the cylinder 22, the strip unclamped and removed. It retains the contour imparted by the side face die with substantially no spring back.

On the other hand, when it is desired to use the machine for wipe forming operations, the motor 17 is operated so as to move the carriage 23, with the piston and cylinder assemblage 13, as close as practicable to the table 2, usually so that the piston 24 overhangs the table 2. However, for wipe forming operations, the piston and cylinder assemblage 13 cannot be allowed to swing freely about the pivot 21. Accordingly, the carriage 23 is provided, preferably at its forward end, with means for selectively latching it against swinging movement about the pivot 21 and releasing it for swinging movement about the pivot 21. This means may comprise forwardly extending lugs 35, each of which is provided with a vertical bore extending entirely therethrough. The top of the base 1 is provided with spaced apertures 36 so positioned that when the assemblage 13 is moved to the operating position nearest the table 2 and the axis of the piston and cylinder assemblage 13 intersects the projected axis of the table 2, the bores of the lugs 35 are aligned with the recesses 36. Thereupon pins 37 are passed through the bores in the lugs 35 and into engagement with the recesses 36, thus constraining the piston and cylinder assemblage 13 from swinging about the axis of the pivot 21. When thus arranged, and as best illustrated in Fig. 5, a suitable metal working tool 38 is secured in the tool holder 25 and a side face die 39 and clamping means 40 are secured to the table 2. One end of the strip S' is secured in fixed position on the table 2 by the clamp 40. Pressure fluid is then admitted to the assemblage 13 in back of the piston so as to force the piston 24 and tool 38 toward the die 39 and into engagement with the strip S and into engagement with the lateral face of the die. While the tool 38 is yieldably held in engagement with the strip, the table is rotated, thus wiping the strip firmly against the lateral face of the die so that it substantially conforms thereto after the wipe forming operation.

In wipe forming excessive lateral thrusts on the piston occur sometimes due to accidents but more frequently due to improper positioning of the dies on the table.

If the die is improperly positioned so that the angle between the axis of the piston and ap-

proaching face portion of the die is too acute, the lateral thrust on the piston or guide becomes so great that the forming tool frictionally locks with the metal. If rotation of the table is not stopped promptly when this locking angle is reached, the die is likely to be sheared off the table or the piston and cylinder assemblage, with the guides, tool holder and the like, are likely to be damaged.

In order to prevent damage from this source, the pins 37 may be shear pins which shear off and release the piston and cylinder assemblage for swinging about the pivot 21 when the lateral thrust has approached the point at which damage to the assemblage or dies is apt to result.

Obviously, instead of the screw means shown for adjusting the pivot 21, other means may be provided. Likewise, other means for anchoring the piston and cylinder assemblage 13 so as to constrain it from swinging movement about the axis of the pivot 21 may be provided.

Referring to Fig. 7, the machine is shown as operated by hydraulic fluid. An electric motor 41 is provided and drives a suitable pump 42 which is connected to the cylinder 22 by means of the conduit 28 through the mechanism of the system illustrated in Fig. 7. The pump 42 delivers pressure fluid to an adjustable pressure regulating valve 43 of set output so that the delivery output pressure may be set at a predetermined value which is indicated by the pressure gauge 44. The valve 43 is connected to a distributing valve 45 of any well known type which is operated by means of a lever 46 suitably accessible on the exterior of the base 1. The distributing valve 45 is adapted selectively to connect the pressure lines 28 and 29 to the source of pressure supplied by the pump 42. The exhaust outlet of the pressure regulating valve 43 is connected through a line 47 to a control valve 48 which, in turn, is connected to an exhaust line 49 leading to the sump or reservoir 50. Thus pressure fluid at constant pressure regardless of volume can be supplied to the cylinder 22 at either side of the piston 24 and the opposite side of the cylinder vented to the sump through the common exhaust line 49.

By means of the system thus described, the metal can be maintained under tension for stretch forming or compressive stresses, for wipe forming, selectively, the tension or compression being of constant value throughout the forming operation. This assures uniformity in results and, particularly in connection with stretch forming, eliminates the danger of overstressing of the metal with possible breaking and springing of the broken pieces.

Having thus described my invention, I claim:

1. In a contour forming machine, a base, a rotatable table thereon adapted to support a side face die and a metal clamping tool for rotation with the table, means to rotate the table, a metal forming piston and cylinder assemblage adapted for connection to a metal engaging tool and mounted on the base for swinging movement about an axis generally parallel to the table axis and with its longitudinal axis in a plane generally normal to the table axis, means to supply pressure fluid to the cylinder to urge the assemblage yieldably toward extended and retracted positions, selectively, and latch means operable selectively to lock the assemblage against said swinging movement and to release the assemblage for said swinging movement, whereby said assemblage may swing about said axis when the latch means is released.

2. The structure according to claim 1 characterized in that said latch means include shearable means adapted to be sheared off and thereby release the latch means upon application to the assemblage of a predetermined excessive force in a direction to urge the assemblage to swing about its axis.

3. A countour forming machine according to claim 1 characterized in that said latch means comprises means in fixed lateral position relative to the cylinder of said assemblage, means in fixed lateral position on the base, and movable detent means complementary to and engageable with both last mentioned means for connecting them to, and disconnecting them from, each other, selectively.

4. The structure according to claim 3 characterized in that the detent means includes a shear pin.

5. In a contour forming machine, a base, a rotatable table thereon adapted to support a side face die, a metal forming piston and cylinder assemblage mounted on the base with its axis in a plane generally normal to the table axis and extending generally toward and away from the table for transverse swinging movement about a pivotal axis which is generally parallel to and offset from the table axis, a guide mounted in fixed position relative to the assemblage and swingable therewith about the pivotal axis of the assemblage and extending parallel to the longitudinal axis of the assemblage, a tool holder reciprocable in the guide and connected to the piston, means to rotate the table, and means to supply pressure fluid to the cylinder so as to yieldably urge the piston in a direction generally toward and away from the table, selectively, and latch means operable, selectively, to lock the assemblage and guide against swinging movement about said pivotal axis and to release the assemblage and guide for swinging movement about said pivotal axis.

6. In a contour forming machine, a base, a rotatable table thereon adapted to support a side face die and metal clamping tool for rotation with the table, means to rotate the able, a pivot member, means supporting the pivot member on the base, with its axis parallel to the table axis, for movement toward and away from the table, a piston and cylinder assemblage carried by the base for movement toward and away from the table, with its longitudinal axis extending in a plane generally normal to the table axis, and connected to the pivot member for swinging movement about the axis of the pivot member, means operable, selectively, to move the pivot member and assemblage relatively toward the table to one position and away from the table to another position and to hold the pivot member in said positions, latch means operable, when the pivot member is in said one position, to lock the assemblage against swinging movement about the pivot member and to release the assemblage for swinging movement about the pivot member, selectively, and means to supply pressure fluid to the cylinder to urge the assemblage toward extended and retracted positions, selectively.

7. A contour forming machine according to claim 6 characterized in that the said means operable to move the pivot member comprises a screw rotatably mounted on the base with its axis extending generally toward and away from the table, a follower connected to the pivot member

and in driving engagement with the screw, and means for rotating the screw in opposite directions, selectively.

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