July 6, 1948. C. J. BATH 2,444,719

METHOD AND APPARATUS FOR CONTOURING ELONGATED METAL STOCK WHILE UNDER TENSION

Filed Oct. 5, 1946 4 Sheets-Sheet 1

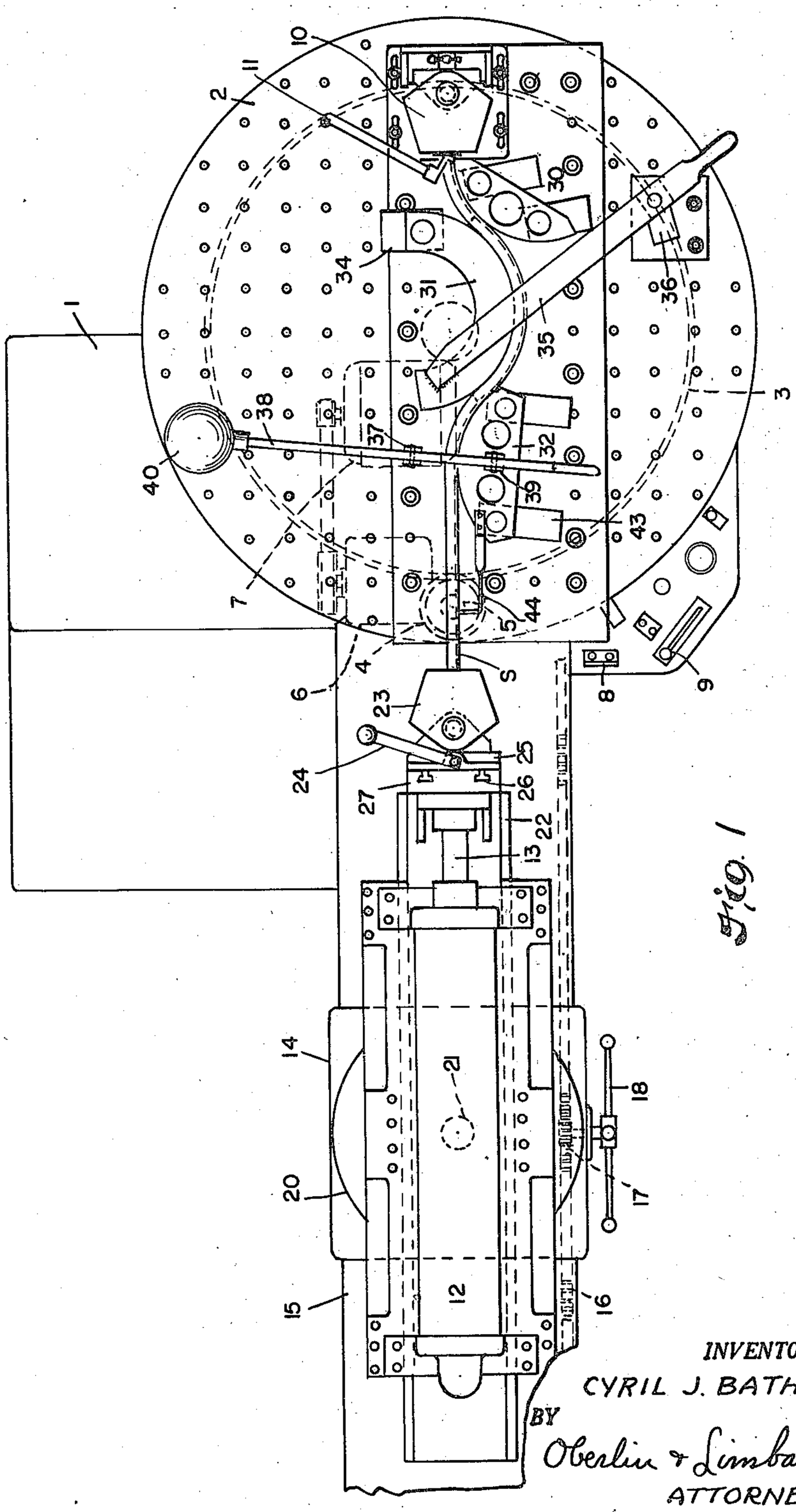

Fig. 1

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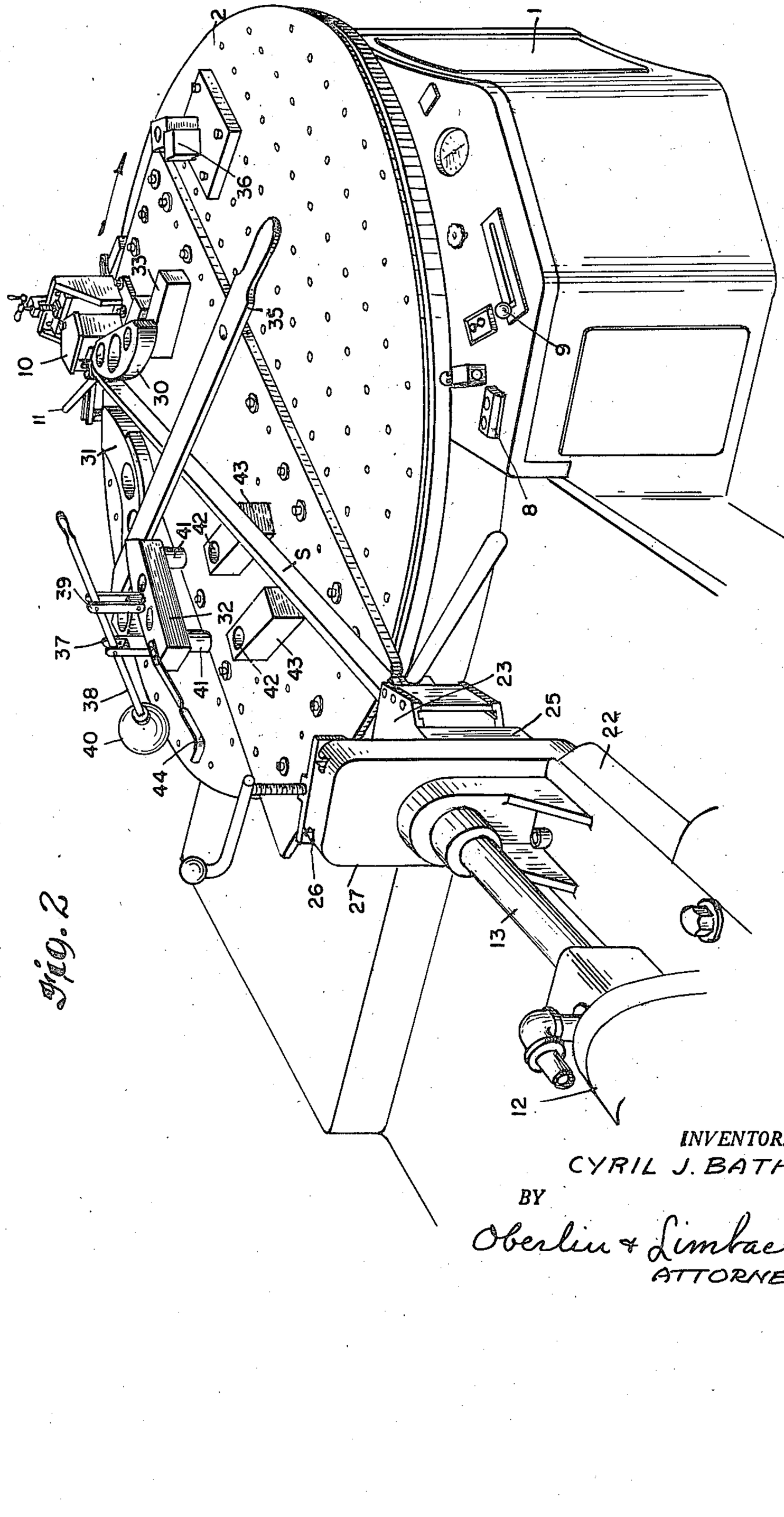

Fig. 2

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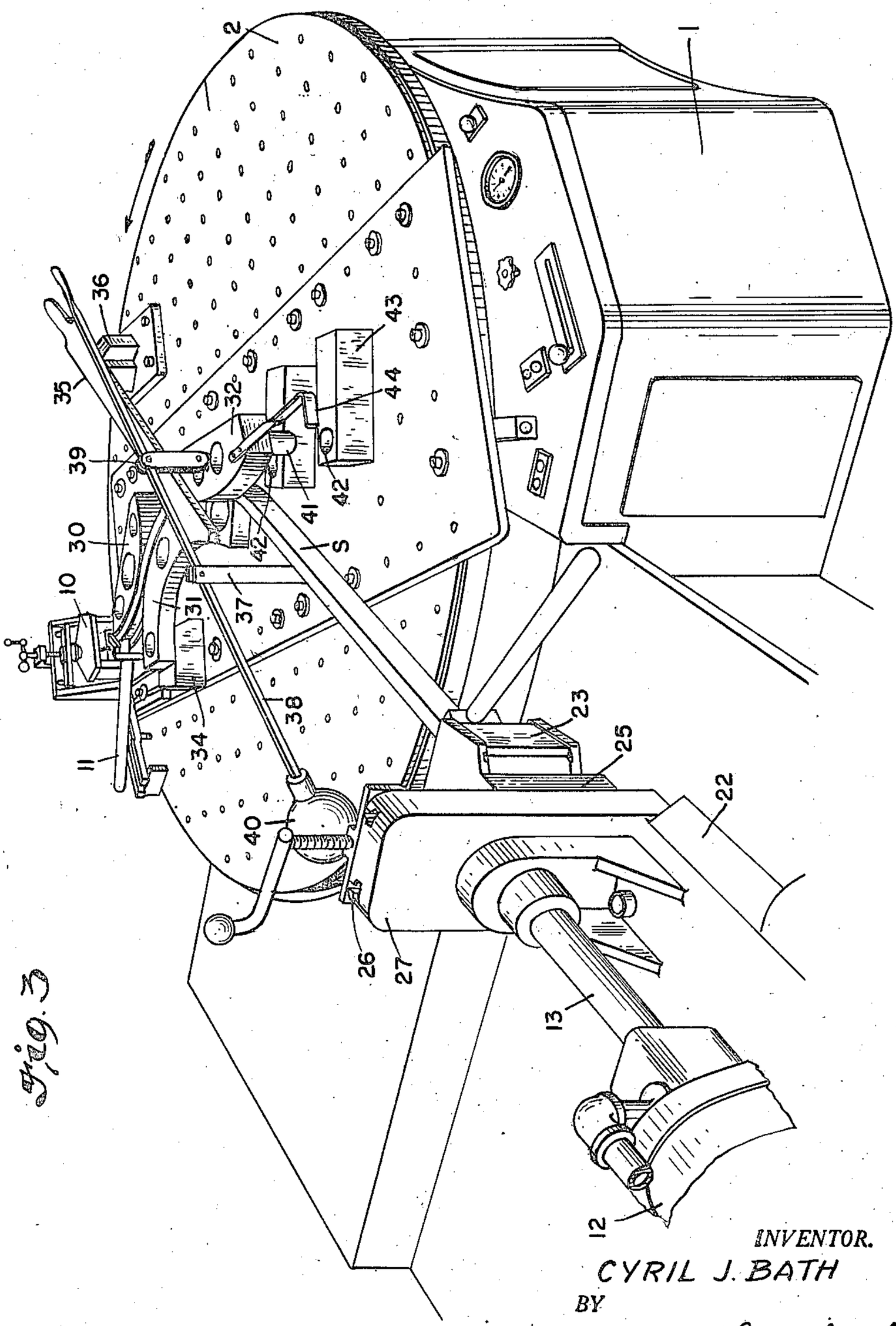

Fig. 3

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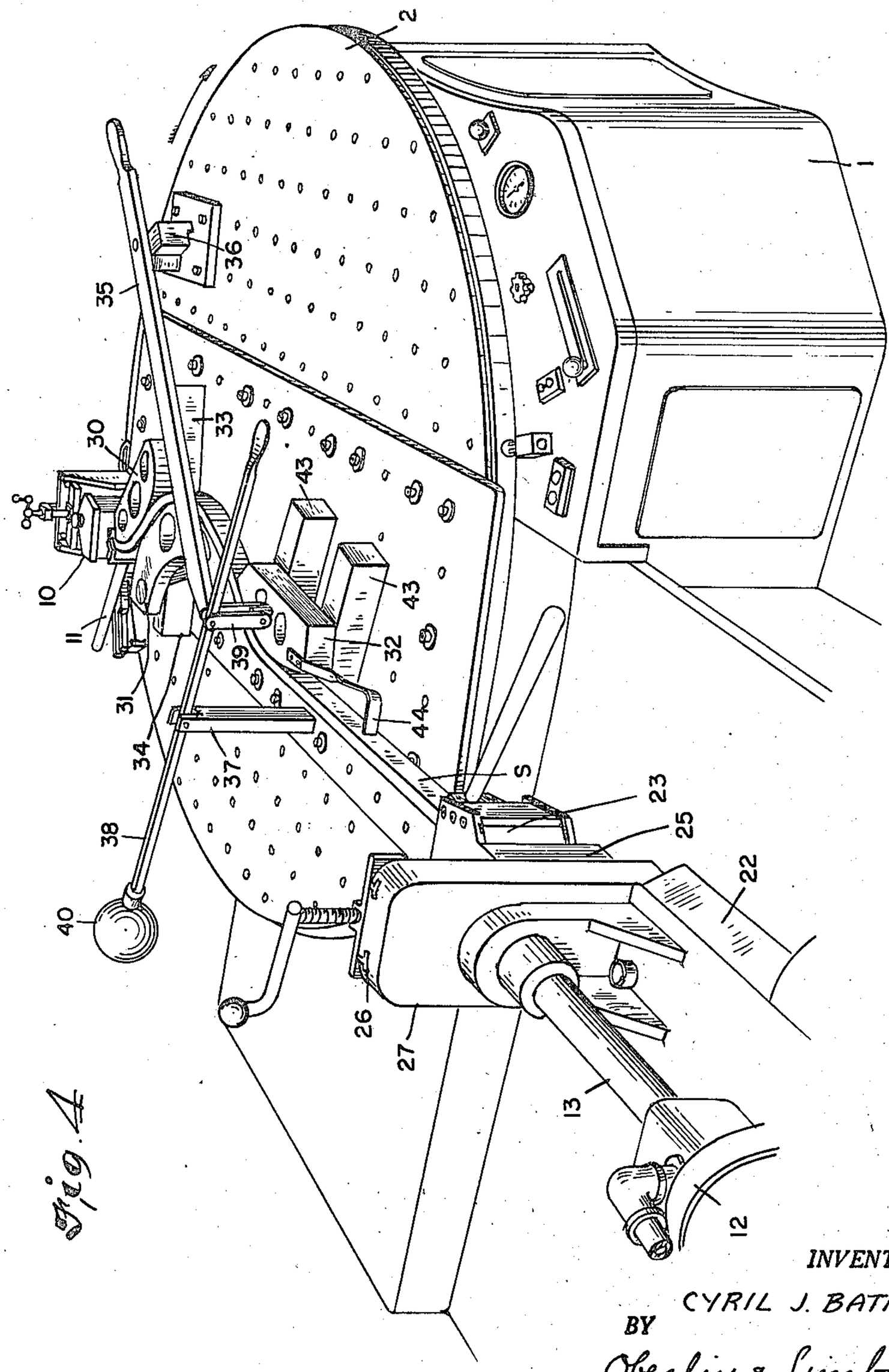

Fig. 4

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UNITED STATES PATENT OFFICE

2,444,719

METHOD AND APPARATUS FOR CONTOURING ELONGATED METAL STOCK WHILE UNDER TENSION

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Application October 5, 1946, Serial No. 701,602

6 Claims. (Cl. 153—40)

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This invention relates to a method and apparatus for contouring elongated metal stock.

One of the principal objects of the present invention is to provide a method and a forming machine for forming elongated members or stock, such as sheet metal strips, rods, angles, channels, and the like, into serpentine or irregular shapes in which adjacent portions of the metal are reversely curved or bent with respect to each other.

Another object is to form such stock about dies while maintaining it under tension sufficient to cause the metal to yield and lay onto the dies and take a permanent set while the stock is held by the dies in the form desired so that "springing back" of the metal with resulting inaccuracies in the finished article is eliminated and more uniform and consistent production of articles of greater accuracy is obtained.

Another object is to adapt a contouring machine of the general type disclosed in my copending application Serial No. 522,700, filed February 17, 1944, to accomplish the above objects by arranging a plurality of dies on the rotatable support thereof so that they can be properly placed in operating position selectively from a position out of the path of swinging movement of the stock across the support, resulting from the normal cooperation of the support and tensioning means of the machine.

Another object is to contour elongated stock material by anchoring an end thereof, applying tension to the other end to stress the metal almost to its elastic limit, swing the stock about its anchored end while maintaining it under tension and, between reversals in the direction of swing of the stock, disposing die blocks, one at each reversal, in the path of swing progressively from the anchored end toward the other end.

Other objects and advantages will become apparent from the following description wherein reference is made to the drawings in which:

Fig. 1 is a top plan view of an apparatus embodying the principles of the present invention;

Fig. 2 is a perspective view of a portion of the apparatus illustrating the position of the parts in forming the first bend in the stock;

Figs. 3 and 4 are perspective views, similar to Fig. 2, illustrating the different successive positions of the apparatus for forming the stock into a serpentine shape.

Referring to the drawings:

The machine comprises a housing 1 on which a die carrying table or support 2 is mounted for rotation about a fixed vertical axis. The table 2 carries a coaxial ring gear 3 which is driven

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by a cooperating gear 4 for rotating the table 2 in reverse directions. The gear 4 is mounted on a suitable shaft 5 which is supported in the housing 1 and in turn is rotatably driven through any suitable reversible variable speed transmission 6 by a suitable motor 7, the transmission and motor being located in the housing 1. The motor is controlled by a switch 8 and the transmission by a control lever 9, both of which are readily accessible to the operator.

A clamp 10, operated by a lever 11 is detachably secured in the desired position on the table 2 for clamping one end of a length of stock to be formed, indicated generally at S, and for securing the end in fixed relation to the table.

The tension applying means may comprise a hydraulic cylinder 12 and cooperating piston 13 which are connected in a hydraulic system to a suitable source of hydraulic fluid by the usual reversible valve. For the present purpose, however, the fluid pressure is applied to yieldably urge the piston lengthwise of the cylinder away from the table under the preselected pressure required to tension the stock to a high degree, preferably just below its elastic limit.

For mounting the cylinder 12 for adjustment toward and away from the table and for free swinging movement about an axis parallel to the axis of the table, a sliding support 14 is mounted on the frame 1 on suitable guideways 15. A rack 16 is fixedly secured on the frame 1 and is engaged by a pinion 17 on the sliding support. A hand wheel 18 is operatively connected to the pinion for rotating the same to move the sliding support 14 to the desired adjusted position lengthwise of the frame 1 toward and away from the table.

The purpose of the sliding support 14 is to make possible the use of the apparatus with stock of different lengths. For example, a piece of stock may be of such length that the piston 13 would have to travel the length of the cylinder before the completion of the contouring operation. In such an instance, the table 2 is stopped and the hand wheel 18 released and the fluid pressure admitted to the cylinder 12 at the left of the piston causes the cylinder to follow up the piston in a direction toward the table while the piston remains fixed. If desired, of course, the hand wheel 18 may be operated for the purpose of advancing the cylinder toward the piston. After the cylinder is in the new position, it may be locked and the operation of the apparatus continued until an additional portion of the length of the piece of stock being formed equal substantially to the stroke of the piston has been suitably

contoured. If, as is frequently the case, a large number of pieces of stock of the same length and requiring less travel of the piston than the length of the cylinder are to be contoured, the slide 14 can be secured in a fixed adjusted position by suitable bolts or otherwise. The rack and pinion are shown diagrammatically for clearness and illustration, it being understood that they are preferably of the self-locking type, usually the type employing a worm gear connection between the pinion and hand wheel. A table 20 is mounted on the support 14 for free rotation about an upright axis, such as the shaft 21, in all positions of the support 14.

The table 20 has a horizontal slideway in which a slide 22 is mounted for reciprocation in a lineal horizontal path. The slide 22 carries a clamp or gripper 23 operable by a handle 24. The gripper 23 is mounted on a carrier 25 which is adjustable vertically in a guide 26 of an upright support 27 on and rigid with the slide 22. The support 27, and through it the gripper 23, is connected to the piston 13 so as to be yieldably opposed by the piston when the gripper 23 is pulled toward the table by the stock being contoured.

The structure thus far described is more fully disclosed in my above identified application and comprises the more basic machine with which the dies and die operating means are combined to provide the present invention.

As more fully set forth in my copending application, a length of stock may be contoured by securing one end in the clamp 10 and the other end in the clamp or gripper 23 and then applying tension thereto by means of the piston 13. With a suitable die on the table 8, the table is rotated so as to lay the tensioned stock S onto the die, the tension being maintained just below the elastic limit of the stock. This is possible because of the free swinging action of the cylinder 12 about an upright axis parallel to the axis of the table and to the fact that the piston is yieldably movable endwise as the stock shortens in overall length during contouring, but the piston maintains the required tension during the contouring operation. With a length of stock S secured at one end to the clamp or anchorage 10 and secured at the other end to the clamp 23 of the piston 13, fluid pressure is admitted into the cylinder 12 to the left of the piston in the Fig. 1 so as to provide the required yieldable pressure and thereupon the table is rotated to lay the stock on the die. For purposes of illustration in the present invention the table 2 is shown as carrying three separate dies for producing a double reverse curve in the stock, it being apparent that any number of such dies may be employed depending on the final contour desired in the finished product. These dies, designated 30, 31 and 32, respectively, are arranged so that when they are in operating position on the table they define a serpentine path for the stock. Due to the swing or sweep of the stock about the pivotal axis of the cylinder 12 as the table is rotated, it is apparent that the dies cannot be maintained fixedly in the position in which they are to operate. Accordingly, each one of the dies is independently movable into and out of the path of swing of the stock and means are carried by the table for anchoring the dies against lateral displacement when they are placed in operating position.

Referring to Fig. 2, the stock is clamped in the clamp 10 at one end and in the clamp or gripper 23 of the piston at the other end. The die 30 is disposed in a position for making the first bend

which is accomplished by rotating the table in a clockwise direction. During this operation the path of swing of the stock is unobstructed by the dies 31 and 32, both of them having been previously moved out of position. When the stock S has been laid on the desired portion of the surface of the die 30, at which time the stock has swung to the right in Fig. 2 beyond the operating position of the die 31, the die 31 is moved into operating positions and anchored, as illustrated in Fig. 3. Thereupon the table is reversed and driven counter-clockwise and the stock is laid on the die 31. The counter-clockwise rotation of the table 2 for laying the stock on the die 31 continues until it is laid on the desired forming surface of the die 31 at which time the stock has swung to the left beyond the operating position of the die 32. When the stock passes this position, the die 32 is moved into operating position within the path of swing of the stock. Thereupon the table is reversed and driven in a clockwise direction as illustrated in Fig. 4 thus laying the stock on the required portion of the forming surface of the die 32. In this manner, starting adjacent the point of anchorage afforded by the clamp 10, the metal stock, while maintained under the required tension, is swung to and fro by successive reversals in the direction of rotation of the table 2 and at the end of each rotation a die block is dropped into the path of swing, this operation progressing from the anchorage of the clamp 10 toward the swinging end of the stock which is held by the gripper or clamp 23.

In order to mount the dies 30, 31 and 32 for manipulation in this manner, the following arrangement has been found satisfactory.

Referring first to the die 30, since the table can be rotated so that this die will not obstruct the path of swing when the stock is inserted the die 30 is mounted on suitable blocks 33 which are secured in fixed position on the table 2 and support the die 30 in spaced relation thereabove.

The die 31, as best illustrated in Fig. 3, is pivotally mounted at one of its ends on a block 34 which is secured in fixed relation to the top of the table beyond the path of swing of the stock and permits swinging of the die 31 about its pivoted end laterally into and out of operating position. An operating lever 35 is secured to the die 31 for swinging the die into and out of the operating position within a path of swing of the stock. In order to secure the die 31 in the operating position, a detent 36 is fixedly mounted on the table and engages an edge of the lever when the lever is moved to the proper position so as to lock it, and thereby the die 31, in said position. The lever 35 is released by lifting its outer end clear of the detent 36.

The die 32, on the other hand, is supported for movement toward and away from the plane of the table so as to be movable into and out of operating position with respect to the path of swing of the stock. For this purpose an upright support 37 is secured on the table in fixed position and a lever 38 is pivoted between its ends to the support 37 by a horizontal pivot for vertical rocking movement. A suitable link 39 is connected at one end to one end of the lever 37 and at the other end to the die 32. An overbalance 40 is carried on the opposite end of the lever 38 and normally raises the die 32 to a position above the path of swing of the stock and holds it in said position. The die is provided with two dependent pins 41 which, when the die is lowered by a downward movement of the lever 38 in opposition to the over-

balance, engage in suitable sockets 42 in blocks 43 which latter are secured in fixed position on the table.

As shown in the drawings, the clamp 10 and the clamp 23 are adjustable vertically and these are set so that the stock clears the top surfaces of the blocks 33 and 43.

In operation the table is rotated clockwise and the stock is first formed around the die 30. The die 31 is moved in place and locked. Thereupon the table is reversed to form the stock about the die 31, the die 31 remaining locked in operating position. The lever 38 is operated by the operator of the machine to move the die 32 into position on the table and anchor it in operating position by engagement of the pins 41 in the sockets 42, and then the table is reversed again.

A suitable gage 44 may be carried on the last die, which in the illustrative form is the die 32. This gage is positioned so as to engage the stock when it has been formed to the required degree about the die 32 at which time the table is stopped and the stock unclamped and removed.

By means of the relatively simple elements described a large number of dies positioned to give a large number of different contours may be arranged on a single table and used for forming the stock in the manner described.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the claims or the equivalent of such be employed.

I therefore particularly point out and distinctly claim as my invention:

1. The method of contouring elongated metal stock comprising anchoring one end of the stock, continuously applying tension to the entire length of the stock and concurrently repeatedly swinging the stock from one end transversely of its length across a predetermined path while maintaining the stock under tension, and interposing die blocks one at a time alternately on opposite sides of the stock progressively from the point of anchorage toward the opposite end of the stock in the path of swinging movement of the stock between reversals in the direction of swing of the stock, and maintaining all of the die blocks between the point of anchorage and the last inserted die block in fixed contact relation to the stock.

2. The method according to claim 1 characterized in that the tension applied to the stock is sufficient to stress the stock to about the elastic limit thereof.

3. The combination with a contouring machine including a rotatable table, a clamp thereon adapted to engage one end of a length of stock, means to rotate the table reversely, selectively, a tension gripper adapted to be connected to the other end of a length of stock, means supporting the gripper for movement toward and away from the table and for concurrent swinging movement about an axis parallel to the axis of the table, means to yieldably urge the gripper away from the table to tension a length of stock held between the gripper and clamp, a row of dies on the table defining a serpentine path for the said stock which path lies in the plane of sweep of the stock, means carried by the table and normally supporting the dies, respectively, out of said path of sweep and for movement into said path, selectively, and means to hold the dies accurately in position when they are moved into said path.

4. In a contouring device, a support, a plurality of dies thereon defining in one position a serpentine path for stock to be contoured therebetween, means for tensioning the stock and concurrently swinging the stock transversely of and laterally beyond the said path in opposite directions successively, means supporting the dies individually for selective movement into and out of the path of the swinging stock, means on the support operatively detachably engageable with the dies, respectively, for securing the dies in said one position, selectively, when the dies are moved into said position.

5. In a contouring device, a support, a plurality of dies thereon defining in one position a serpentine path for stock to be contoured therebetween, means for tensioning the stock and concurrently swinging the stock transversely of and laterally beyond the said path in opposite directions successively, means on the support to grip one end of stock, means cooperable with the support for gripping the other end of the stock and tensioning the stock and swinging the stock to and fro across the said serpentine path, means on the support suspending one of said dies above its operating position out of and above the path of swinging of said stock, and operable to lower said one of the dies into its operating position wherein it intersects said path of swing, and means on the support operative to engage and hold the said one die in position when it is lowered into position.

6. In a contouring device, a support, a plurality of dies thereon defining in one position a serpentine path for stock to be contoured therebetween, means for tensioning the stock and concurrently swinging the stock transversely of and laterally beyond the said path in opposite directions successively, means on the support to grip one end of stock, means cooperable with the support for gripping the other end of the stock and tensioning the stock and swinging the stock to and fro across the said serpentine path, means on the support connected to one of the dies and supporting the said one die for movement transversely of said path to an idle position outwardly beyond the limit of swing of said stock, means operably connected to said one die and to the support and operable to swing the die from said idle position into operating position in said path and to latch the die in said operating position.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
898,424	Bartlett	Sept. 15, 1908
983,664	Wilson	Feb. 7, 1911
1,264,248	Yoder	Apr. 30, 1918
1,354,770	Little	Oct. 5, 1920
1,968,010	Bailey	July 31, 1934
2,190,821	Broomhan	Feb. 20, 1940
2,275,619	Enberg	Mar. 10, 1942
2,331,294	Bank et al.	Oct. 12, 1943
2,411,801	Nielsen	Nov. 26, 1946

FOREIGN PATENTS

Number	Country	Date
190,361	Great Britain	Dec. 21, 1922
494,702	Germany	Mar. 27, 1930