July 6, 1948. C. J. BATH 2,444,718

CONTOUR FORMING MACHINE HAVING A PIVOTED BENDER WITH METAL BLANK ATTACHED

Filed June 2, 1945 2 Sheets-Sheet 1

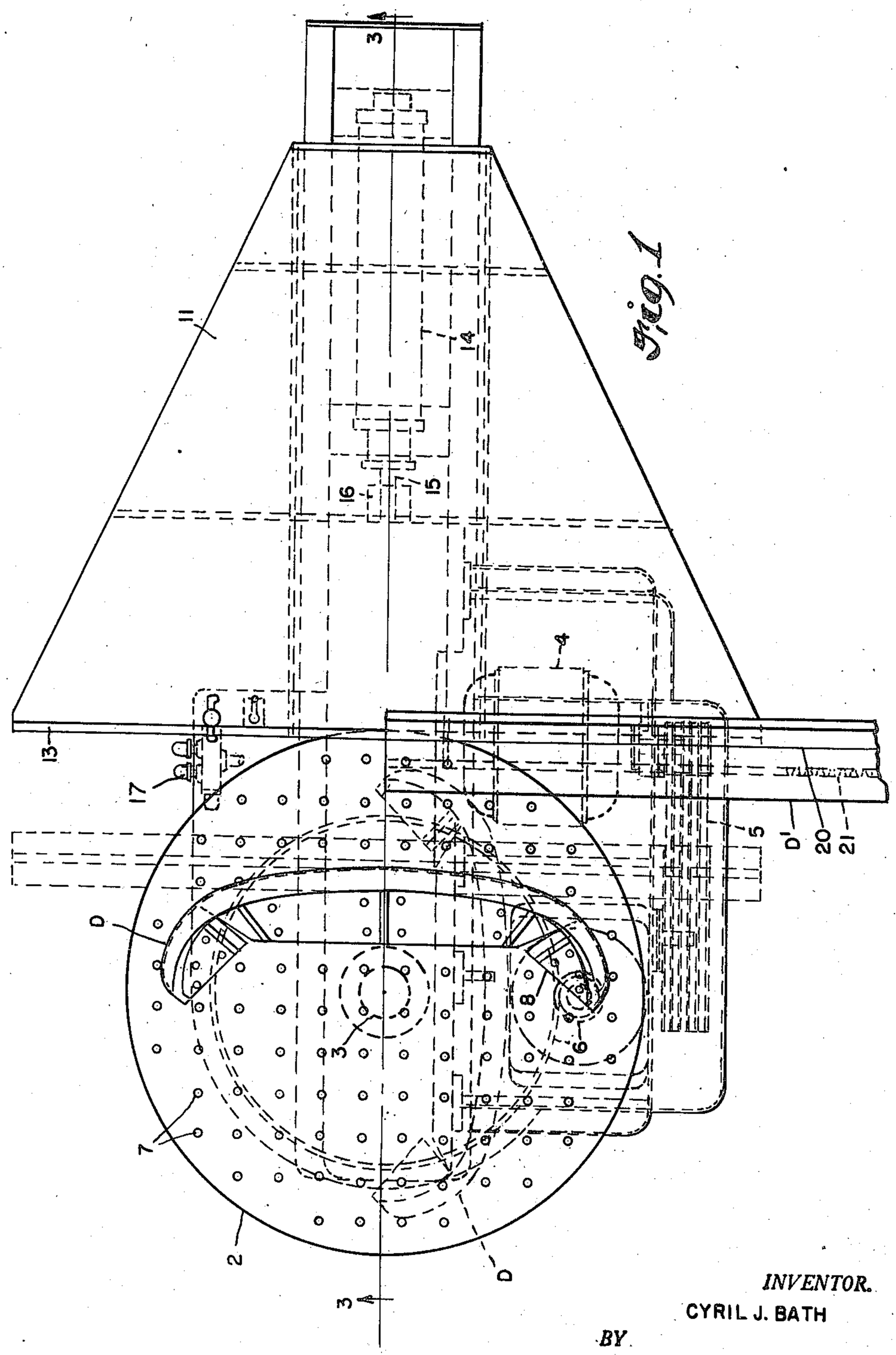

Fig. 1

INVENTOR.
CYRIL J. BATH
BY
Oberlin & Limbach
ATTORNEYS

July 6, 1948. C. J. BATH 2,444,718

CONTOUR FORMING MACHINE HAVING A PIVOTED BENDER WITH METAL BLANK ATTACHED

Filed June 2, 1945 2 Sheets-Sheet 2

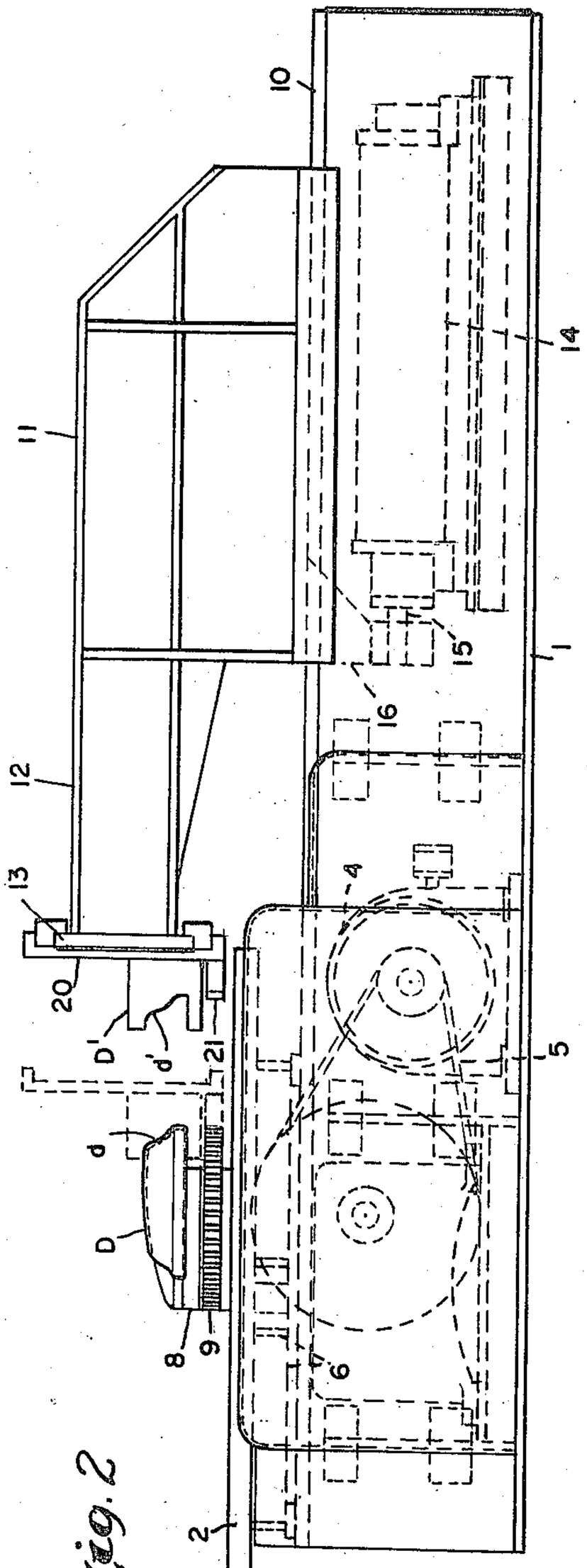

Fig. 2

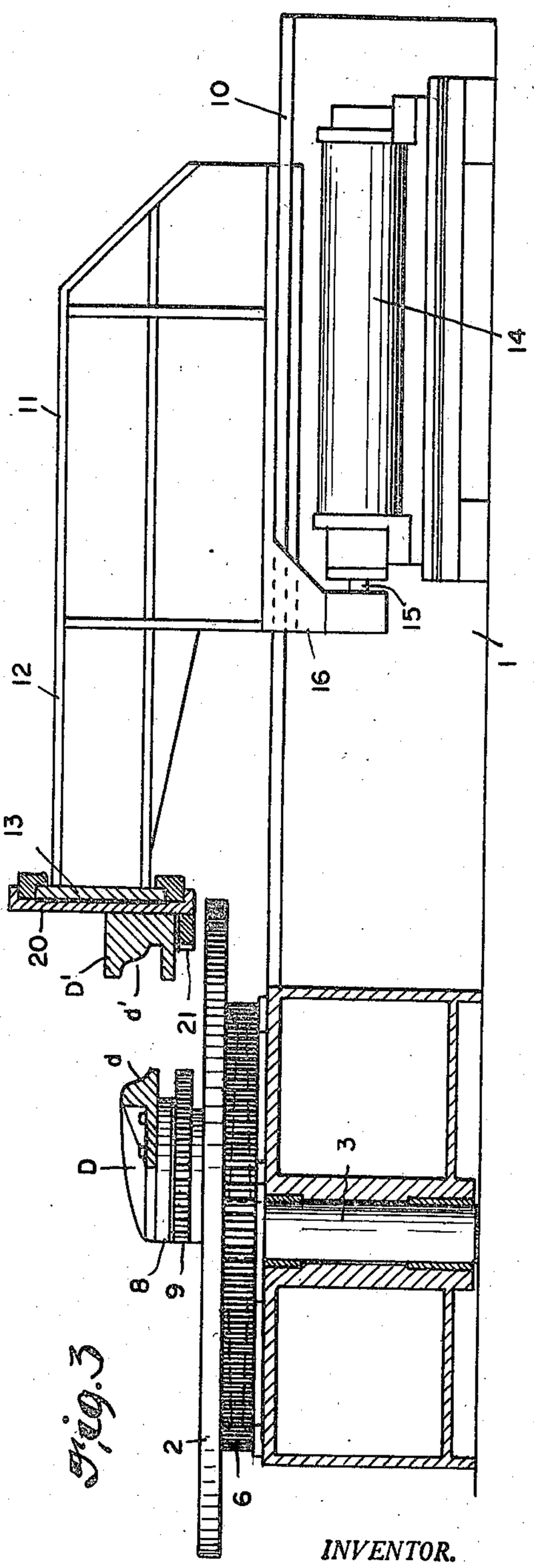

Fig. 3

INVENTOR.
CYRIL J. BATH
BY
Oberlin & Limbach
ATTORNEYS

Patented July 6, 1948 2,444,718

UNITED STATES PATENT OFFICE

2,444,718

CONTOUR FORMING MACHINE HAVING A PIVOTED BENDER WITH METAL BLANK ATTACHED

Cyril J. Bath, Chagrin Falls, Ohio, assignor to The Cyril Bath Company, Cleveland, Ohio, a corporation of Ohio

Application June 2, 1945, Serial No. 597,305

3 Claims. (Cl. 153—40)

1

The present improvements, relating as indicated to contour forming machines, have more particular regard to a metal working machine for forming stock pieces into regularly or irregularly curved or contoured forms by conjoint pressure and rolling action.

As illustrating the character of work-piece which my present improved machine is designed to produce, such metal structures may be mentioned as the curved bumpers used on automotive vehicles, frame members or carlines, cabinet sections, and the like, which are characterized by having portions thereof bent or formed to a desired shape and also have a flange or flanges extending along such bent or formed portion either for stiffening purpose or as a part of the structure. The fashioning of such work-pieces by pressure directly acting through dies involves first of all the expenditure of considerable power and in the second place such work-pieces are frequently of such a shape as not to be adapted to be formed between dies.

I have discovered that in many cases work-pieces of the type in question may be very simply and expeditiously fashioned, and at much less expense both in cost of equipment and in operation, by subjecting the blank from which the work-piece is to be fashioned to a moving, in particular a rolling, pressure, whereby only a limited portion of the blank requires to be deformed at a given stage in the operation. Accordingly, one principal object of the present invention is to provide suitable mechanism whereby contiguous portions of a blank work-piece may thus be successively subjected to the action of such rolling pressure so as to impart to the same various forms or contours both longitudinally and transversely. A further object is to provide a machine in which the forming parts which take the place of dies in a conventional press may be of relatively simple construction and readily interchanged so as to adapt the machine for the making of work-pieces of different shapes. Another object is to provide a machine wherein the work-piece blank may be conveniently introduced and the finished work-piece removed. Still another object is to provide a machine which is simple and compact in its organization, with a minimum of operating parts, and wherein such parts are readily accessible.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims.

The annexed drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of the various mechanical forms in which the principle of the invention may be used.

2

In said annexed drawings:

Fig. 1 is a top plan view of a machine embodying my present improvements;

Fig. 2 is a side elevation thereof; and

Fig. 3 is a central longitudinal section thereof, the plane of such section being indicated by the line 3—3, Fig. 1.

In the illustrative machine shown in the aforesaid drawings, the base or main bed 1 will be seen to comprise an elongated structure upon which, adjacent one end thereof (the left as shown in the drawings), a table 2 is rotatably supported upon a vertical spindle 3 that is suitably journalled in said base. Said table will preferably be of circular outline and is adapted to be rotated in either direction as required by means of a motor 4 connected by a belt drive 5 with a suitable chain of gears 6 as need not be described in detail.

The upper face of table 2 is provided with a series of spaced apertures 7, of which only a few are shown on Fig. 1, or with a corresponding series of undercut grooves, whereby a forming die D may be secured in place on such top by the use of bolts or clamps of familiar type (not shown). Preferably said die will not be thus clamped directly to the upper face of the table but will be mounted on a block or equivalent fixture 8 secured to the table top in the manner just stated, the operating face of the die overlying or projecting beyond such fixture and the latter also being formed with or carrying a series of gear teeth 9 disposed in a curve conforming with the horizontal contour of the die D.

It will be understood that the shape of the forming die D will vary with each different work-piece to be fashioned on the machine and that its position on the table top may be correspondingly varied to suit the exigencies of the particular forming or contouring operation. The die member illustrated is designed to shape or form a flat elongated strip into a buffer or bumper such as is familiarly used on automobiles and trucks, such bumper being symmetrically contoured in horizontal planes with relation to a transverse median plane and being variously bent or contoured in different transverse sections corresponding with vertical planes spaced at different distances from such median plane. As best shown in Fig. 2, the working face *d* of said die will in

effect be a replica of the contour which it is desired the finished work-piece should assume.

The portion of bed 1 which lies to the right of table 2 is formed on its upper face with a slide way 10 disposed radially with respect to the axis about which said table is rotatable. Mounted on such slideway so as to be reciprocable in such radial direction is a head 11 which includes an overhanging structure 12 that projects toward the opposite end of the machine, i. e. toward table 2, and is provided with a transverse slideway 13. As shown, reciprocation of head 11 and thus of the transverse slideway 13 carried thereby in overhanging relation with respect to table 2 is obtained by means of an hydraulic cylinder 14 conveniently housed in the bed of the machine below slideway 10, the piston in said cylinder being connected through its piston rod 15 with a projection or bracket 16 depending from said head. Suitable connections will be provided with the respective ends of cylinder 14 whereby the piston therein, and thus head 11, may be reciprocated, and more particularly whereby such head may be urged forwardly, i. e. in the direction of table 2, under such a constantly maintained pressure as may be required during operation of the machine, as will be presently described. While the valve 17 whereby the supply of liquid under pressure to cylinder 14 may be controlled is shown in Fig. 1, it has been deemed unnecessary to show the detailed connections since these will of course be readily understood. It will also be understood that any equivalent means for forcing the slidable head 11 forwardly under continuously maintained pressure may be utilized, as for example a system of cables and weights.

Mounted on the transversely disposed slideway 13 carried by the overhanging portion 12 of head 11 is a slide 20 which is substantially shorter than such slideway and capable of free reciprocable movement in either direction therealong. Said slide will have affixed to its forward face a forming die D', the working face *d'* of which in its transverse conformation matches the face *d* of the rotatable forming die D mounted on the top of table 2, as previously described; however said die D' is not curved but extends rectilinearly in a plane parallel with the direction of transverse movement of slide 20. The latter also has secured to its front face a rack 21, the teeth of which are adapted to mesh with the gear teeth 9 on the fixture 8 whereby die D is secured to the table top.

Such intermeshing of the rack teeth with the gear teeth will occur when head 11 is pressed forwardly from its retracted position shown in full lines to the position shown in dotted outline in Fig. 2, and at the same time die member D' carried by the slide will be brought into register with the die member D on the table. The relative position which the parts will occupy during the various stages of operation will vary. When the operation is initiated the slide 20 will occupy one extreme position, as shown in full lines in Fig. 1, and the table 2 will be rotated so as to bring one end of die D into juxtaposition with the corresponding end of die D'. The work-piece blank will of course be first introduced between the two dies in proper relation both lengthwise and transversely thereof, and if necessary a suitable holding means such as a clamp or electromagnet will be provided on the one such die, preferably the rotatable die D, to retain the blank in place pending the contouring thereof. The desired degree of pressure is now applied through hydraulic

cylinder 14 and the reciprocable head 11 so as to press the portion of such interposed work-piece blank which is thus immediately engaged between the two dies and shape the same to the transverse contour desired at this point, e. g. at one end. Then, while maintaining the pressure substantially constant in the manner previously described, the table 2 will be slowly rotated in a counterclockwise direction as viewed in Fig. 1 until die D occupies the reverse of its starting position, shown in dotted outline on said figure, said die being shown in full line at an intermediate position, i. e. at the point where the work-piece is half fashioned. By reason of the intergearing of the fixture which supports die D on the table top with the transversely reciprocable slide 20, the latter, and thus die D', will be caused to move transversely, i. e. in a tangential direction with respect to the direction of rotation of die D, so that corresponding parts of the two dies will be brought into opposing relation on a line radial to the shaft 3 along which pressure is exerted on slide 20 by the piston operating in cylinder 14.

Upon completion of the operation as just described, the contoured work-piece will be removed from die D and the operation thereupon repeated either in the reverse direction or by bringing the parts of the machine back to their initial position as just described.

From the foregoing description of the construction and mode of operation of my improved contour forming machine it will be seen that the work-piece is formed in a slow progressive manner, analogous to a rolling operation, and is not shaped at one blow as in a press. As a result, considerably less power is required to produce a given shape, as for instance, a truck or bus bumper such as the illustrated machine is designed to make. Thus while pressure as great as 600 T. would be required to shape such a part complete by a single stroke in a press, the present improved contour forming machine, due to the fact that only a small section of the work-piece is being operated on at any given time, and due to the progressive rolling action of the machine, will not require more than 25 T. pressure to be exerted.

Furthermore, in view of the fact that the outer periphery of the die face *d* of die D is disposed radially outward of the pitch line of the gear teeth 9 on fixture 8, as best shown in Figs. 2 and 3, the slide 20 carrying the rectilinear die D' having a gear rack 21 in mesh with the teeth 9 will be caused to move at a lesser speed than the outer periphery of the die face *d* which projects radially outward of the pitch line of teeth 9. It is thus apparent that the outer peripheral portion of a workpiece blank clamped to the die face *d* will have a sliding or wiping engagement with the die face *d'* whereby to effect forming of the workpiece to desired contour not only by a rolling action but additionally by a stretching action, which latter action has both a smoothing or ironing effect and a spring back minimizing effect. The workpiece blank when finished will, therefore, accurately conform with the contour of the die face and any irregularities in the surface thereof, which would not otherwise be obliterated by simple rolling, are effectively smoothed by the combined wiping and rolling action.

While as illustrated and described the base or main frame of the machine is shown as horizontally disposed, it will be understood that for some classes of work, and particularly where handling work-pieces of relatively small size, it may be found more convenient to dispose such frame in

a vertical plane, i. e. with the axis of the rotatable table disposed horizontally and with the reciprocable head which carries the transversely reciprocable slide located either above or below such axis. It will also be understood that the interconnection between such slide and the fixture or support on the table which carries the die D may take on various forms instead of the rack and gear shown, so long as the stated object is obtained, viz. the coordination of the transverse movement of the slide with the rotative movement of said die.

As indicated, the present improved contour forming machine is particularly adapted for the formation of shapes which change in contour, as well as in cross section, and the speed of the operation makes it particularly applicable to hot formed work, which is a large proportion of bumper work. While such bumpers can be formed hot or cold on presses by breaking them up into sections, this involves the necessity of fastening such sections together with consequent weak joints and hand finishing cost, as well as the usual amount of trim involved in a drawing die process with attendant waste of material. It has been found impractical to stretch-form these bumpers, both from the point of view of time and loss of material at each end and also due to the fact that in many designs the bumper itself will vary in cross section. Neither can bumpers or other parts of similar type be rolled, because the rolls must of necessity remain constant and cannot therefore follow a changing cross section. All these problems are satisfactorily solved by the provision herein made of a rotatable die supporting table working in conjunction with a compound slide whereby the cooperating die may be maintained under a steady or variable pressure as required and at the same time while under such pressure be moved transversely of the axis of the rotatable die.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the claims or the equivalent of such stated means be employed.

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

1. In a contour forming machine, the combination of a rotatable table, a laterally facing die of non-circular contour carried by said table and constituting a substantial replica of the finished workpiece, driving means for rotating said table and the die carried thereby, a second elongated die movable endwise transversely of the axis of said table and tangentially of said first die in all relative positions of the dies, pressing means yieldably urging said dies toward one another, and intergearing between said dies operative when said table and first die are rotated by said driving means to effect transverse movement of said second die in predetermined relation to the rotation of the first die, whereby such rotation and transverse movement of said dies can effect progressive wrapping of a workpiece blank clamped to said first die around said first die.

2. The machine according to claim 1 further characterized in that the gearing on said first die comprises a single gear segment conforming generally to the contour of the first die.

3. The machine according to claim 2 characterized in that the pitch line of the said gear segment is disposed radially inwardly from the outer periphery of said first die whereby to effect a sliding and stretching action of the workpiece.

CYRIL J. BATH.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,013,839	Cox	Jan. 2, 1912
1,714,083	Frank	May 21, 1929
2,091,749	Christman	Aug. 31, 1947
2,142,443	Goin	Jan. 3, 1939
2,217,053	Henricson	Oct. 8, 1940
2,303,058	Misfeldt	Nov. 24, 1942
2,412,731	Hoffman	Dec. 17, 1946