March 21, 1950 R. M. SHAW, JR 2,501,241

BENDING MACHINE

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FIG. 1.

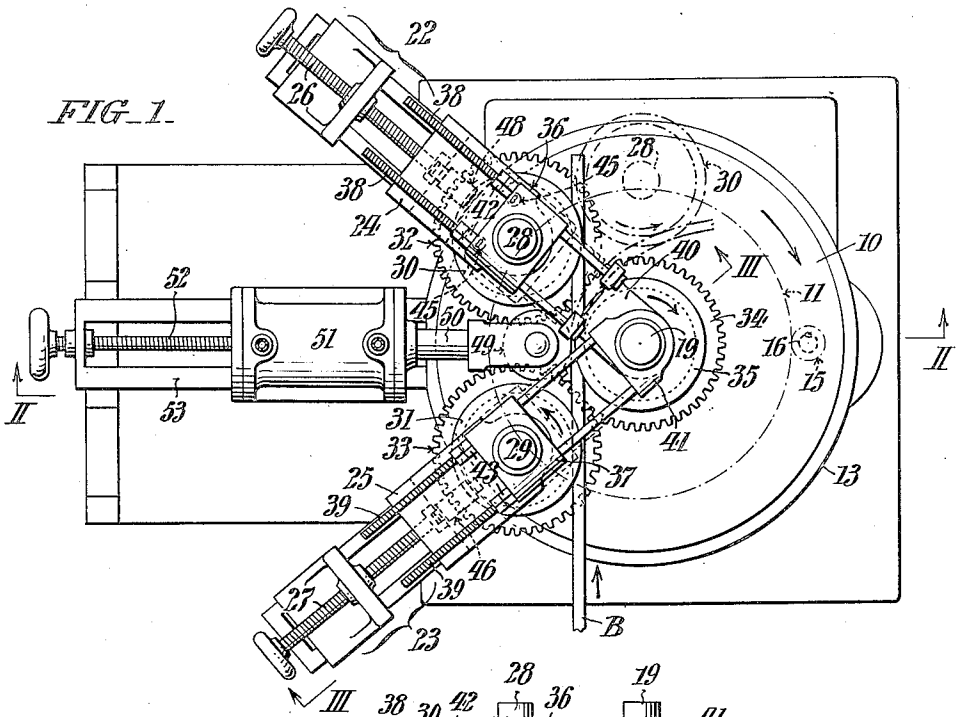


FIG. 2.

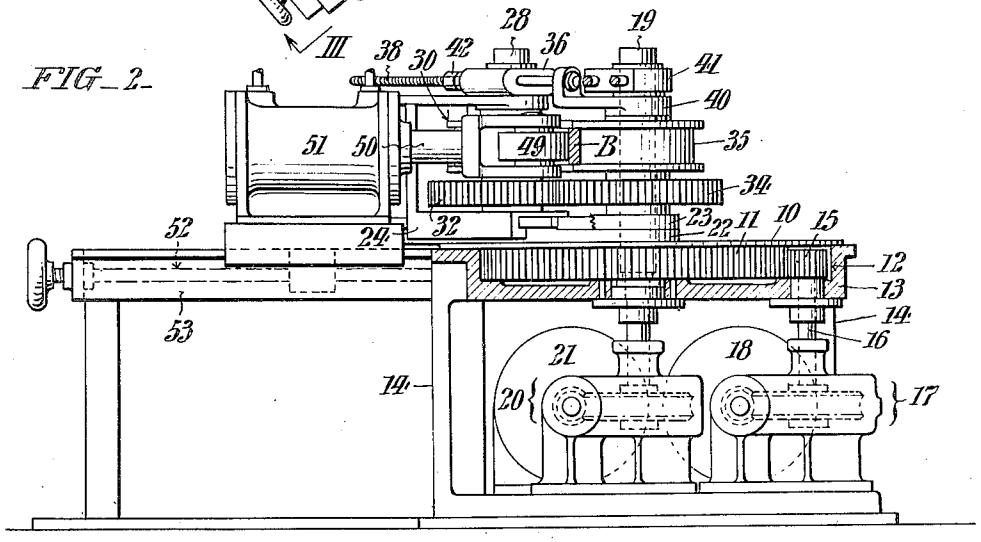
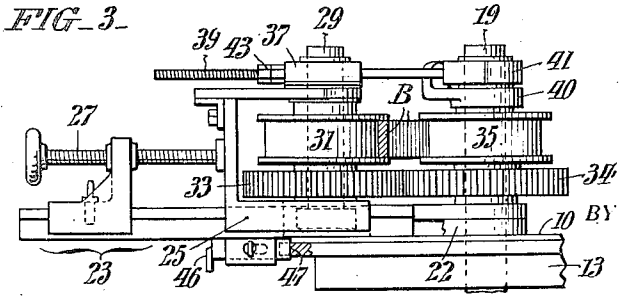


FIG. 3.



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BENDING MACHINE

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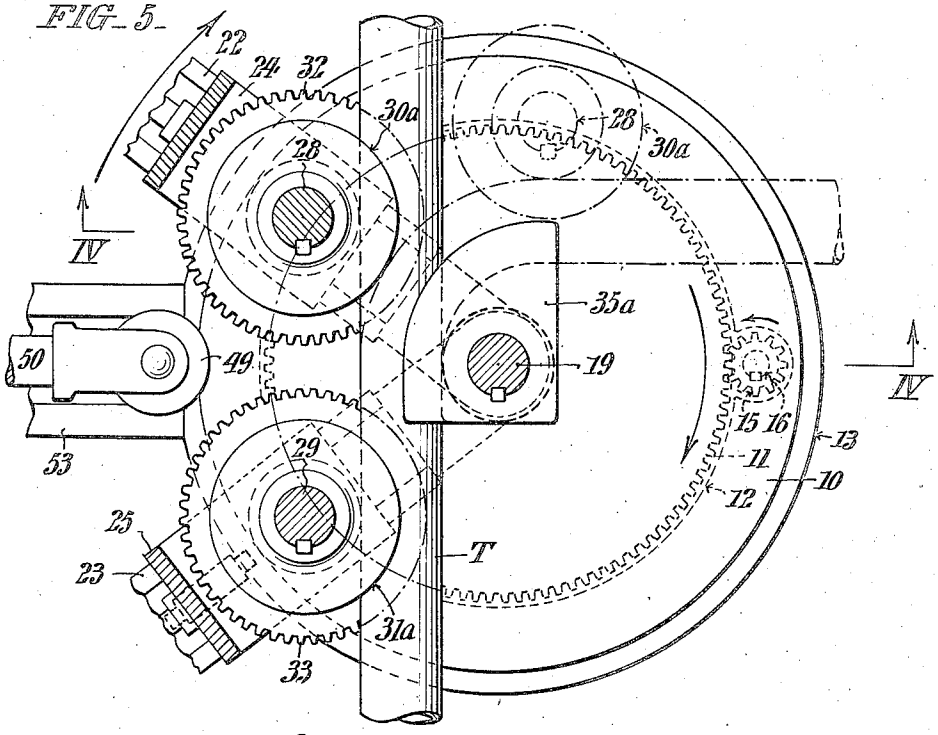
FIG. 5



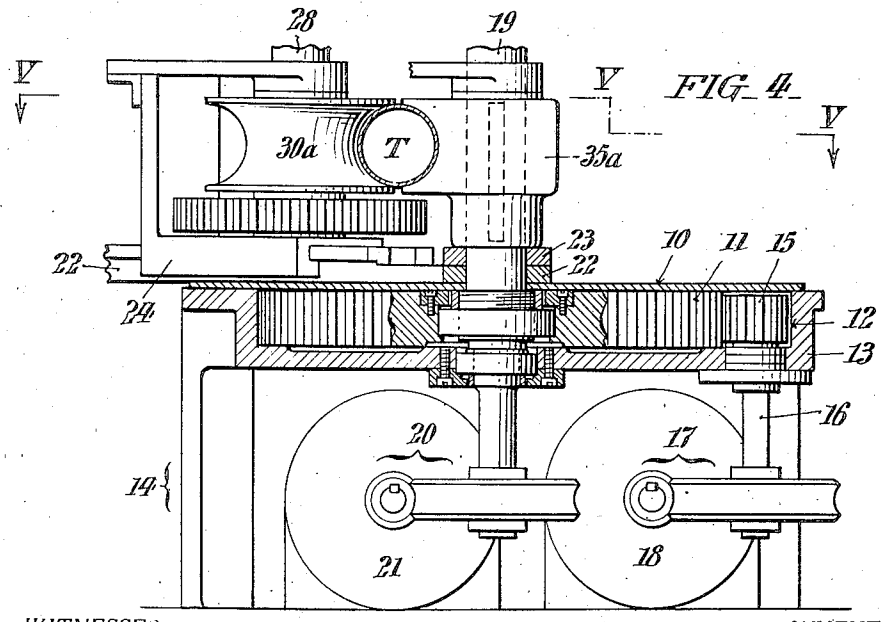


FIG. 4

WITNESSES

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BENDING MACHINE

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FIG. 6.

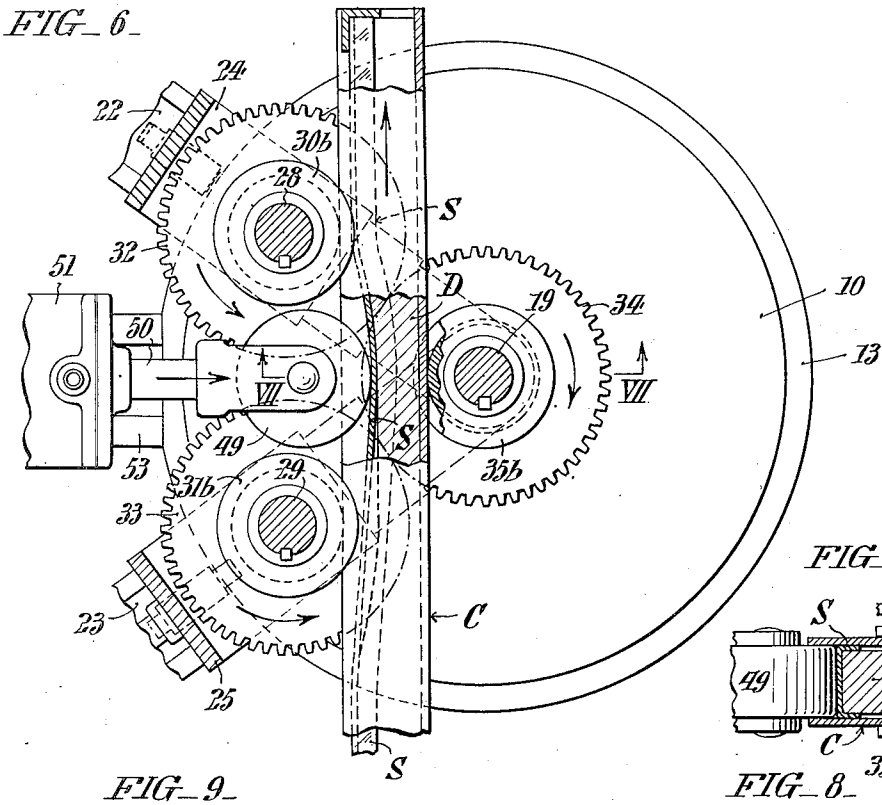


FIG. 7.

FIG. 9.

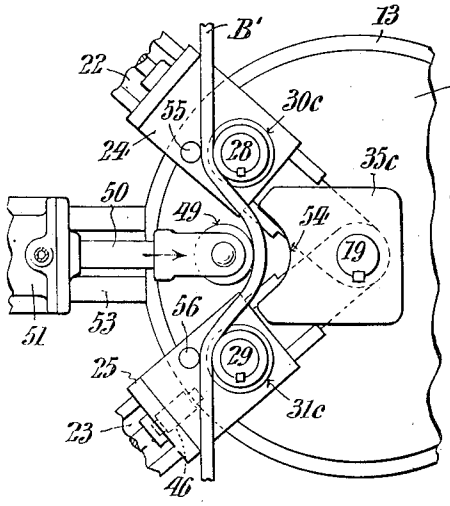
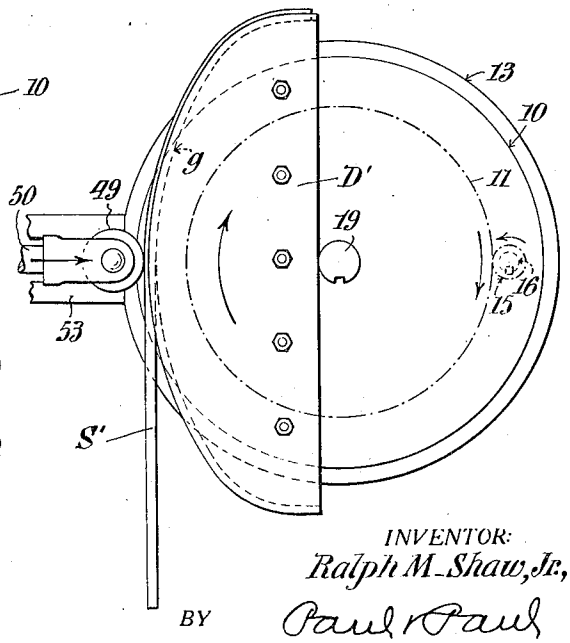


FIG. 8.



WITNESSES

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2,501,241

UNITED STATES PATENT OFFICE

2,501,241

BENDING MACHINE

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Application October 10, 1946, Serial No. 702,463

10 Claims. (Cl. 153—45)

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The invention relates to machines useful in bending bar, tube and strip materials to different shapes. Bending machines as heretofore ordinarily constructed were more or less individually restricted in their performance to definite types of work.

The chief aim of my invention is to enlarge upon the versatility of such machines so that different bending operations which heretofore entailed the employment of separate machines can be carried out in a single structure.

How the foregoing and other important objects and advantages are realized in practice will appear from the following detailed description of the attached drawings wherein:

Fig. 1 is a view in top plan showing a universal bending machine conveniently embodying my invention and arranged to perform one type of bending.

Fig. 2 is a longitudinal section taken as indicated by the angled arrows II—II in Fig. 1.

Fig. 3 is a fragmentary view in elevation looking as indicated by the angled arrows III—III in Fig. 1.

Fig. 4 is a view like Fig. 2 showing the machine arranged for a different bending operation, the section being taken as indicated by the angled arrows IV—IV in Fig. 5.

Fig. 5 is a horizontal section taken as indicated by the angled arrows V—V in Fig. 4.

Fig. 6 is a view corresponding to Fig. 1 showing the machine arranged to perform another type of bending.

Fig. 7 is a fragmentary detail sectional view taken as indicated by the angled arrows VII—VII in Fig. 6.

Figs. 8 and 9 are views in turn corresponding to Fig. 1 showing the machine variously arranged for use in carrying out still other types of bending.

With more detailed reference first more particularly to Figs. 1–3 of these illustrations, it will be noted that my universal bending machine comprises a circular face plate 10 which is affixed to a bull gear 11 confined within an annular recess 12 in a bed 13 having a supporting frame 14. The bull gear 11 is arranged to be rotated by an intermeshing pinion 15 which is also recessed into the bed 13 and whereof the shaft 16 is adapted to be driven through a worm gear speed reduction unit 17 by a reversible electric motor 18. Extending up through the bull gear 11 and the face plate 10 is an independently rotatable shaft 19 which is adapted to be driven, through another worm gear speed reduction unit

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20, by a separate reversible electric motor 21. Fulcrumed on the shaft 19 above the face plate 10 are two arms 22 and 23 respectively with slide carriages 24 and 25 which are individually adjustable along said arms by means of screw spindles shown at 26 and 27 and which rotatively support upstanding stud shafts 28 and 29. To these stud shafts are removably keyed circumferentially-grooved forming rollers 30 and 31 respectively and also spur gears 32 and 33 to mesh with a spur gear 34 which latter is removably keyed, together with a third circumferentially-grooved forming or master roller 35, to the shaft 19. In order to brace the stud shafts 28 and 29 against displacement during the bending, their upper ends are engaged in bearing blocks 36 and 37 which are restrained by parallel tension rods 38 and 39 extending from collars 40 and 41 free on the upper end of shaft 19. As shown, the rear ends of the tension rods 38 and 39 are threaded to permit backing-off or advancing of abutment nuts at 42 and 43 when the slides 24 and 25 are being adjusted along the arms 22 and 23. The bracing means just described is employed only in large heavy-duty bending machines, and may be dispensed with in smaller machines designed for operation on light work. The arm 22 is detachably connected to the face plate 10 by removable dowel pins 45, and the arm 23 in this instance fixed against rotation about the shaft 19 by a retractable latch 46 (Figs. 1 and 3) in engagement with a notch 47 in the periphery of the table 13. For use during certain types of bending as later explained, the arm 22 is likewise provided with a similar latch 48.

The machine is further provided with a fourth roller 49 for use in other bending operations as also later explained, the same being supported at the outer end of the piston rod 50 of a pressure fluid cylinder 51. As shown, the cylinder 51 is adjustable by means of a screw spindle 52 along a fixed guideway 53 formed as a part of the machine framing and extending radially of the table 13 as best seen in Fig. 1.

In Figs. 1–3, the machine is arranged for bending bars or the like such as the one indicated at B which is passed between the auxiliary rollers 30, 31 and the master roller 35, and in readiness for the bending, the fourth or press roller 49 is yieldingly urged against it by admission of pressure fluid into the rear end of the cylinder and so maintained throughout the bending, the latch 46 being withdrawn. With this preparation, the motor 18 is operated to rotate the face plate 10 clockwise or in the direction of the arrow in

Fig. 1, to move the arm 22 for moving the roller 30 relative to the rollers 31 and 35 in accordance with the curvature desired in the bend, for example to the position shown in dot-and-dash lines in Fig. 1, whereupon the motor 18 is stopped. Due to the idiosyncrasy of the worm gearing in speed reduction unit 17, the face plate 10 and the arm 22 will be locked against subsequent accidental movement. In this initial step, the bar B will be deflected as also shown in dot-and-dash lines by action of the roller 30, while its movement otherwise will be prevented by virtue of its engagement between the rollers 31 and 35. Finally, the motor 21 is started to drive the gears 32, 33 and 34 in the directions indicated by the arrows on them with the result that the bar B is advanced endwise in the machine and bent to a prescribed curvature in a manner readily understood from Fig. 1.

For use in bending tubes the machine is arranged as shown in Figs. 4 and 5, i. e. by removing the gear 34 and roller 35 from the shaft 19 and replacing them with a die 35*a*; substituting concavely-grooved rollers 30*a* and 31*a* on the shafts 28 and 29 for the rollers 30 and 31 employed in the first described instance; and withdrawing the roller 49 to inactive position. As exemplified, the die 35*a* is in the form of a quadrant and has a concaved groove to match the grooves of the rollers 30*a* and 31*a* and the outer curvature of the tube T. All being now in readiness, the motor 18 is started to drive the table plate 10 clockwise as before with attendant movement of the arm 22 and bending of the tube about the die 35*a* by action of the roller 30*a* as indicated in dot-and-dash lines. In this way angular bends can be made up to ninety degrees.

In Figs. 6 and 7, I have shown the machine arranged to effect a profile bend. Here smaller circumferentially-grooved rollers 30*b*, 31*b* and 35*b* are substituted for the rollers 30, 31 and 35 of Fig. 1. The die to which the bend is to be made is designated by the character D, the same being placed with the edge-flanged strip S which is to be bent in a holding channel C, and this assemblage passed endwise through the interval between the auxiliary rollers 30*b*, 31*b*, and the master roller 35*b* for advance by them as the associated intermeshing gears 32, 33 and 34 are driven upon starting of the motor 21. In this instance the motor 18 is not used and as a consequence the face plate 10 and the arm 22 are held against rotation by the worm gearing 17. As the die holding channel C is advanced with the strip S in place, the latter is pressed to the shape of the die surface S by the roller 49 which is constantly urged outwardly yieldingly by the action of the pressure fluid admitted to the rear end of the cylinder 51.

Fig. 8 shows another way that profiled bending can be accomplished in the machine. Here a die D' is bolted fast to the face plate 10 and the latter rotated while the strip S' is pressed into the curved groove *g* of the die by the cylinder actuated roller 49, none of the other rollers being used in this instance.

In Fig. 9, the machine is arranged to carry out another type of bar bending. In this case still smaller circumferentially grooved rollers 30*c* and 31*c* are used on the shafts 28 and 29 and a die 35*c* on the shaft 19. As shown the die 35*c* has a concaved recession or notch 54 in its front end in the longitudinal axis of the machine and facing the interval between the auxiliary rollers 30*c*, 31*c*, to the shape of which the bar B' is to be bent, said bar B' being buttressed by the rollers 30*c* and 31*c* and held in position between them and adjacently placed studs or auxiliary rollers 55 and 56 on the slides. Neither the face plate 10 nor the rollers 30*c*, 31*c* are driven in this instance, the bending being effected simply by means of the cylinder-actuated press roller 49 without endwise advance of the work.

Due to the retractability of the slides 24 and 25 along the arms 22 and 23 it is obviously possible to employ rollers and gears differing in size as occasion may require in making bends of different radii; and it is to be understood that in accordance with my invention, removable dowel pins like those hereinbefore described in connection with the arm 22, are provided for detachably securing the arm 23 to the face plate 10 so that it may be made to swing about the shaft 19 in making reverse bends, if desired, with the arm 22 latched.

Having thus described my invention, I claim:

1. A bending machine of the character described having a face plate; a shaft about which the face plate is rotatable; means constructed and arranged for driving the face plate; a master roller or die fast on the shaft; a pair of arms fulcrumed on the shaft and each carrying an auxiliary roller to cooperate with the master roller or die during the bending; and means whereby one arm is securable to the face plate for rotation and the other is fixable against movement.

2. A bending machine according to claim 1, further including means for rotating the shaft independently of the face plate; and a group of intermeshing gears whereby the auxiliary rollers are driven from said shaft.

3. A bending machine according to claim 1, further including a retractable press roller; and pressure means for yieldingly urging the press roller toward the master roller to assist in effecting certain types of bending.

4. A bending machine according to claim 1, further including means for rotating the shaft independently of the face plate; a group of intermeshing gears whereby the auxiliary rollers are driven from said shaft; mounting slides respectively for the auxiliary rollers; and means whereby the slides are adjustable along the arms to permit the interchangeable use of rollers and/or driving gears of different sizes in the machine.

5. A bending machine of the character described having a face plate; a shaft about which the face plate is rotatable; a motor and interposed worm gearing for driving the face plate; a separate motor and interposed worm gearing for driving the shaft; a master roller fast on the shaft; a pair of arms independently fulcrumed on the shaft and each carrying an auxiliary roller to cooperate with the master roller in the bending; means whereby one arm is securable to the plate for rotation therewith and the other arm is securable against movement; and a group of intermeshing gears whereby the auxiliary rollers are driven from said shaft.

6. A machine for bending rods, tubes and the like, comprising a master roller and two cooperative auxiliary bending rollers between which and the master roller the specimen to be bent is placed; a pair of arms fulcrumed upon the axis of the master roller on which the respective auxiliary rollers are rotatively mounted; means for moving one of the arms through a definite angle about the axes of the master roller while the other arm is held stationary to initially flex the

specimen about the master roller; and means for thereafter positively driving the three rollers to progress the specimen endwise in the machine.

7. A bending machine according to claim 6, further including a retractable press roller to cooperate with the master roller in the interval between the auxiliary rollers; and means for yieldingly urging the press roller toward the master roller during the bending.

8. A machine for bending rods, tubes and the like comprising a master roller and two cooperative auxiliary bending rollers between which and the master roller the specimen to be bent is placed; a shaft to which the master roller is secured together with a coaxial gear wheel; a pair of arms fulcrumed on the shaft of the master roller on which the auxiliary rollers are rotatively mounted together with individual coaxial gear wheels, in mesh with the gear wheel associated with the master roller; means for moving one of the arms about the shaft of the master roller through a definite angle while the other arm is held stationary to initially flex the specimen about the master roller; and means for thereafter driving the shaft of the master roller so that it and the auxiliary rollers are rotated, through the intermeshing gear wheels, to progress the specimen endwise in the mechanism.

9. A bending machine according to claim 8, further including a retractable press roller to cooperate with the master roller in the interval between the auxiliary rollers; and means for yieldingly urging the press roller toward the master roller during the bending.

10. A bending machine according to claim 8, further including means for adjusting the axes of the auxiliary rollers along the respective arms

to permit interchange of rollers and gears of different sizes in the machine.

RALPH M. SHAW, JR.

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