Nov. 16, 1943. R. M. WEIMER 2,334,661

PIPE BENDING MACHINE

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Fig. 3.

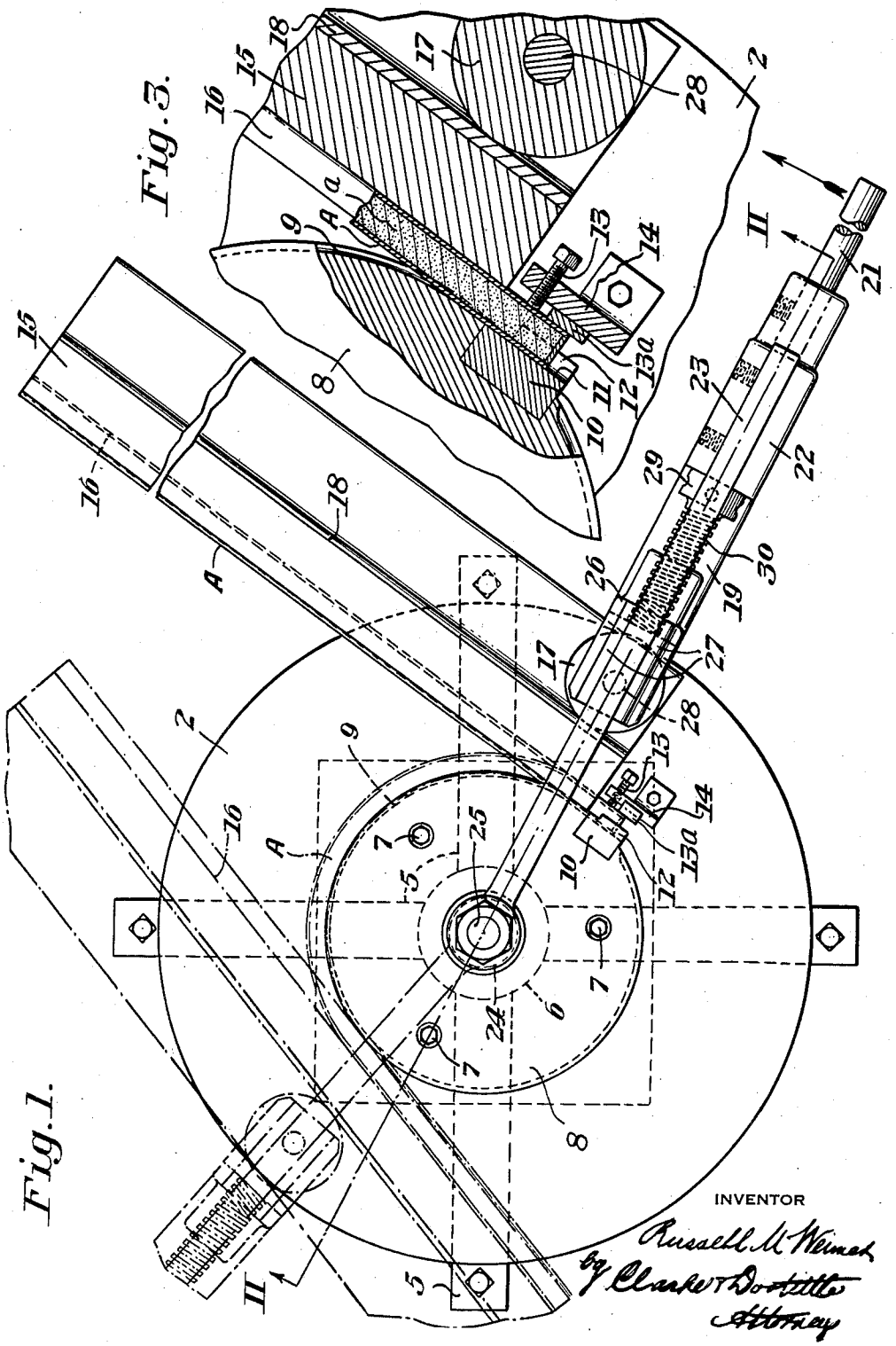


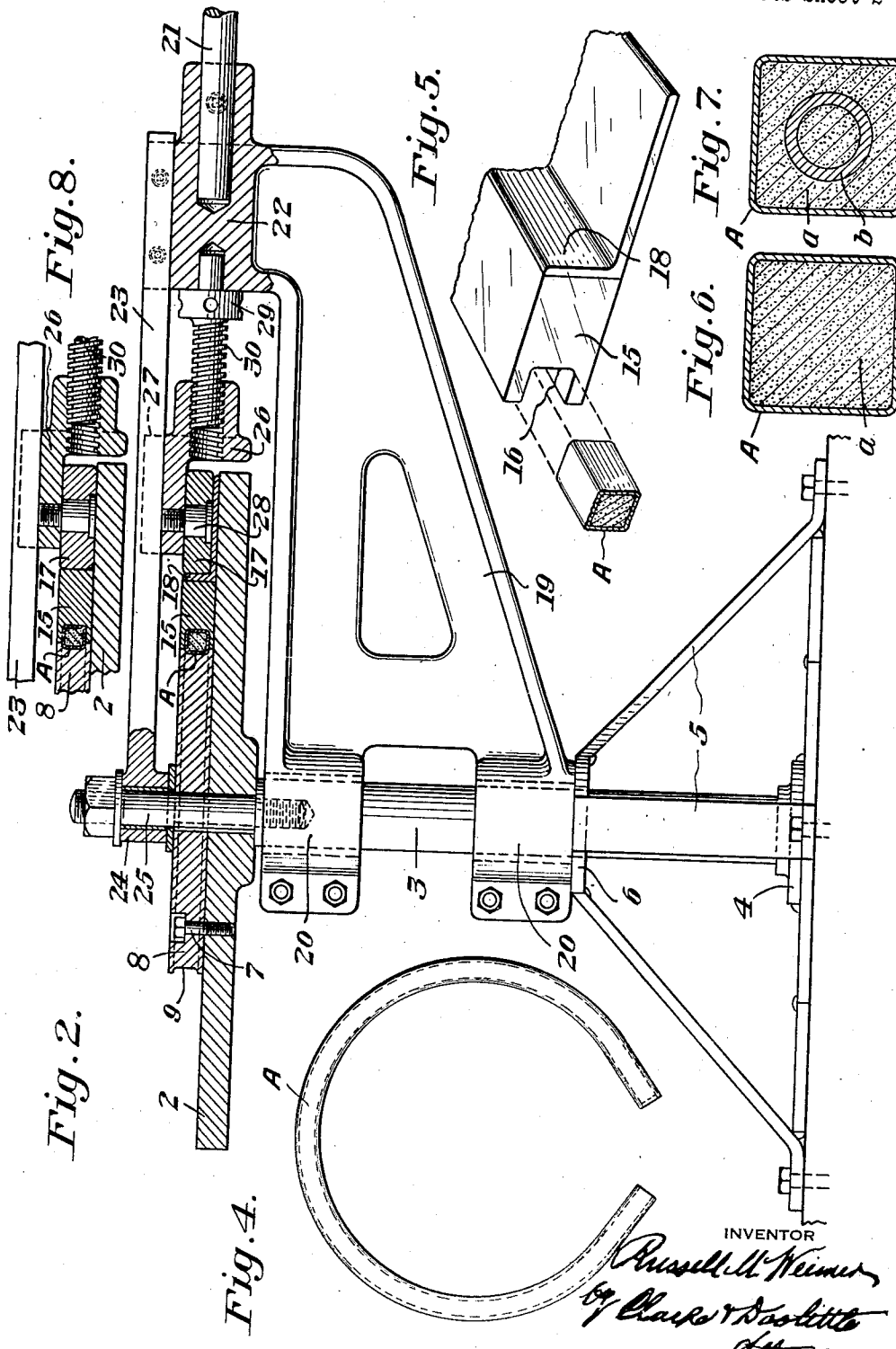
Fig. 1.

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PIPE BENDING MACHINE

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8 Claims. (Cl. 153—46)

This invention is an improvement in the art of bending pipe or tubing, particularly conduits of thin wall type, and in machines therefor. In such operations it is essential that the pipe or tube, of whatever cross section, be effectively reinforced or braced internally, but also bent or curved by a progressive deflecting treatment whereby to effect and maintain continuous uninterrupted smoothness of all of its surfaces, both exterior and interior. In the machine involved I utilize a curved edge stationary resisting former or die, around which the pipe or tube is bent by an outer straight channelled partly-embracing bar member, actuated by an annularly moving roller. The invention is adapted to effect bending of the tubular blank to any extent less than a complete circle, but substantially so.

One preferred embodiment of the machine is illustrated in the accompanying drawings, in which:

Fig. 1 is a plan view, partly broken away, showing the working elements at their initial position;

Fig. 2 is a view in elevation, partly in section on the line II—II of Fig. 1;

Fig. 3 is a sectional detail plan view showing the terminal of the blank connected with the resisting former and engaged by the inner end of the embracing bar member;

Fig. 4 is a plan view of the bent blank;

Fig. 5 is a perspective detail view showing cooperating relation between the blank and the bending bar;

Fig. 6 is a full size cross section of a square blank and internal mandrel filling;

Fig. 7 is a similar view showing a modification thereof;

Fig. 8 is a partial sectional view as in Fig. 2, showing the wiping roller bearing directly against the channelled bar member.

Referring to Figs. 1 and 2, a supporting circular table 2 is rigidly mounted upon a cylindrical post 3 having a base 4 and supporting floor connecting braces 5 terminating in a post-surrounding frame supporting bearing 6.

Fixedly secured upon table 2 in any suitable manner, as by bolts 7, is the annular die wheel 8 having the shallow edge groove 9 for interfitting reception of one side portion of the squared blank A, of Figs. 6 and 7. Die wheel 8 is provided with an inserted block 10 having an outer flat face 11 between upper and lower flange projections 12 forming a channeled tangential extension of the peripheral groove 9.

Block 10 is preferably of hard metal, firmly held in position by a conforming socket and welding, or otherwise as preferred. It thus provides a short flat bearing for the end of the blank against which it is temporarily clamped, as by temper screw 13 in bearing bracket 14 firmly attached to table 2, supplemented if desired by a shim or wedge 13a.

For the purpose of wiping the blank progressively around the annular grooved edge of wheel 8, in tight curve formation therewith, is provided an elongated straight rigid bar 15 having a blank-engaging groove 16 of sufficient depth to closely embrace the outer major portion of the blank.

Bar 15 is of sufficient length to correspond at least to the entire annular length of the grooved edge of die wheel 8, and is initially located with its inner end closely adjacent to block 10, as in Figs. 1 and 3.

An annularly moving wiping roller 17 is adjusted towards the straight bar 15 and against an intervening flange 18 of an angle bar, coextensive with bar 15, and welded or otherwise secured to the bar. Both together, being stiff and rigid, are moved around over the face of table 2, sliding thereon, by annular movement of the roller, as indicated in dotted lines in Fig. 1.

For such purpose a swinging supporting frame or bracket 19 is carried by journalled bearings 20 around post 3, supported upon bearing 6, and having an operating lever arm 21 extending beyond a terminal head 22. A supplemental guide bar 23 connects head 22 by its inner pivoting terminal 24 rotatably around the upper end of a short shaft or stud 25 which, with bolts 7, fixedly connects die wheel 8 and table 2 with the upper end of post 3. Between head 22 and roller 17 is an adjusting housing 26, slidably mounted underneath the straight connecting guide bar 23 by embracing sides 27, and having a depending supporting stud 28 around which the wheel 17 is rotatably mounted. Connecting head 22 and the housing, rotatably engaging the head and having a rotating collar 29, is a screw 30 in threaded engagement with the housing, as in Fig. 2. By such means the housing and roller may be adjusted into operative relation with the bar 15, whereby to hold it and the blank A in continuous close working relation with the die wheel 8, when lever arm 21 is swung around, as indicated by the arrow, Fig. 1.

Thus, as the roller 17 after being accurately adjusted inwardly by the screw to snugly embrace the blank by straight groove 16 of bar 15, and with opposite edge placement of the blank in shallow groove 9 of wheel 8, and with the end of

the blank tightly clamped to said wheel, the bending of the blank A commences. Continuous movement of lever 21 effects and maintains the necessary pressure throughout the entire annular movement of the roller, successively acting along and against the straight bar 15. Bar 15 meantime is automatically shifted over the supporting surface of table 2, until completion of the bending of the blank, as in Fig. 4. Thereupon, the pressure of the screw 30 may be released by its reversal, the swinging frame may then be returned for the next operation, the resulting article is removed, and the operation repeated. Such removal is effected by releasing the grip of bolt 13, retraction of housing 26 along its guide bar 23 with roller 17, removal of bar 15, resulting loosening of the thin wall blank A outwardly from shallow groove 9, assisted by its tendency to slight radial resilience outwardly, whereby the formed blank may be lifted away from die wheel 8, with limited outward swinging, if necessary.

The machine as designed and used, is particularly adapted for operation on relatively thin wall blanks and requires internal mandrel resistance, as indicated in Figs. 6 and 7. Such resistance is afforded by means of an entire filling of a suitable flexible and later removable substance *a* as in Fig. 6, or in combination with a flexible core *b*, as in Fig. 7.

The ratio of contraction of the mandrel being less than that of the surrounding shell of the tube, results in a very intimate resisting contact, so that, due to the higher ratio contraction of the tube walls themselves, there results a very closely contacting and perhaps slight further compressing action on the mandrel.

The tube then being subjected to the action of the annular forming and rolling action of the machine elements, and due to the internal mandrel resistance, the tube and its mandrel are laid or wiped around the stationary disk wheel. Such treatment is without any frictional action such as results in usual die forming bending, the operation contining until the complete resulting ring is formed, with the intervening gap.

Thereafter, the tube with its contained mandrel, is subjected to sufficient temperature, as by hot water immersion, sufficient to melt the mandrel, which then freely flows outwardly from the shaped blank and is re-claimed for further use.

By reason of the adjustability of the roller the machine is well adapted to perfect bending operations, notwithstanding slight variations in outer dimensions of the blank, more or less, from any standard sizes being operated on.

While there is an advantage in reinforcing the bar 15 by the co-extensive angle bar, with its flange 18 between the roller 17 and said bar, the bar 15 may be made sufficiently strong and rigid itself, so that the roller may bear directly against it, as in the modification shown in Fig. 8.

It will also be understood that for bending other than almost completely circular or ring-like forms, the die wheel or disk 8 may be replaced by segments thereof of any varying annular length, curvature or radius, for curved bending thereover, merely by reorganizing the design of the machine conformably.

Also, that instead of manual swinging of the frame 19, it may be power actuated, as by incorporating suitable gearing with the swinging frame, as an annular rack or gear wheel coinciding with the axial center of post 3.

The construction and operation of the machine will be readily understood and appreciated by those skilled in the art of bending pipes, tubing, etc. It effectively, rapidly and successfully bends such, especially of small gauge walls, without buckling or wrinkles, due to the non-frictional application of rolling pressure through the means employed, while successively and continuously advancing the pressure zone during closely confining embracement of the pipe-in-process.

The machine may be changed or varied in construction, dimensions or details, by the skilled mechanic to adapt it to any particular or special resulting product, within the scope ofthe following claims.

I claim:

1. A bending machine for pipe or tubing comprising a table having an upper annular face stationary die member provided with a peripheral groove, a freely movable straight bar having a blank-engaging channel registering with said peripheral groove, a wiping roller operatively related to said bar, an annularly movable frame pivotally mounted below the table having an outer portion extending upwardly above the table, and adjusting and guiding means on the upwardly extending outer portion of said frame for maintaining the roller in operative relation to the bar.

2. A bending machine for pipe or tubing comprising a table having an upper annular face stationary die member provided with a peripheral groove, a freely movable straight bar having a blank-engaging channel registering with said peripheral groove, a wiping roller operatively related to said bar, an annularly movable frame pivotally mounted below the table having an outer portion extending upwardly above the table, and adjusting and guiding means on the upwardly extending outer portion of said frame for adjusting the roller to operative relation with the bar and holding it against the die member during movement of the frame.

3. A pipe bending machine consisting of a supporting column having a stationary table and die member thereon having an annular blank engaging groove, an annularly swinging frame mounted on the column having a terminal extending above the table, a straight rigid bar slidably mounted on the table having a blank engaging channel for movable co-operation with the die member and its groove, a roller movable with the swinging frame for exerting inward pressure against the bar and moving it and an interposed blank around the die member, guiding means connecting the roller and the terminal of the swinging frame, and inwardly and outwardly adjusting means for the roller between it and the swinging frame terminal.

4. In a pipe bending machine for making a substantially complete ring, the combination with a central supporting column having a terminal extension, of a stationary table having a fixed die member thereon provided with an annular edge portion, a swinging frame below the table having an outer terminal portion extending above the table movable around the axial center of the column and its extension, means connecting a tubular blank to the die member, a straight rigid bar slidably mounted on the table having a blank-engaging channel, a guide bar connecting the terminal portion of the swinging frame with the terminal extension, a radially movable housing engaging the guide bar and

provided with a roller, and adjusting means for the housing and its roller carried by the terminal portion of the swinging frame.

5. In a pipe bending machine, the combination with a central supporting column having a terminal extension, of a stationary table having a fixed die member thereon provided with an annular edge portion, a swinging frame below the table having an outer terminal portion extending above the table movable around the axial center of the column and its extension, means connecting a tubular blank to the die member, a straight rigid bar slidably mounted on the table having a blank-engaging channel and adapted to be moved over along the working edge of the die member in confining engagement with an interposed blank, a guide bar connecting the terminal portion of the swinging frame with the terminal extension, a radially movable housing engaging the guide bar and provided with a roller, and adjusting means for the housing and its roller carried by the terminal portion of the swinging frame.

6. In a pipe bending machine, the combination with a central supporting column having a terminal extension, of a stationary table having a fixed die member thereon provided with an annular shallow grooved edge portion, a swinging frame below the table having an outer terminal portion extending above the table movable around the axial center of the column and its extension, means connecting a tubular blank to the die member, a straight rigid bar slidably mounted on the table having a blank-engaging channel, a guide bar connecting the terminal portion of the swinging frame with the terminal extension, a radially movable housing slidably engaging the guide bar and provided with a roller, and adjusting means for the housing and its roller consisting of a screw journalled in the terminal portion of the swinging frame and in threaded connection with the housing.

7. In a pipe bending machine, the combination with a central supporting column having a terminal extension, of an upper table secured to the column, a circular die member fixedly mounted thereon having an annular groove, a straight rigid bar slidably mounted on the table having a blank-engaging channel co-operating with the die member, an annularly movable swinging frame journalled on the column below the table having an outer terminal portion extending beyond and above the table, a guide bar journalled on the terminal extension of the column and secured to the terminal portion of the frame, a housing slidably engaging the guide bar provided with a pivoted roller for exerting continuous inward pressure against the bar as the frame is moved annularly, and adjusting means for the housing between it and the terminal extension of the swinging frame.

8. In a pipe bending machine, the combination with a central supporting column having a terminal extension, of an upper table secured to the column, a circular die member fixedly mounted thereon having an annular groove, a straight rigid bar slidably mounted on the table having a blank-engaging channel co-operable with the die member, an annularly movable swinging frame journalled on the column below the table having an outer terminal portion extending beyond and above the table, a guide bar journalled on the terminal extension of the column and secured to the terminal portion of the frame, a housing slidably engaging the guide bar provided with a pivoted roller for exerting continuous inward pressure against the bar as the frame is moved annularly, and an adjusting screw for the housing between it and the terminal extension of the swinging frame.

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