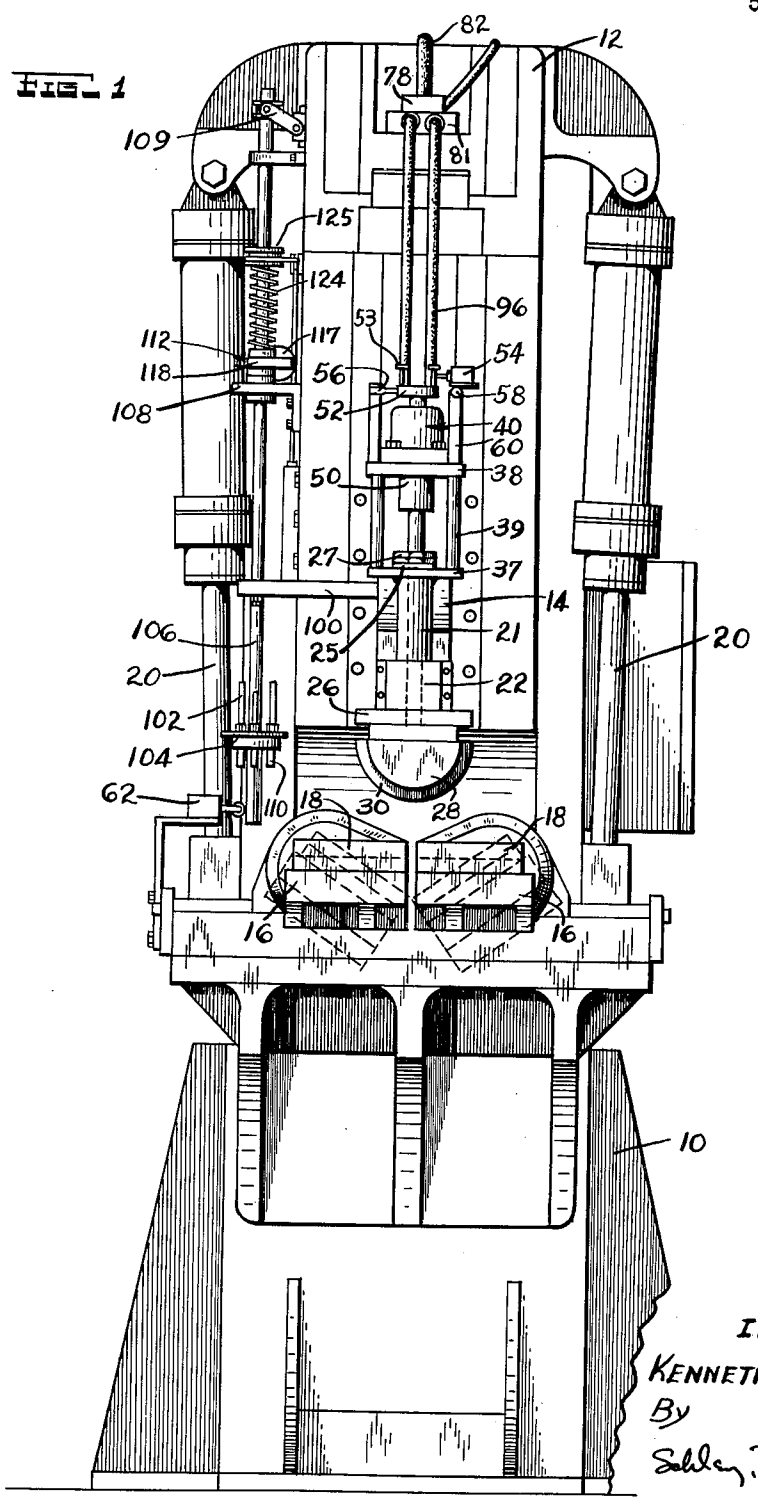
Feb. 20, 1962 K. D. FERRIS 3,021,886

TURRET PUNCH FOR PIPE BENDING MACHINE

Filed March 16, 1960 5 Sheets-Sheet 1

FIG. 1



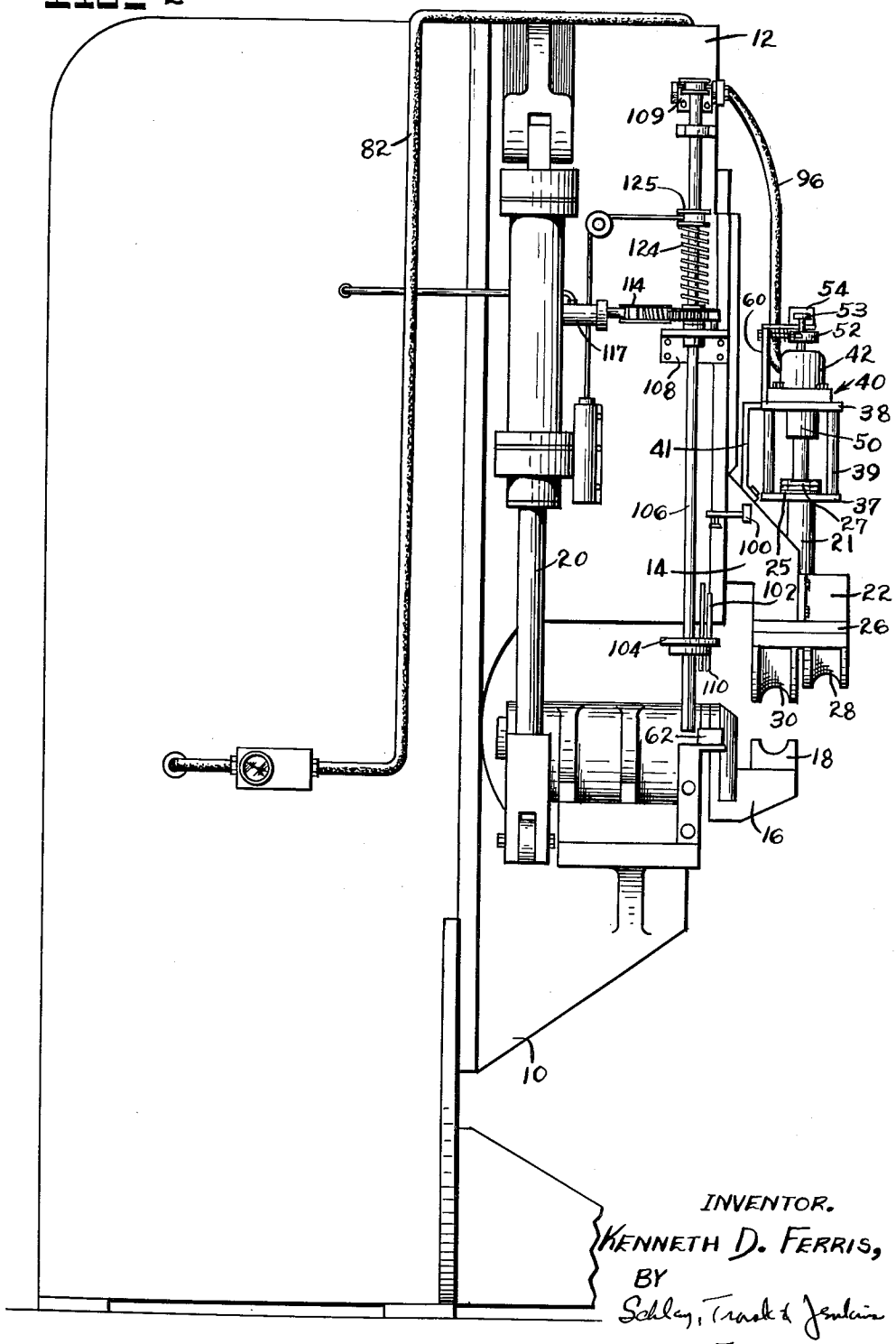
INVENTOR
KENNETH D. FERRIS,
By
Sahlen, Traub & Jenkins
ATTORNEYS.

Feb. 20, 1962 K. D. FERRIS 3,021,886

TURRET PUNCH FOR PIPE BENDING MACHINE

Filed March 16, 1960 5 Sheets-Sheet 2

FIG. 2



INVENTOR.
KENNETH D. FERRIS,
BY
Schley, Traub & Jenkins
ATTORNEYS.

Feb. 20, 1962 K. D. FERRIS 3,021,886

TURRET PUNCH FOR PIPE BENDING MACHINE

Filed March 16, 1960 5 Sheets-Sheet 3

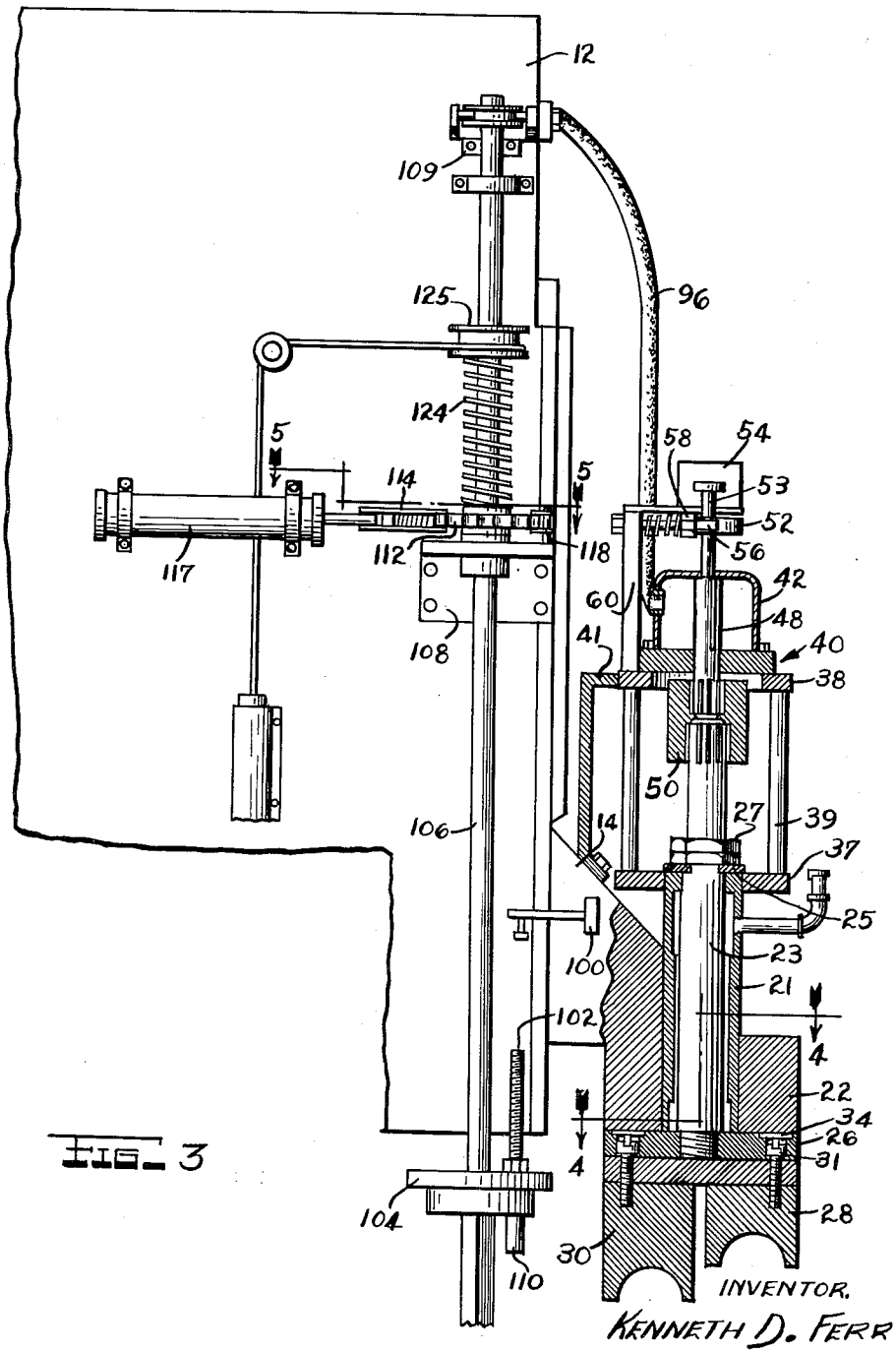


FIG. 3

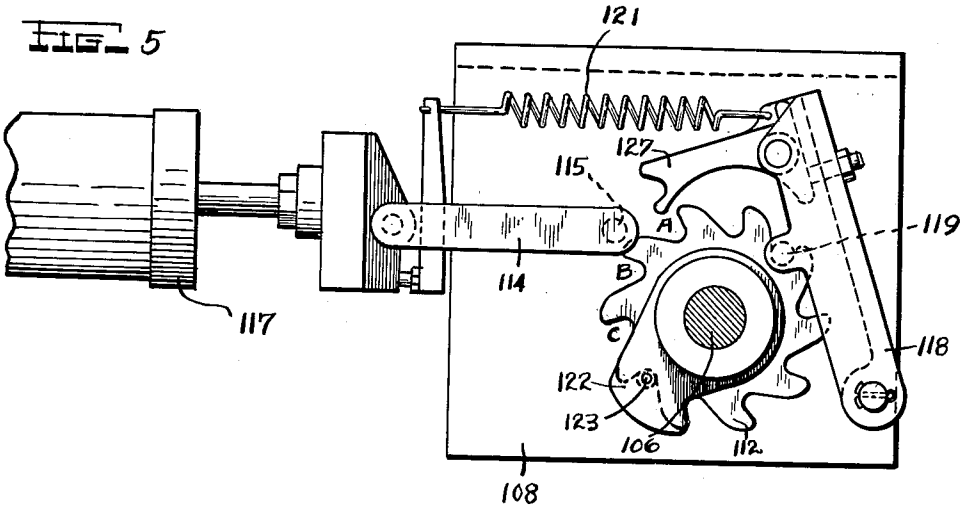
INVENTOR.
KENNETH D. FERRIS,
BY
Sebby, Trask & Jenkins
ATTORNEYS.

Feb. 20, 1962 K. D. FERRIS 3,021,886

TURRET PUNCH FOR PIPE BENDING MACHINE

Filed March 16, 1960 5 Sheets-Sheet 4

FIG. 5



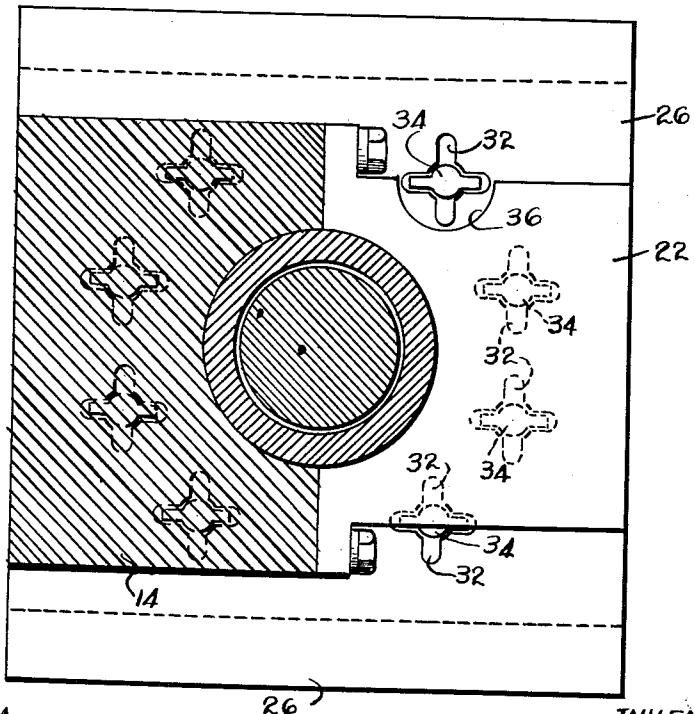


FIG. 4

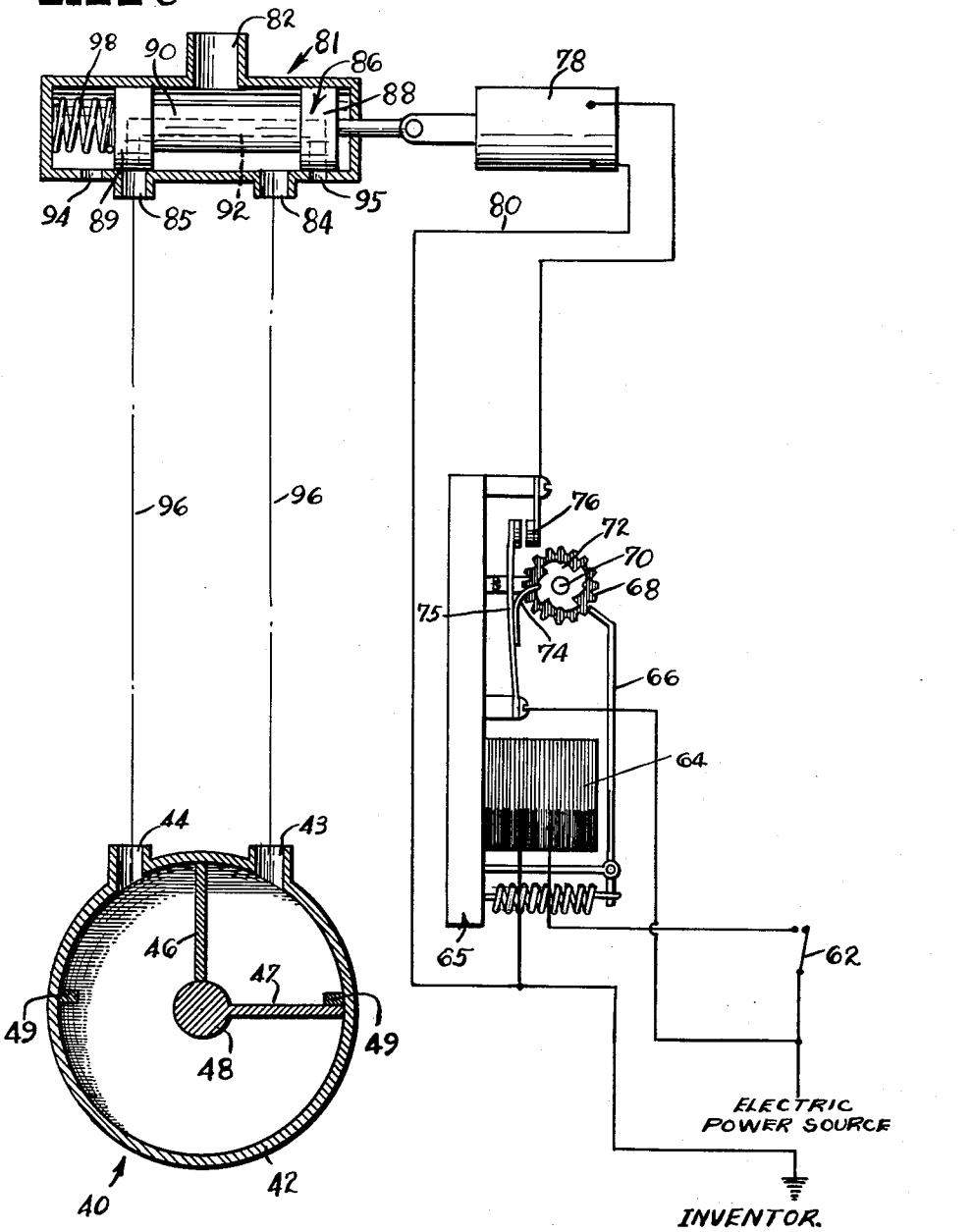
INVENTOR.
KENNETH D. FERRIS,
BY
Schley, Trosk & Jenkins
ATTORNEYS

Feb. 20, 1962 K. D. FERRIS 3,021,886

TURRET PUNCH FOR PIPE BENDING MACHINE

Filed March 16, 1960 5 Sheets-Sheet 5

FIG. 6



INVENTOR.
KENNETH D. FERRIS,
BY
Schley, Trask & Jenkins
ATTORNEYS.

United States Patent Office 3,021,886 Patented Feb. 20, 1962

3,021,886

TURRET PUNCH FOR PIPE BENDING MACHINE

Kenneth D. Ferris, Seymour, Ind., assignor to Arvin Industries, Inc., Columbus, Ind., a corporation of Indiana

Filed Mar. 16, 1960, Ser. No. 15,308
14 Claims. (Cl. 153—48)

This invention relates to a turret punch, and more particularly to a turret punch for use on pipe bending machines for forming bends in lengths of pipe.

In many pipe bending operations, such as for example in the bending of tail pipes and exhaust pipes for automobile exhaust systems, it is necessary to produce a pipe having a plurality of bends in which said bends have two different radiuses of curvature. In production line practices, such an operation has required the use of two pipe bending machines, each one of which is equipped with a different diameter punch. Prior to my invention, it was impractical to employ one such machine for producing such pipe, since it was a difficult and time consuming task to change the punches on the machine in order to produce the differently curved pipe bends.

It is thus an object of my invention to provide a turret punch having a pair of different diameter punches which can be mounted on a conventional pipe bending machine, which will automatically dispose the proper punch in operative position for producing the desired radial bend in a pipe, and which will releasably retain the desired punch in its operative position.

In the preferred form of my invention, there is provided a sleeve mountable on the ram of a conventional pipe bending machine. The sleeve carries a rotatable shaft projecting outwardly therefrom, with one of its ends being rigidly connected to a pad carried against the adjacent faces of said sleeve and the ram, and provided with a pair of different diameter punches selectively movable upon rotation of said shaft to force a pipe against a pair of dies on the machine for forming a plurality of bends in said pipe. The opposite end of said shaft is connected to rotatable driving means mounted above the sleeve and adapted to rotate said shaft through an angle of 180° in both a clockwise and counterclockwise direction for disposing the desired punch in operative position.

Conveniently, the rotatable driving means is pneumatically actuated with the direction which said means rotates the shaft being controllable by a spring-biased two-way valve controlled by a solenoid. The solenoid is energized by a circuit comprising a normally open switch and a relay. The normally open switch is selectively closed by indexing means actuated by movement of the ram so that opening and closing of said switch will control the actuation of the relay to thus control the solenoid and the valving movements of said two-way valve for rotating the rotatable shaft in the proper direction to dispose the desired punch in operative position.

Other objects and features of my invention will become apparent from the more detailed description which follows, and from the accompanying drawings, in which:

FIG. 1 is a front elevation of a pipe bending machine having a turret punch embodying my invention mounted thereon;

FIG. 2 is a side elevation of the machine shown in FIG. 1;

FIG. 3 is a fragmentary enlarged view of the machine shown in FIG. 2, but showing portions of the turret punch in section;

FIG. 4 is a horizontal section taken on the line 4—4 of FIG. 3;

FIG. 5 is a horizontal section taken on the line 5—5 of FIG. 3; and

FIG. 6 is a schematic showing of the means for controlling the positioning of the turret punches.

My invention is concerned with a turret punch adapted to be mounted on a conventional pipe bending machine to permit said machine to form a plurality of bends having two different radiuses of curvature in a length of pipe, and to form said bends in the desired sequential order. In the drawings, my invention is shown as being mounted on an offset ram pipe bending machine such as is manufactured and sold by the Pines Engineering Co., Inc. Such a machine normally comprises a base 10 having a frame 12 projecting upwardly therefrom. An hydraulically actuated ram 14 is carried on the frame 12 and is vertically movable with respect to a pair of pivotally mounted rocker shoes 16 mounted on the base 10. As shown in FIGS. 1 and 2, the rocker shoes 16 support a pair of horizontally aligned wing dies 18 in the general vertical plane of the ram 14, said rocker shoes and dies being releasably retained in horizontal alignment by a pair of rams 20. In normal operation, the ram 14 carries a single punch which is vertically movable with said ram into operative engagement with a pipe carried in the dies 18 so that upon downward movement of the ram 14 said punch will bear against the pipe carried in the dies for bending it about the radius of curvature of said punch, the dies and rocker shoes being pivoted into the dotted line position shown in FIG. 1 during such bending.

My invention comprises a turret punch adapted to be mounted on the ram 14 for movement therewith to selectively form bends having two different radiuses of curvature in a length of pipe. As shown, my invention comprises a vertically extending sleeve 21 recessed in the forwardly presented face of the ram 14. Conveniently, the sleeve 21 is mounted on the ram by welding it to a bearing block 22 which is bolted onto the forwardly presented ram face. As shown in FIG. 3, the lower faces of the bearing block, sleeve, and ram are coplanar. Rotatably carried in the sleeve 21 is a shaft 23 having its ends projecting outwardly therefrom. The lower end of the shaft 23 is rigidly connected, as by welding, to a thrust pad 26 adapted to be drawn up against the lower faces of the ram 14, bearing block 22, and the sleeve 21 by a pair of thrust nuts 27 adjustably received on the upwardly projecting end of the shaft 23 and adapted to bear against the upper face of a thrust collar 25 interposed between the nuts 27 and the upper end of the sleeve 21 for controlling the axial positioning of the shaft 23 with respect to said sleeve while permitting said shaft to rotate within the sleeve.

Rigidly mounted on the lower face of the pad 26 is a pair of parallel punches 28 and 30 having different radiuses of curvature for forming two differently curved bends. To mount said punches on the pad 26, I provide a plurality of tapped openings in the upper face of said pad equally spaced from the axis of the shaft 23 and receiving Allen shoulder bolts 31 mounting the punches 28 and 30 on the lower face of the pad. In normal operation, strong forces of vibration are produced which tend to loosen the bolts 31 and the punches. To overcome this difficulty, I provide a plurality of radially extending recesses 32 at the upper ends of the bolt-receiving openings. Said recesses are adapted to receive the cross arms of T-shaped locking pins 34 whose shanks are lockingly received in the upper ends of the Allen shoulder bolts 31 and thereby prevent said bolts from becoming loose. The pad 26 abuts the lower faces of the ram 14 and bearing block 22 to releasably hold the pins in position in the pad openings.

As shown in FIG. 4, the pad 26 underlies substantially the entire extent of the ram 14 and the bearing block 22 to thus dispose the locking pins 34 and bolts 31 there-

under. In order to remove the punches 28 and 30 without having to remove the bearing block 22, I provide a vertically extending recess 36 in said bearing block so that the pad 26 may be rotated to move the bolts 31 and their locking pins 34 under said recess to permit their removal from the pad for changing the punches.

In order to dispose the desired punch 28 or 30 in vertical alignment with the plane of the dies 18, it is necessary that the shaft 23 be rotatable through an angle of 180°. To this end, I mount a base platform 37 on the upper end of the sleeve 21. As shown in FIG. 3, a plurality of supports 39 are mounted on the base platform 37 and support a second platform 38 on their upper ends. Conveniently, the platform 38 may be braced by a brace 41 extending downwardly therefrom and bolted onto the ram 14. The platform 38 carries a rotatable driving unit 40, which is conveniently actuated by compressed air. In the embodiment illustrated in the drawings, I employ a rotatable driving unit manufactured by the Ex-Cell-O Corporation and sold under the trademark "Rotac." As shown in FIG. 6, such a unit comprises a housing 42 provided with a pair of ports 43 and 44 disposed on either side of a divider 46. As will be more fully explained hereinafter, air entering one of the ports 43 or 44 rotates a vane 47 carried in the housing 42 and rigidly connected to a driving shaft 48 projecting outwardly through the upper and lower housing walls. The angle of rotation of the vane 47 is limited to 180° by a pair of pins 49 mounted on the inner housing wall and engageable with said vane during its rotating movements. The lower end of the shaft 48 is connected to the upper end of the shaft 23, as by a spline coupling 50, so that rotation of the vane 47 will thus be transmitted to the shaft 23 through the driving shaft 48 for rotating the punches. The opposite or upper end of the shaft 48 is rigidly connected to a disk 52 carrying a pair of diametrically opposed pins 53 adapted to engage a safety switch 54 connected to the power source for the ram 14 to prevent the vertical movement of said ram when either one of the punches 28 or 30 is out of vertical alignment with the plane of the dies 18. An arm 56 parallel to the plane of the pins 53 is also mounted on the disk 52 and is rotatable therewith to engage a pair of spring-biased stops 58 mounted on supports 60 connected to the platform 38 at the rear thereof. The angle of movement of the arm 56 between the stops 58 is slightly less than 180° so that during rotation of the shaft 23 the arm 56 will hit one of the spring-cushioned stops 58 before the vane 47 hits a pin 49 to thus cushion the engagement of the vane against said pin, which engagement limits the rotation of said shaft through an angle of 180°.

In order to actuate the driving unit 40 for rotating the shaft 24 to dispose the proper punch in alignment with the dies 18, I provide an actuating system illustrated in FIG. 6 which comprises a normally open switch 62 mounted on the machine base 10. One side of the switch 62 is connected to an electric power source, and the other side of said switch is connected to the coil 64 of a relay 65, the opposite side of said coil 64 being connected to the grounded side of the power source. The relay shown in the drawings is manufactured by the Struthers Dunn Company, and is a normally open normally closed relay comprising a spring-biased armature 66 adapted to bear against and rotate a gear 68 mounted on a shaft 70 supported from the relay base. The shaft 70 also carries a cam gear 72 engageable by a finger 74 on a contact arm 75 connected to the power source ahead of the switch 62 and spring-biased toward a fixed contact 76 connected to one side of a solenoid 78. The opposite side of said solenoid is connected by a lead 80 to the grounded side of the power source.

The solenoid 78 is connected to a two-way center valve 81 for actuating the driving unit 40. The valve has an air inlet port 82 and a pair of outlet ports 84 and 85 which are opened and closed by a double headed piston 86 having a pair of longitudinally spaced heads 88 and 89 interconnected by a cylindrical web 90 and driven by the solenoid 78. The heads 88 and 89 and their interconnecting web 90 are provided with an exhaust passage 92 adapted to provide communication between the outlet port 84 and an exhaust port 94 and the outlet port 85 and a second exhaust port 95. As shown in FIG. 6, a pair of tubes 96 connect the valve outlet port 84 to the port 43 of the driving unit 40, and the valve outlet port 85 to the port 44. The piston 86 is spring biased by a coil spring 98 into a position to provide communication between valve inlet port 82 and the outlet port 84 when the solenoid 78 is de-energized, and to retain the piston in that position until the solenoid is energized. In this position, air will be moved out of the outlet port 84 and into the port 43 of the unit 40 to rotate the vane 47 in a clockwise direction as viewed in FIG. 6. During such rotation of the vane 47, the air in the unit 40 adjacent the port 44 will be exhausted through said port to the port 85 of the valve 80, thence through the exhaust passage 92 and out the valve exhaust port 95. Conversely, energization of the solenoid 78 drives the piston 86 to the left as viewed in FIG. 6 to place the valve inlet port 82 in communication with the outlet port 85 for driving the vane 47 in a counterclockwise direction, the air in the housing 42 adjacent the port 43 exhausting through the valve port 84 and exhaust port 94. The compressed air acting against the vane 47 also holds the desired punch in operative position until said vane is caused to rotate due to a change in the valve position 86 for changing the punch disposed in operative position.

The circuit shown in FIG. 6 is in position such that the relay 65 is in its normally open position with the solenoid 78 de-energized. To energize the solenoid for rotating the shaft 23 to change the punches, the switch 62 is closed energizing the relay coil 64 to move the armature 66 for rotating gears 68 and 72. As the cam gear 72 is rotated, the finger 74 under the spring tension of contact arm 75 will move into one of the cam gear recesses to close the switch at the contact 76 to thus complete the circuit to the solenoid 78 for forcing the valve piston 86 to the left as viewed in FIG. 6, for rotating the shaft 23 in the manner previously described. Because of the camming engagement of the contact arm finger 74 and cam gear 72, the circuit to the solenoid will remain closed until the normally open switch 62 is again closed when the relay 65, valve 81, and rotating unit will again resume their positions shown in FIG. 6.

In order to selectively control the closing of the switch 62 for actuation of the relay 65 to control the time and direction of rotation of the shaft 23, there is provided an indexing assembly as shown in FIG. 3. Such an assembly comprises an outwardly projecting arm 100 mounted on the ram 14 for movement therewith. The arm 100 upon each downward stroke of the ram 14 engages one of a plurality of annularly disposed rods 102 projecting upwardly from a circular indexing plate 104 mounted adjacent the lower end of a shaft 106 vertically slidable in a pair of brackets 108 and 109 mounted on the side of the housing for the machine. Thus, upon each downward stroke of the ram 14, the arm 100 will engage one of the rods 102 to move the shaft 106 and the indexing plate 104 downwardly. Pins 110 are mounted on the lower ends of rods 102 and project downwardly from the indexing plate 104, whereby downward movement of said indexing plate by the ram will cause one of the pins 110 to engage and close the switch 62 to effect a rotation of the shaft 23 in the manner previously described. Thus, where it is desired to change from one to the other of the punches 28 or 30 one of the pins 110 is mounted on its respective rod 102 for engagement with the switch 62 upon downward movement of the ram 14. When it is not desired to change from one punch to the other, the pin 110 will of course not be mounted on its respective rod 102. Conveniently, the rods 102 are merely set in

openings in the indexing plate 104 and the pins 110 extend upwardly through said openings and are threadably connected to the lower ends of said rods.

In order to provide the proper rotational sequence of the punches 28 and 30, it is necessary to rotate the indexing plate 104 after each of its downward movements to dispose the proper pin 110, or the lack of such pin, in alignment with the switch 62. To effect such rotation, a gear 112 is slidably mounted on the shaft 106 above the bracket 108. The gear is rotated to rotate the shaft by a link 114 having a pin 115 adjacent one of its ends engageable with said gear. The opposite end of the link 114 is pivotally connected to the ram of a hydraulic cylinder 117 operatively connected to the ram 14 so that during the return stroke of said ram 14 the ram of the cylinder 117 moves the link 114 outwardly toward the gear 112. As said link is moved toward the gear 112 it engages the teeth thereon to rotate said gear and thus the shaft 106 through an angle of rotation equal to the annular spacing between the rods 102 on indexing plate 104. To releasably lock the gear 112 and shaft 106 in position between the actuating strokes of the link 114, a lever 118 is mounted on the bracket 108. As shown in FIG. 5, a pin 119 on said lever is spring-biased into the spaces between the gear teeth for releasably locking the gear against rotation in a counterclockwise direction by means of a spring 121 connected to the lever 118 and the ram on the cylinder 117. A cam 122 is also carried on the shaft 106 and is provided with a pin 123 adapted to be received between the teeth on said gear. The pin 123 on said cam is releasably retained between the gear teeth by means of a coil spring 124 interposed between the upper face of the cam 122 and the lower face of a spring weighted pulley 125 rigidly mounted on the shaft 106, said spring moving the shaft upwardly after its downward movement by the arm 100.

In order to better explain the indexing sequence of the gear 112, assume that the indexing assembly is in the position shown in FIG. 6 and three bends are to be made in the length of pipe; a first bend formed by the punch 30, a second bend formed by the punch 28, and the third bend by the punch 30 again. To perform such an indexing sequence, the cam 122 is rotated on a shaft into the position illustrated in FIG. 5 so that the link pin 115 is free to engage notches A, B, and C in the gear 112 during its reciprocating movements by the cylinder 117. On the next stroke of the link pin toward the gear 112, after it has been received in the notch C, the pin 115 will engage the cam 122 which will swing said link pin away from the gear 112 into a notched finger 127 on the lever 118, thereby forcing the pin 119 out of engagement with the gear 112. The gear 112 is then rotated in a counterclockwise direction as viewed in FIG. 5 under the action of the spring weighted pulley 125 to rotate the gear 112 back into a position such that upon its next stroke toward said gear, the link pin will once again engage the gear notch A to begin a new indexing sequence. In the sequence just described, three of the pins 110 will be mounted on their respective rods 102 so that during this indexing sequence the normally open switch 62 in the control circuit will be closed three times. Of course, where more bends are to be formed in a pipe, the cam 122 will be rotated with respect to the gear 112 to expose a larger number of gear teeth to the action of the link pin 115; the number of such gear teeth corresponding to the number of bends to be formed in said pipe.

Thus, the entire operation of my turret punch may be briefly described as follows: The cam 122 is first oriented with respect to the gear 112 to dispose the desired number of teeth on the gear 112 in position for the reception of the link pin 115; the number of open teeth corresponding to the number of bends to be formed in the pipe. Likewise, a pin 110 is mounted on each of the rods 102 in the same number and sequence as are the number and sequence of the different radiuses of curvature bends to be

formed in the pipe. That is, a pin 110 is provided only where on the next downward stroke of the ram it is desired to produce a bend having a different radius of curvature than the bend formed on the previously downward stroke of the ram.

With these adjustments made, the machine is then placed in operation and the ram 14 is moved through its first downward stroke to produce the first bend in the pipe. During such downward stroke, the thrust is imparted from the ram and bearing block 22 to the pad 26, thence to the punch disposed in vertical alignment with the dies 18. Assuming that the next bend is to have a different radius of curvature, the downward stroke of the ram 14 carries the arm 100 against one of the rods 102 having a pin 110 mounted on its lower end so that said pin will close the limit switch 62. Closing of the limit switch 62 actuates the relay 65 whereby the solenoid 78 or the spring 98 will move the piston 86 in the valve 81 into a position opposed to what it was during the downward stroke of the ram. This reversing movement of the piston admits compressed air into the rotatable driving unit 40 for rotating the shaft 23 and pad 26 through an angle of 180° to dispose the other of the two punches in operative position for the next downward stroke of the ram 14. This rotational movement of the shaft 23 is limited by the arm 56 engaging one of the stops 58 and the vane 47 engaging one of the pins 49. The punches are retained in this position of orientation by the continuous air pressure on the rotatable driving unit 40 until another one of the pins 110 engages the switch 62 to cause a reverse rotation of the shaft 23 in the manner just described.

I claim as my invention:

1. In a turret punch for a pipe bending machine having a ram vertically movable with respect to a pair of pivotally mounted horizontally aligned dies, a sleeve rigidly mounted on said ram for movement therewith, a rotatable shaft carried in said sleeve and movable therewith, said shaft extending below said ram and sleeve and rigidly connected to a thrust pad carried against the lower faces of said ram and sleeve, a pair of arcuate punches mounted on said thrust pad and movable upon rotation of said shaft and pad to dispose one of said punches in vertical alignment with said dies, said punches having different radiuses of curvature for forming different radial bends along the axis of a pipe supported on the dies upon movement of said punches through the plane of the pipe, and means for selectively rotating said shaft to dispose the desired punch in alignment with said dies.

2. The invention as set forth in claim 1 with the addition that said means comprises a driving member mounted on a platform above said sleeve and having a driving shaft rigidly connected to the upper end of said rotatable shaft.

3. The invention as set forth in claim 2 with the addition that said driving member has means for limiting the rotation of the rotatable shaft through an angle of 180°, and a radially extending arm is mounted on said driving member for movement therewith, said arm being engageable with a pair of stops mounted on said platform for further limiting the rotation of said rotatable member through an angle of 180°.

4. The invention as set forth in claim 2 with the addition that a radially extending arm is mounted on said driving shaft for movement therewith, said arm being engageable with a pair of stops mounted on said platform for limiting the rotation of said rotatable shaft through an angle of 180°, and means rotatable with said driving shaft for actuating a switch controlling the downward strokes of the ram, whereby said ram is free to move downwardly only when the driving shaft has rotated said rotatable shaft into a position to dispose one of said punches in alignment with the dies.

5. The invention as set forth in claim 1 in which said means for rotating the shaft is actuated to rotate said shaft by switch means selectively open and closed by in-

dexing means mounted on said ram for movement therewith.

6. The invention as set forth in claim 1 in which said means for rotating the shaft comprises a pneumatically operated driving member connected to said shaft for rotating the same in clockwise and counterclockwise directions, and a two-way valve connected to said driving member whereby air admitted to said member from one discharge port on said valve will actuate said member to rotate said shaft in one direction and air admitted to said member from the other discharge port on said valve will actuate said member to rotate the shaft in an opposite direction.

7. The invention as set forth in claim 6 in which said valve has a piston movable to effect a closing of one of said discharge ports with a simultaneous opening of the other of said discharge ports, said piston being normally biased to open one of said discharge ports and being movable out of its normally biased position into a position to open the other of said discharge prts by a solenoid, and means for selectively energizing said solenoid.

8. In a turret punch for a pipe bending machine having a ram vertically movable with respect to a pair of pivotally mounted horizontally aligned dies, a sleeve rigidly mounted on said ram for movement therewith, a rotatable shaft carried in said sleeve and movable therewith, said shaft extending below said ram and sleeve and rigidly connected to a thrust pad carried against the lower faces of said ram and sleeve, a pair of arcuate punches mounted on said thrust pad and movable upon rotation of said shaft and pad to dispose one of said punches in vertical alignment with said dies, said punches having different radiuses of curvature for forming different radial bends along the axis of a pipe supported on the dies upon movement of said punches through the plane of the pipe, and a pneumatically operated driving member connected to said shaft for rotating said shaft to dispose the desired punch in alignment with said dies, said driving member being actuated to rotate the shaft in the desired direction by a solenoid actuated valve, said solenoid being selectively energized by indexing means operable upon each downward stroke of the ram to control the energization and de-energization of the solenoid.

9. The invention as set forth in claim 8 with the addition that said solenoid is connected to a power source and a relay switch, a normally open switch connected to said relay switch and power source whereby closing of said normally open switch will energize the relay switch to close the same for energizing the solenoid, and means on said relay switch for holding it closed until said normally open switch is closed again, said indexing means being operable to close said normally open switch.

10. The invention as set forth in claim 9 in which said indexing means is operable to close said normally open switch upon the downward strokes of the ram.

11. The invention as set forth in claim 9 in which said indexing means comprises a plurality of pins mounted on a vertically movable indexing plate, said pins being mounted on the plate in an annular predetermined pattern, and an arm movable with said ram for moving the indexing plate downwardly with the ram, and means for rotating and moving said indexing plate upwardly between each downward stroke of the ram whereby said pins will be selectively disposed in or out of position for engaging said normally open switch upon successive downward strokes of the ram.

12. In a turret punch for a pipe bending machine having a forwardly offset ram vertically movable with respect to a pair of pivotal horizontally aligned dies, a sleeve carried on said ram, a bearing block connected to said sleeve and rigidly mounted on said ram, a rotatable shaft carried in said sleeve with its ends projecting outwardly therefrom, a thrust pad rigidly connected to the lower end of said shaft and a thrust collar on the opposite end of said shaft adapted to retain said shaft in a fixed axial position with respect to said sleeve for disposing said thrust pad against the coplanar lower faces of said ram and bearing block, a pair of arcuate punches mounted on said thrust pad and movable upon rotation of said shaft and pad to dispose one of said punches in vertical alignment with said dies, said punches having different radiuses of curvature for forming different radial bends along the axis of a pipe supported on the dies upon movement of said punches through the plane of the pipe, and means for selectively rotating said shaft to dispose the desired punch in alignment with said dies.

13. The invention as set forth in claim 12 with the addition that said punches are mounted on the lower face of said thrust pad by a plurality of countersunk bolts disposed at equal radial distances from the axis of said rotatable shaft, and said bearing block is provided with a recess adapted to be disposed in alignment with each of said bolts to provide access to each of said bolts upon rotation of said thrust pad.

14. The invention as set form in claim 13 with the addition that said bolts are countersunk in tapped openings formed in the upper face of said thrust pad, the upper end of each of said openings having a plurality of radially extending recesses, and a T-shaped member received in each of said thrust pad openings for releasably locking the bolts therein, the shank of each of said members being lockingly received in the upper end of one of said bolts and the cross arms of said members being received in a pair of said radially extending recesses.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,021,886 February 20, 1962

Kenneth D. Ferris

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 20, for '"Rotac"' read -- ROTAC --;
column 4, line 30, for "position" read -- piston --;
column 7, line 18, after "biased" insert -- into a position --
line 20, for "prts" read -- ports --.

Signed and sealed this 7th day of August 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patent