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(54) Pipe bending machine with cantilevered bending head, with interchangeable multifunction tool, and being programmable by means of a computerized unit.

(57) Pipe bending machine including a bending head placed on an overhanging arm, a bending pulley with race, which is controlled by the final gear of a speed reducer powered by an electric motor, thus determining the pipe bending until 180° in cooperation with an engagement tooth installed on the pulley, and with an adjustable shoe pad, with a junction unit installed between the pulley and the speed reducer, thus consenting the quick interchangeability of the pulley and the connection, if any, with a complementary machine, and a computerized unit in order to have the operational programming of the above described machine.

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PIPE BENDING MACHINE WITH CANTILEVERED BENDING HEAD, WITH INTERCHANGEABLE MULTIFUNCTION TOOL, AND BEING PROGRAMMABLE BY MEANS OF A COMPUTERIZED UNIT

The instant invention has as its purpose a pipe bending machine with an interchangeable multifunction tool which is supported by a cantilevered bending head, thus being able to perform 180° bendings in all directions.

The aim of the invention is to create a machine of the above mentioned kind, being different from the existing machines for its greater versatility in use, for its more accurate performance and quickness in bending the pipes, with a wide range of pipes diameters, and being also able to produce bendings in all directions, up to 180°.

According to the instant invention, it is foreseen to have a pipe bending machine having a cantilevered bending head, wherein a race pulley is driven by an electric motor with speed reducer, and having also an engaging tooth which performs the bending of the pipe in cooperation with a pressure pad having an adjustable position, which can be read on a graduated scale with a vernier scale or even, alternately, in association with a reading element giving the exact position of the above mentioned pressure pad on a display being part of an unit being able to arrange the preogrammed performance of the whole operating cycle of the above mentioned machine.

Between the output gear of the speed reducer and the bending pulley there is a quick junction unit installed, consenting the interchangeability of the pulley and eventually the connection of a complementary machine, such as a punching press,a cambering machine, or another tool machine.

Always in accordance with the invention, the above mentioned quick junction system includes also a hexagonal rod, on which the bending pulley is set up in an interchangeable manner, a bar or diametral key carried by a boss being integral with the above mentioned hexagonal rod, a way for the above mentioned diametral bar, being opened in a keg forming an unitary part with the speed reducer's output gear, and four anti-withdrawal screws, whose purpose is to fasten the boss and the hexagonal bar on the above mentioned keg; the shearing and torsional stresses coming from the gear are absorbed by the above mentioned diametral bar.

The race pulley is part of a series including several diameters, and is set up the diametral pin, and is kept in position by a cap, being in turn secured by an axial screw.

There is also a computerized programming system with cards, controlling the whole operating cycle of the machine.

The invention shall be described now with reference to the attached drawings, which do represent, as an example without limitation, a preferred form of carrying out the invention.

In the drawings:

- the figure 1 is a schematic prospect view of the basic version of the machine, with the pipe bending pulley and the contrast pad in an exploded view.
- the figure 2 is a partial view of the machine according to the figure 1, seen from the front side and in a larger scale.
- the figure 3 is the plan corresponding to the figure 2.
- the figure 4 is a cross section view of the output gear of the speed reducer and of the pipes bending pulley.
- the figure 5 is an exploded view of the interchangeable joint system of the pulley tool.
- the figure 6 shows a pipe bending tool for small diameter pipes.
- the figure 7 shows a variancy for the machine according to the figure 1, being equipped with a computerized programming unit.
- the figures 8 and 9 show the details marked by A and B in the figure 7.

With reference to the figures 1 to 3, the number 1 indicates as a whole the pipe bending machine, having inside a series of speed reducing gears 2 being powered by the motor 3. The inside members of the machine are not described in detail, since they are not included in the instant invention, and are protected by another patent issued to the same applicant firm.

The final gear 4 of the speed reducing unit, revolving around the pivot H, is connected with a race pulley 5 having the bending tooth 6 and a marginal notch 7.

On the floor 8 of the machine there is the sliding shoe 9 installed on the threaded shaft 10 being turned by the crank 11. The above mentioned shoe 9 has a pivot 12 on which the jaw 13 having the pad 14 is installed; the pad 14 is interchangeable by means of the dovetail coupling 15, or another suitable system.

In the form of the machine being shown in the figure 1, the position of the pad 14 may be controlled through the graduatad scale 30 which has also a vernier scale.

The operating way is as follows: the pipe to be bent, indicated by 16, is placed between the bending pulley 5 and the pad 14, which can be placed nearer or farther to or from the pulley 5 by means of the crank 11.

The threaded shaft 10 and the crank 11 can be associated with a positions reading unit, as one can better see in the following.

The race pulley 5, with its engagement tooth 6, turning in the sense shown by the arrows of the figure 3, forces the pipe to be bent around the pulley, until

the desiderd bending is obtained; this bending can reach 180°, as one may see in the figure 3 on the short dashes lines. The marginal notch 7 being made on the edge of the pulley 5 serves to make the taking of the pipe easier when the bending operation is finished.

In order to be able to perform the bendings in all directions, with a special consideration for those giving the orientation down from above of the already bent pipe lengths (figures 2 and 3) the bending head including the pulley 5 and the drive gear 4 of the pulley 5 and the drive gear 4 of the same pulley are placed in a bracket 17 made on the lengthened area of the floor 8, and protruding on the side with reference to the machine body.

The bending pulley 5 must be replaced in accordance with some well determined sizes of bending pipes diameters; in order to be able to fulfil this operation in a quick and easy way, the invention includes the interchangeability and quick connection system as shown in detail in the figures 4 and 5.

The pulley 8 has an hexagonal hole 18 wherein one may introduce a pivot 19, with hexagonal cross section, being integral with the boss 20 carrying the diametral bar 21 and the axial round pivot 22. The details 19, 20, 21 and 22, as it appears clearly from the figure 5, form an unitary body. The final gear of the speed reducer, in turn, carries integral a barrel 23 whereinside they did carve the seat 24 for the diametral bar 21, and the axial cylindric hole 25 for the pivot 22. The four screws 26 are there only to hold together the boss 20 and the barrel 23, since the shearing stress and the torsional stress (not to be absorbed by the screws 26) are entirely supported by the diametral bar 21.

In order to replace the pulley 5 (figure 4) it is sufficient to unscrew the axial screw 27 holding the pulley by means of the cap 28.

In the cases of small diameter pipes with reduced bending radiuses, beyond the axial screw 27 and the cap 28, one must unscrew the four screws 26 and, by means of the above mentioned screws, one shall install the tool of the figure 6, having instead of the hexagonal pivot 19 a groove pivot 29.

One must remark that the hexagonal pivot 19, once the race pulley 5 has been disassembled, may be used as a power takeoff for another complementary operating machine. The hexagonal pivot 19, in turn, may be replaced by another power takeoff, such as for instance a gear intended to power the rolls of a plate bending machine, or the rack of a punching machine, or whatever other usable machine.

In the figures 7, 8 and 9 there is an amendment to the machine shown in the figure 1 being able to operate automatically with a computerized programming.

In the version shown according to the figure 7, wherein the same reference numbers indicate the already described parts, there is a supporting and guiding unit for the pipe 16 to be bent, serving to support the pipe without needing a man for this task.

This unit includes a block 31 sliding on the guides 32, parallel to the sides of the machine, and having an arm 34 with an articulated joint 35, thus being able to turn around a vertical axis. On the arm 34 the rolling supports 36 can slide;they can be locked with the clamps 37. In parallel position referring to the arm 34 there is a stick 38 being hold in the supports 36 and having a series of reference stops 39 sliding on the stick, which can be locked by means of the butterfly holds 40. The reference stops 39 are adjusted in accordance with the different curved to be carried out on the pipe 16. The latter, in its movement to the bending pulley 5, slides on the rolls 36, whereas the articulated arm 34, in turn, can be moved "in feathering" around the pivot 35 in order to perform the direction changes of the pipe.

The machine is provided with a feedingp electric panel 41, and is under control by the pedal keyboard 42 with two pedals, to give the controls "ahead" and "backward" to the race pulley 5.

All the operation cycle of the machine can be programmed with a computerized card. The exact position of the pad 14 (see also the figures 8 and 9) is shown every moment on the warning panel 43, being protected by the overturning transparent door 44.

The above mentioned door 43 has many digital displays indicating all the data concerning the program being performed. In this case, the turning of the threaded shaft 10 is controlled by a direct current small motor 45, which by means of the toothed belt 46 causes the turning of the above mentioned shaft. The angular turning of the threaded shaft 10 and therefore the position of the pad 14 is read by a reading element 51 in cooperation with the surveying star 52, with contemporary mention and showing on the panel 43 in an extremely exact way, say one-tenth of a mm. It is clear that, in this case, the scale 30 and the relevant vernier according to the figure 1, are of no use.

The crank 11 is of alternate use instead of the motor 45, however one must keep in mind that, if the hand movement of the pad 14 by means of the above mentioned crank is not in agreement with the previously established program, the machine is stopped because the computerized unit does not give its consent to start the motor 3.

Also the angular position of the raced pulley 5 in its turning around the H axis is controlled by a position reading device, not being shown in the figure because it is very similar to the one of the figure 9. Also this angular position is programmable on the panel 43, according to the sequence of bends to be made on the pipe 16, and is shown in a bidirectional manner by the relevant display on the panel 43.

Near to the readout panel 43 there are the programming pushbuttons 47 (ahead, astern and program changing), the emergency pushbutton 48 stopping at

once the machine, and finally the pushbutton 49 to control the speed gear of the motor 3 powering the pipes bending pulley 5. Over the distribution board 41 there is the connection for the small cable 50 of the control pedal switchboard 42.

The operation of this version of the machine is completely the same as the one already described before.

The instant invention has been described and illustrated with reference to two preferred forms of realization, but it is clearly understood that some modifications and/or constructional amendments in practice can be made by an expert of the branch, without anyway coming out from the protection area of the invention.

Claims

1).- Pipe bending machine of the type making use of a speed reducing unit powered by an electric motor, and a race pulley whose movement is controlled by the above mentioned speed reducing unit, and cooperating with a contrast shoe, characterized by the fact to hare means for the quick interchangeability of the above mentioned pulley, and a computerized unit, for programming the whole operational cycle of the machine.

2).- Machine according to the Claim 1, characterized by the fact, that the above mentioned interchangeability means are consisting of a hexagonal pivot, being integral with the output gear of the speed reducer, said pivot being introduced into a corresponding seat whose hollow space has been carved in the race pulley.

3).- Machine according to the Claims 1 and 2, characterized by the fact that the above mentioned hexagonal pivot is integral with a boss bearing a key or diametral bar put at the base, which is put into a corresponding seating being made in the upper face of a barrel made at the top of the above mentioned gear unit.

4).- Machine according to the claims from 1 to 3, characterized by the fact that the above mentioned boss is fastened to the barrel by means of through screws, having the only purpose to avoid that both parts may be separated, since the shearing and torsional stresses given by the gear to the pulley are entirely absorbed by the above mentioned diametral bar.

5).- Machine according to the claims from 1 to 4, characterized by the fact that the fastening of the pulley on the hexagonal pivot is obtained by means of an axial screw, in cooperation with a cap being interposed between both elements.

6).- Machine in accordance with the claims from 1 to 5, characterized by the fact that the unit consisting of the gear system, of the interchangeable joint, and of the bending pulley are installed on a projecting bracket, overhanging on one side over the machine's body, such as it becomes possible to bend the pipe to every direction, and particularly to the floor, thus reaching an angular value of 180°.

7).- Machine in accordance with the claims from 1 to 6, characterized by the fact, that in order to bend the small diameter pipes, there is a race pivot directly installed on the diametral bar boss, with an engagement tooth.

8).- Machine in accordance with the claims from 1 to 7, characterized by the fact, that the hexagonal pivot, the boss and the diametral bar together do form an unitary block, together with a centering pivot placed directly under the boss, to be inserted into a coaxial hole, made in the gear.

9).- Machine in accordance with the claims from 1 to 8, characterized by the fact, that the hexagonal pivot may be used as a power takeoff to drive a complementary operating machine, such as a plate bending machine, a punching machine, or another acceptable machine.

10).- Machine in accordance with the claims from 1 to 9, characterized by the fact, that the contrast pad is installed on a threaded shaft, being placed into a turning movement by a crank, or provided with an arrow running on a graduated scale being provided with a vernier.

11).- Machine in accordance with the claims from 1 to 10, characterized by the fact, that the turning of the threaded shaft is controlled by a direct current small motor, being operatively associated with the computerized programming unit,by means of a reading element in association with a star detector integral with the above mentioned shaft, which detector exactly indicates the bi-directional displacement of the pad, by showing it on a readout panel with a digital display, or another representation system.

12).- Machine in accordance with the claims from 1 to 11, characterized by the fact, that the whole operational sequence of the machine is programmed on a suitable card, and the different program forwarding steps are given and shown on the above mentioned panel.

13).- Machine in accordance with the claims from 1 to 12, characterized by the fact, that the pipe upstream of the bending pulley and of the relevant contrast pad, rests on rolling supports being brought by an articulated arm which is provided with a number of reference points.

14).- Pipe bending machine with an overhanging bending head, with a multifunctional interchangeable tool, all programmable by means of a computerized unit, in accordance with the claims from 1 to 13, substantially as described and as illustrated in the attached drawings.

FIG. 2

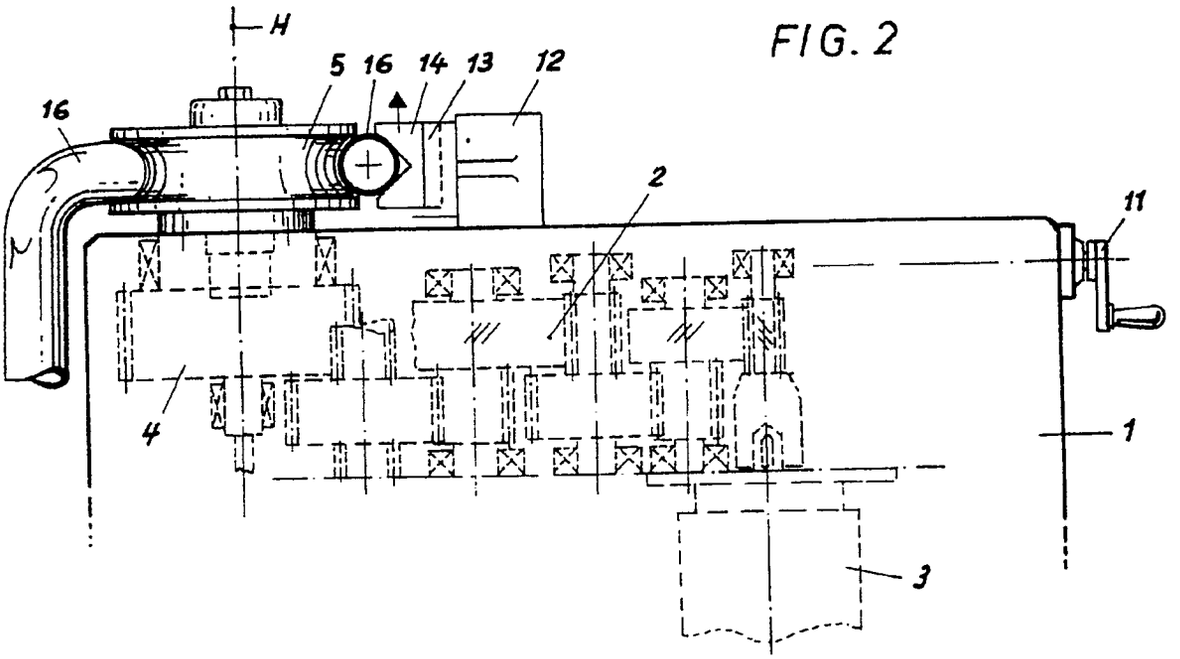
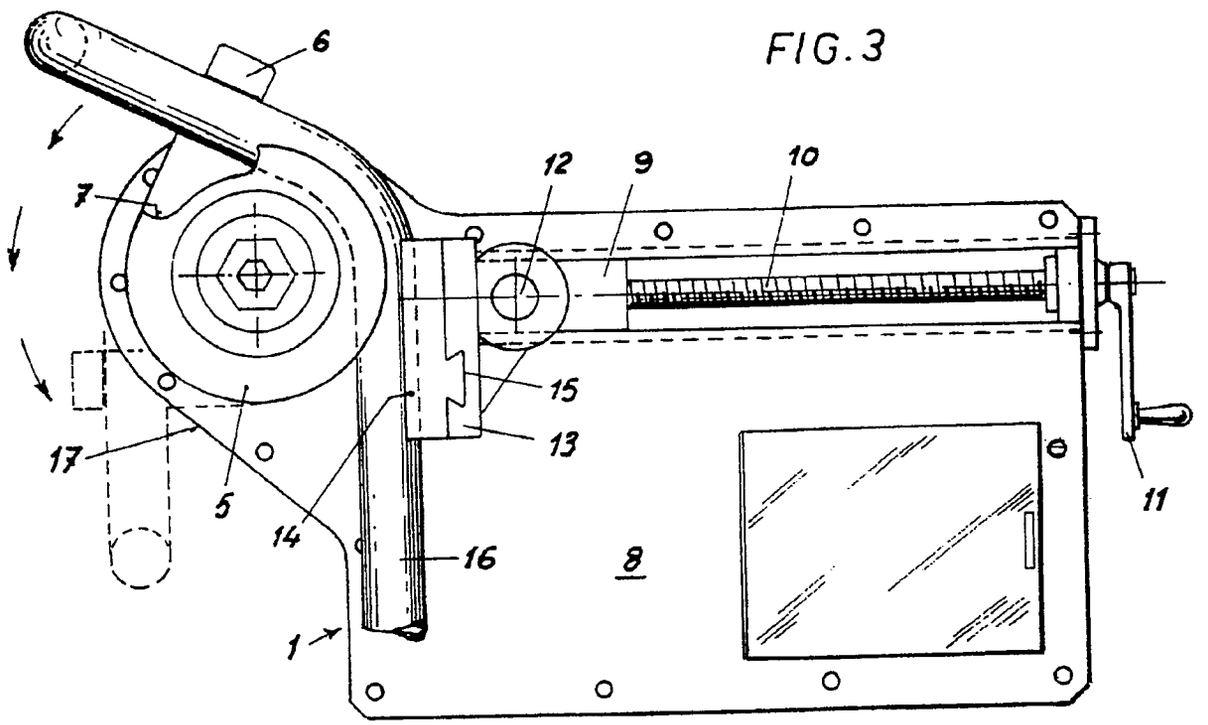


FIG. 3



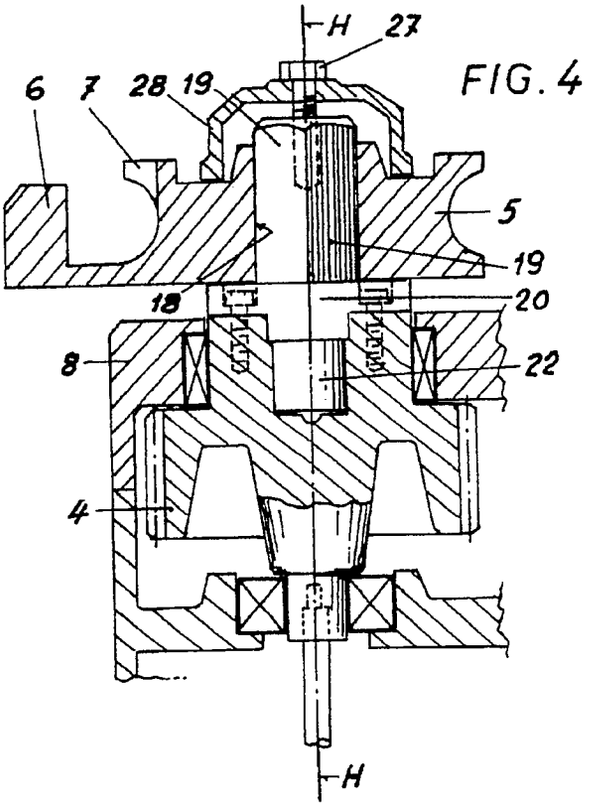


FIG. 4

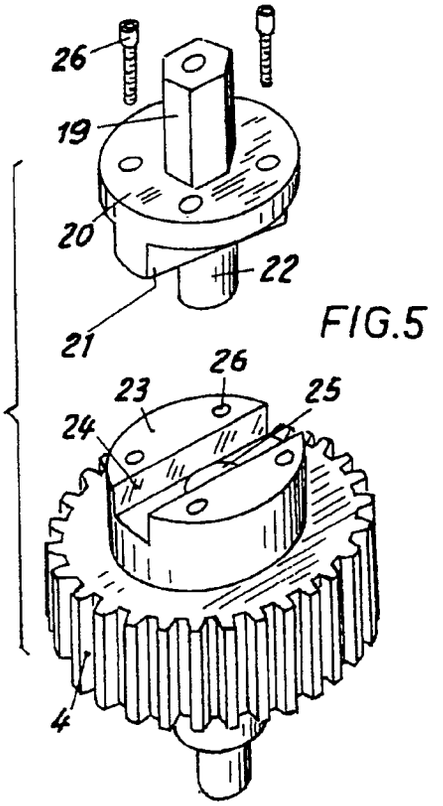


FIG.5

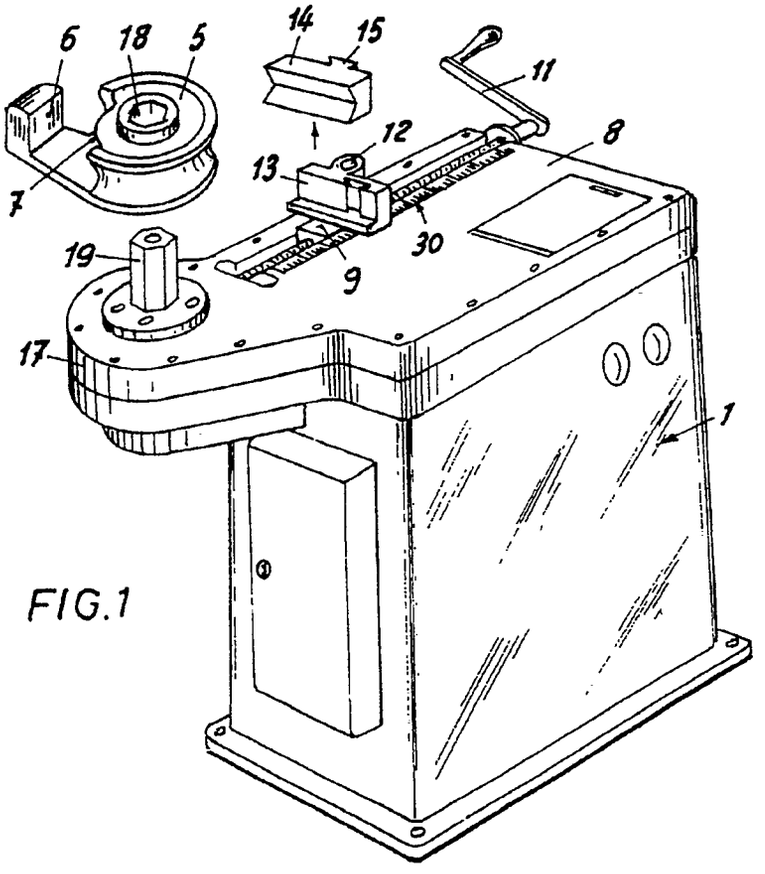


FIG.1

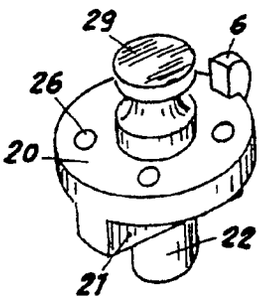
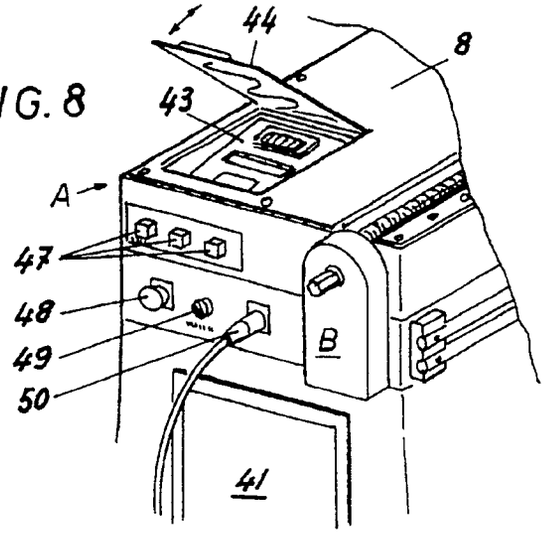


FIG.6

FIG. 8



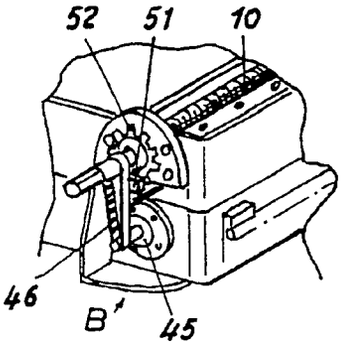


FIG 9

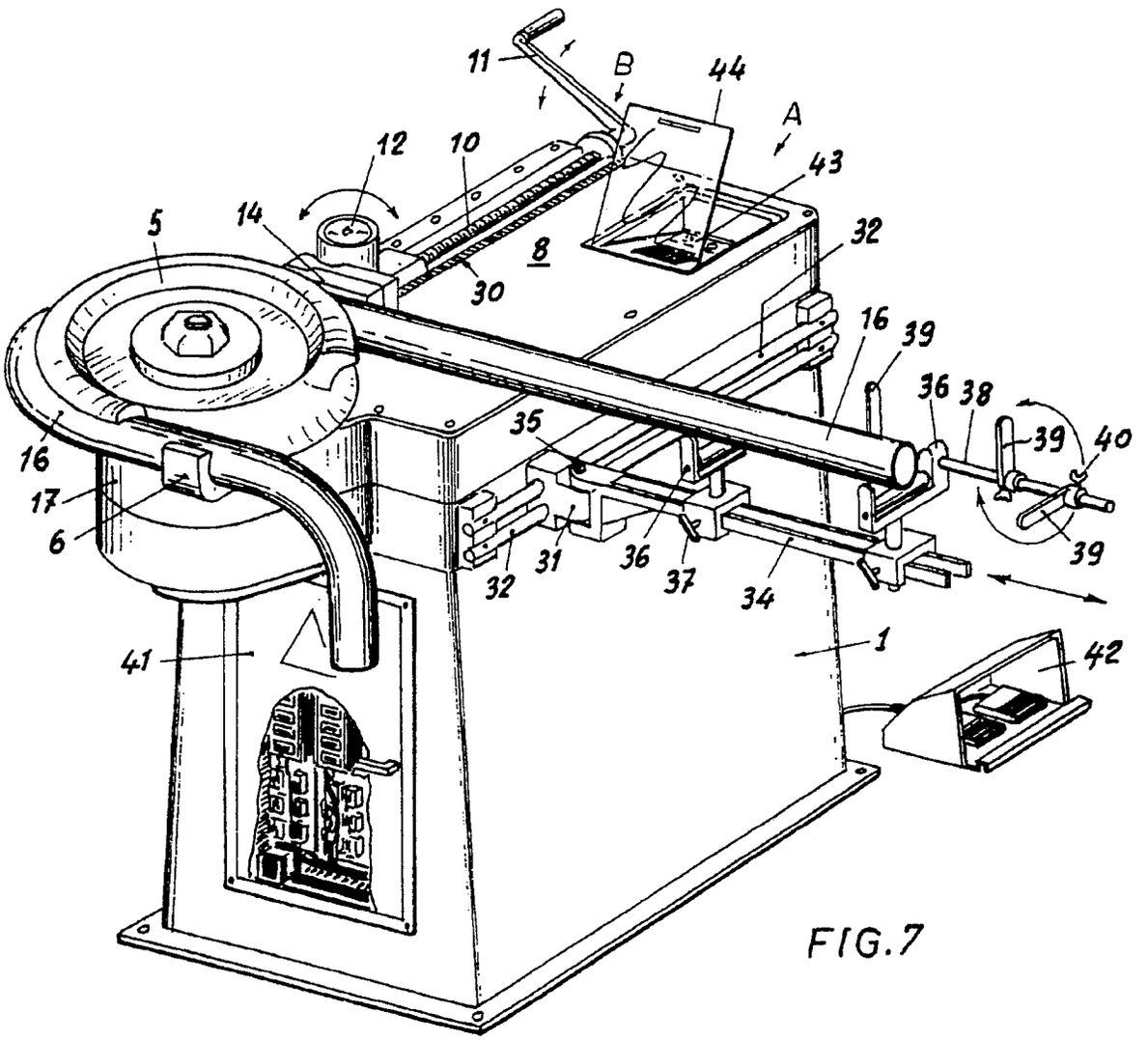


FIG.7