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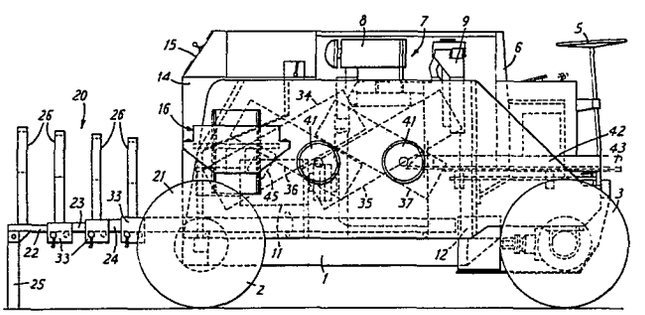
(54) Mobile machine for straightening tubes.

(57) A mobile scaffold straightening machine comprising a chassis 1 and four road wheels 2, 3. A prime mover 7 is mounted on the chassis and drives a hydraulic pump 11. Fluid from the pump can be directed via a hydraulic circuit to a plurality of hydraulic drive motors for driving respective rollers 34-37 through which scaffold or similar tubes may be fed for straightening. The straightening rollers are waisted and their axes are inclined to the path of the tube being bent in such a manner that the line of contact of the tube is a tangent to the centre of the curved surface of each roller.



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"Machine for Straightening Tubes"

This invention relates to a machine for straightening tubes, particularly scaffold tubes.

When scaffolding is erected, the various tubes are connected together by clamps. Invariably the clamps are overtightened, which causes the tubes to become bent. When the scaffolding is dismantled, it is necessary for the tubes to be straightened before they can be re-used. Currently this is an operation which is carried out by means of large fixed machines at the depot of the scaffolding supplier. No machine currently available is sufficiently small or portable enough to be used on site.

The invention provides such a machine.

According to the invention there is provided a tube straightening machine comprising a chassis and, mounted on said chassis a prime mover, a hydraulic pump driven by said prime mover, a plurality of rollers through which tubes may be fed for straightening, one or more hydraulic motors for driving said rollers to rotate about their longitudinal axis to draw tubes through during bending and hydraulic circuit means connecting said pump with the or each hydraulic motor, said hydraulic circuit means incorporating means for controlling the operation of said hydraulic motor or motors.

In a preferred mobile version of the machine, the chassis is supported by four road wheels. The two rear wheels may be mounted on a rigid axle, and the two front wheels steerable on a driven axle. In an alternative, two of the wheels are driven, the

the other two steerable. The chassis may alternatively be supported on a fixed base or legs, or the machine may be made semi-portable by supporting the chassis on skids. A prime mover is mounted on the chassis and drives a hydraulic pump. The prime mover may for example be a petrol or diesel engine, or an electric motor. Fluid from the pump can be directed to a hydraulic drive motor for driving a plurality of rollers through which the tubes are fed for straightening. These straightening rollers are waisted, and their respective axes are inclined to the path of the tube being bent in such a manner that the line of contact of the tube is a tangent to the centre of the curved surface of each roller. Preferably, each roller is driven by its own individual hydraulic drive motor, thus providing a power feed for the tubes as well as straightening them. The rollers are arranged on opposite sides of the path of the tubes - for example two on each side. The roller or rollers on one side of the path may be mounted on a sub-frame which can be moved laterally with respect to the path of the tube clamped in position to apply pressure to the tube and in order to take up any wear in the rollers. In order to accommodate different diameters of tube the roller or rollers may be pivoted about their axis as will be explained in more detail later.

At the out-feed end of the machine is preferably fitted an extensible feed-out trough lined with resilient material such as plastics and

into which the straightened tube runs after passing through the straightening rollers.

Preferably the hydraulic pump is also operable to supply fluid to a drive motor for the road wheels.

In order that the invention may be better understood, an embodiment thereof will now be described by way of example only and with reference to the accompanying drawings in which:-

Figure 1 is a side view of a mobile tube straightening machine in accordance with the invention;

Figure 2 is a plan view of the machine of Figure 1;

Figure 3 is an enlarged detail of part of Figure 2;

Figure 4 is a perspective view of one of the feed-in guides used in the machine of Figures 1 and 2;

and

Figures 5A, B, C is one embodiment of a diagram hydraulic circuit for use in the machine of Figures 1 to 4.

Referring firstly to Figures 1 and 2, the machine comprises a chassis 2 and four road wheels 2, 3. The rear wheels 2 are mounted on a rigid axle 4 and the front wheels 3 are steerable by means of a steering wheel 5 mounted in front of a driver's seat 6. Mounted on the chassis is a

prime mover in the form of an internal combustion engine 7 having an air filter 8 and a radiator 9. The output shaft of the engine is coupled via a flexible coupling 10 to a hydraulic pump 11, which is preferably of the variable-displacement type - see later. Fluid from the pump is selectively passed to a hydraulic motor 12 which drives the front wheels 3 and to a plurality of roller drive motors 13 (Figure 3), to be referred to later. An oil tank 14 acts as a reservoir for the hydraulic circuit, and operation of the machine is controlled from a control panel 15.

Mounted to one side of the machine is a hydraulically-operated pipe straightener 16 which may optionally be used as a pre-straightener for particularly badly bent tubes. The device is known per se and will therefore not be described in detail. Tubes to be pre-straightened are fed in from left to right in Figures 1 and 2 in the approximate line of the arrow A in Figure 2. The tubes are passed between rollers 17 and a curved anvil 18 which is moveable horizontally under power from a hydraulic ram 19.

After the pre-straightening operation tubes to be straightened are introduced into the machine at the left-hand end in Figures 1 and 2 along a path coincident with the centre line of the machine. Tubes enter a telescopic feed-in unit 20 which comprises a support bar 21

having at its outer end three telescopic sections 22, 23 and 24 of smaller size. The outermost section 22 carries a leg 25 which may be folded down to a support position, shown in Figure 1 to support the feed-in unit on the ground. Each section of the feed-in unit, as well as the bar 21 carries a respective feed-in guide 26 which takes the form shown in Figure 4. Each guide 26 comprises a base 27 which is attached to the respective section of the support bar 21 and on which is mounted a framework made up of steel angle 28 and steel channel 29 which carries an insert 30 made of high density polyethylene. The insert 30 is equipped with an aperture 31 through which pipe to be straightened is passed. It will be seen from Figure 4 that the neck of the aperture is misplaced. This is to contain the tube which otherwise has a tendency to jump out due to its rotation once it enters the machine. The inserts 26 are positioned such that their respective apertures 31 fall as the machine is approached, this feature assisting the introduction of bent pipe into the machine along the correct axis.

When the machine is being moved from place to place, the feed-in unit is retracted from the operative position shown in Figures 1 and 2 to an inoperative position in which the innermost feed-in guide 26 abuts against a vertical plate 32. The feed-in unit may be clamped in its operative position by means of cam locks 33.

The tube to be straightened is passed into the central part of the machine by being placed into the feed-in guides 26 and pushed into the machine to the first, 34, of four straightening rollers 34 to 37. The height

of the tube as it enters the machine is set by a centre balance block 70 which is pivotted by a single pivot 71 to pivot in its own plane. The block 70 is made of high density polyethylene and its top surface supports the tube as it enters the machine. The height of this top surface may be adjusted by means of a spring (not shown) acting upwards on the opposite side of the block to the tube and a corresponding set screw (also not shown) acting downwards against the spring bias.

After passing a kick plate 44, the tube comes against the roller 34. In order to initiate positive drive of the tube through the machine, it is now necessary to actuate by hand a safety roller 45. The safety roller is essentially an idler roller which is positioned opposite the roller 34 and which can be pressed towards the roller 34 by means of a hydraulic ram to thereby nip the tube between itself and roller 34 so that the tube is drawn forwards into the machine. Once the roller 45 has been actuated, the tube passes fully into the four straightening rollers: roller 34 mentioned above, and the three following rollers referenced 35, 36 and 37. The arrangement of the straightening rollers is shown in detail in Figure 3. Each roller is driven by its own individual hydraulic motor 13, so that the roller assembly acts not only to straighten the tubes, but also to drive them through the machine. The rollers are individually mounted in respective pairs of bearing blocks 38. As seen clearly in Figure 1, the rollers are inclined to the horizontal, the angle of inclination being adjustable to cope with tubes of different diameter. Further, the rollers are waisted in such a way that the line of contact of a

tube 39 passing through is a horizontal tangent to the centre of the curved surface of each roller. The angle of inclination of the rollers is set such that the locus of the points of contact of the curved surface of each roller against the tube is such as to define a part helix around the tube. Provided the curved face of the rollers adopt this attitude with respect to the tube, the diameter, curvature and angular setting of the rollers can be varied in relation to tubes of varying diameters. Furthermore, it follows that, if the tube is presented in any other place, provided the centre of the curved surface of the rollers contacts the tube in the given plane, the angle of the rollers can be set to obtain the part-helical contact.

The rollers 36, 37 on one side of the tube 39 are mounted on a plate 40 which is moveable laterally by means of hand wheels 41 to adjust the distance between the rollers in order to apply pressure during straightening. Once the rollers have been adjusted correctly, the hand wheels can be clamped.

Optionally, the roller 36 may be provided with a steel die 73 which fits into a slot formed in its outer surface as shown. The bottom of this slot communicates with an aperture which extends diametrically across to the opposite surface of the roller and houses a bolt (not shown) which screws into a threaded blind bore in the back of the die to removably secure the die in the slot. The die may have a suitable trade logo or other symbol in order to mark the tube passing through. If marking is not required, the die may be

replaced by an insert which, when bolted in place, simply fills in the die slot so that the outer surface of the roller is continuous.

After passing through the straightening rollers, the tube passes onto a V-section feed-out trough 42 which is lined with plastics material. The trough 42 may be adjusted both in height and angle to cope with different circumstances, and is equipped with an automatic discharge arrangement. One example of a suitable closed circuit system for the machine will now be described with reference to Figure 5.

Referring to Figure 5, it will be seen that the principal components of the hydraulic circuit have been given the same reference numerals as those used in earlier Figures. The main pump 11 is a variable swashplate type and includes an integral boost pump 11a and two auxilliary gear pumps 11b and 11c. The pumps 11a, 11b and 11c draw fluid from the 45 gallon oil storage tank 14. A suction filter 51 is provided in the line to boost pump 11a. The main output lines from the pump 11 are indicated under references 55 and 56. Line 57 is a control line, as will be explained below.

The selection of roller or axle drive is made by valves 52 and 53 which are mechanically inter-linked so that they cannot both be selected at the same time. Valves 52 and 53 are also mechanically inter-linked with control valves 54 and 58 which take fluid under control pressure from line

57. Control valve 54 in turn controls pump control valves 59 and 60 in such a way that, when the roller drive is connected, the valve 59 is inoperative while the valve 60 is operative and, when the road wheel drive is connected, the valve 59 is operative while the valve 60 is inoperative. The valve 59 is the forward/neutral/reverse selector for the road wheel drive; the valve 60 provides infinitely variable control of the speed of rotation of the rollers from 0 to 183 R.P.M., forward or reverse. The axle drive speed is controlled directly by a foot throttle control on the prime mover (not shown). The control valve 58 applies pressure to wheel brake cylinders to lock the road wheels when the roller drive is connected.

When roller drive is selected, oil is diverted along line 62 into a rotary flow divider 61 which splits the flow equally into four and thence into the individual roller drive motors 13. The flow divider 61 acts to prevent freewheeling of the unloaded rollers as a tube is inserted since this would otherwise lead to loss of traction of the infeed rollers. The oil returns to the valve 52 via a line 64. Relief valve 63 protects the motors 13 from pressure intensification by the flow divider.

When axle drive is selected, oil is directed along line 65 to a pair of axle drive motors 12 (one for each wheel) via a motion control and lock valve 66. The valve 66 is controlled by fluid along line 67 and acts to prevent vehicle runaway on slopes by providing a measure of hydrostatic braking. The

valve 66 also acts to provide differential wheel motion, thus eliminating the necessity for a mechanical differential.

The safety roller 45 and steering are both driven by the pump section 11c which takes oil direct from the storage tank 14 via pressure filter 73. The safety roller ram 45 is selected by valve 68 and protected by pressure relief valve 72. The right-hand end of the safety roller cylinder 45 is supplied with a constant low pressure pilot supply derived from control line 57, while the left-hand (piston) end of the cylinder is fed with line pressure via valve 68. The steering mechanism comprises an hydraulic steering valve 69 and cylinder 70 which acts on the wheel steering mechanism. The steering valve 69 receives oil through a priority valve 71 and incorporates a blocked port arrangement to prevent steering deviation.

The hydraulic ram 19, forming part of the pre-straightener 16 is driven by pump section 11b, taking oil from tank 14 via a pressure filter 74. The ram 19 is activated by valve 75 and, in operation, cycles backwards and forwards due to the cyclic action of valves 76 and 77.

A valve 78 in the main pump circuit acts to divert oil from the main flow to flush the pump casing via line 79 to act as a pump coolant. After cooling the pump, the oil passes through the oil cooler unit on the prime mover, shown under reference 80, together with leakage oil from the roller motors 13.

A valve 81 across the main pump lines to the road wheel motors enables the wheel drive circuit to be vented so that the vehicle may be towed in the event of mechanical failure.

CLAIMS

1. A tube straightening machine comprising a chassis and, mounted on said chassis:

a prime mover;

a hydraulic pump driven by said prime mover;

a plurality of rollers through which tubes may be fed for straightening;

one or more hydraulic motors for driving said rollers to rotate about their longitudinal axis to draw tubes through during bending;

and

hydraulic circuit means connecting said pump with the or each hydraulic motor, said hydraulic circuit means incorporating means for controlling the operation of said hydraulic motor or motors.

2. A machine as claimed in claim 1 wherein each straightening roller takes the form of an elongated cylinder which is mounted in such a way that its axis of rotation is inclined with respect to the path of the tubes through the machine.

3. A machine as claimed in claim 2 including means for adjusting the angle of inclination of the rollers in order to take account of different diameters of tube.

4. A machine as claimed in claim 2 wherein each roller has an outer surface which is shaped in such a way that the line of contact of a tube passing through is a tangent to the centre of the curved outer surface.

5. A machine as claimed in any one of the preceding claims wherein each straightening roller is

driven by its own hydraulic motor.

6. A machine as claimed in any one of claims 1, 2 or 4 wherein respective rollers are arranged on opposite sides of the path of the tube through the machine.

7. A machine as claimed in claim 8 wherein the roller or rollers on one side of the tube path are adjustable towards and away from the roller or rollers on the other side of the tube path.

8. A machine as claimed in any one of the preceding claims wherein said chassis is supported on four road wheels, to make the machine mobile.

9. A machine as claimed in claim 8 further comprising at least one hydraulic drive motor for driving one or more of the road wheels to propel the vehicle along the ground, and hydraulic circuit means connecting said pump with the or each hydraulic drive motor.

10. A machine as claimed in claim 9 wherein said hydraulic circuit includes valve means whereby hydraulic fluid may be passed either from said pump to said hydraulic motor or motors, or from said pump to said hydraulic drive motor or motors, but not both.

11. A machine as claimed in any one of the preceding claims wherein, at an input end of the machine, there is provided an infeed mechanism whereby tubes to be straightened are correctly guided into the machine.

12. A machine as claimed in claim 11 wherein said infeed mechanism comprises a support arm attached

at one end to the chassis and extending substantially horizontally in a direction approximately parallel to the path of the tube through the machine, and a plurality of feed-in guides supported on said arm, each guide having an open-sided aperture therein whose axis is approximately in line of the intended path of tube through the machine.

13. A machine as claimed in claim 12 wherein the height of said apertures, as between individual feed-in guides, falls in a direction towards the machine.

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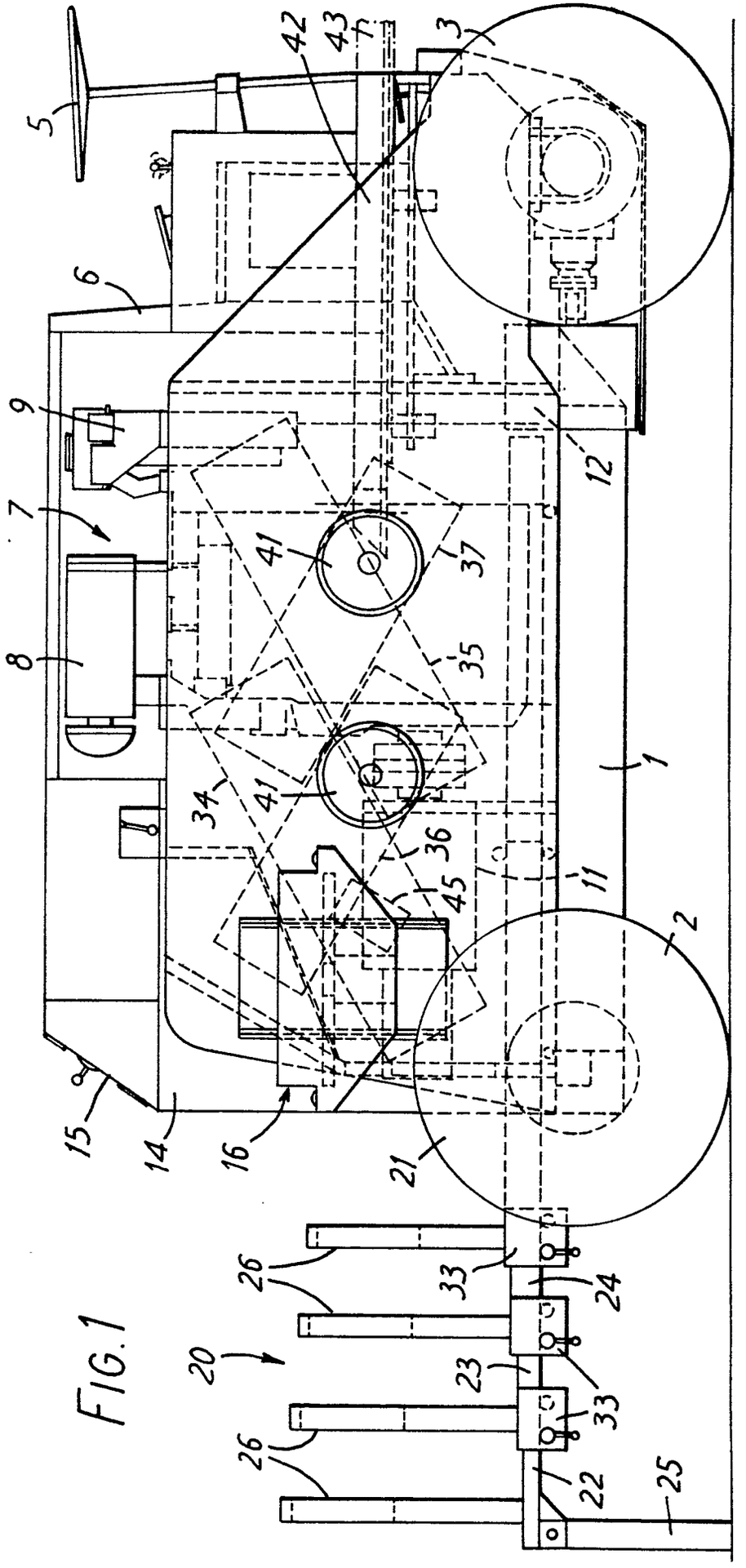

FIG.1

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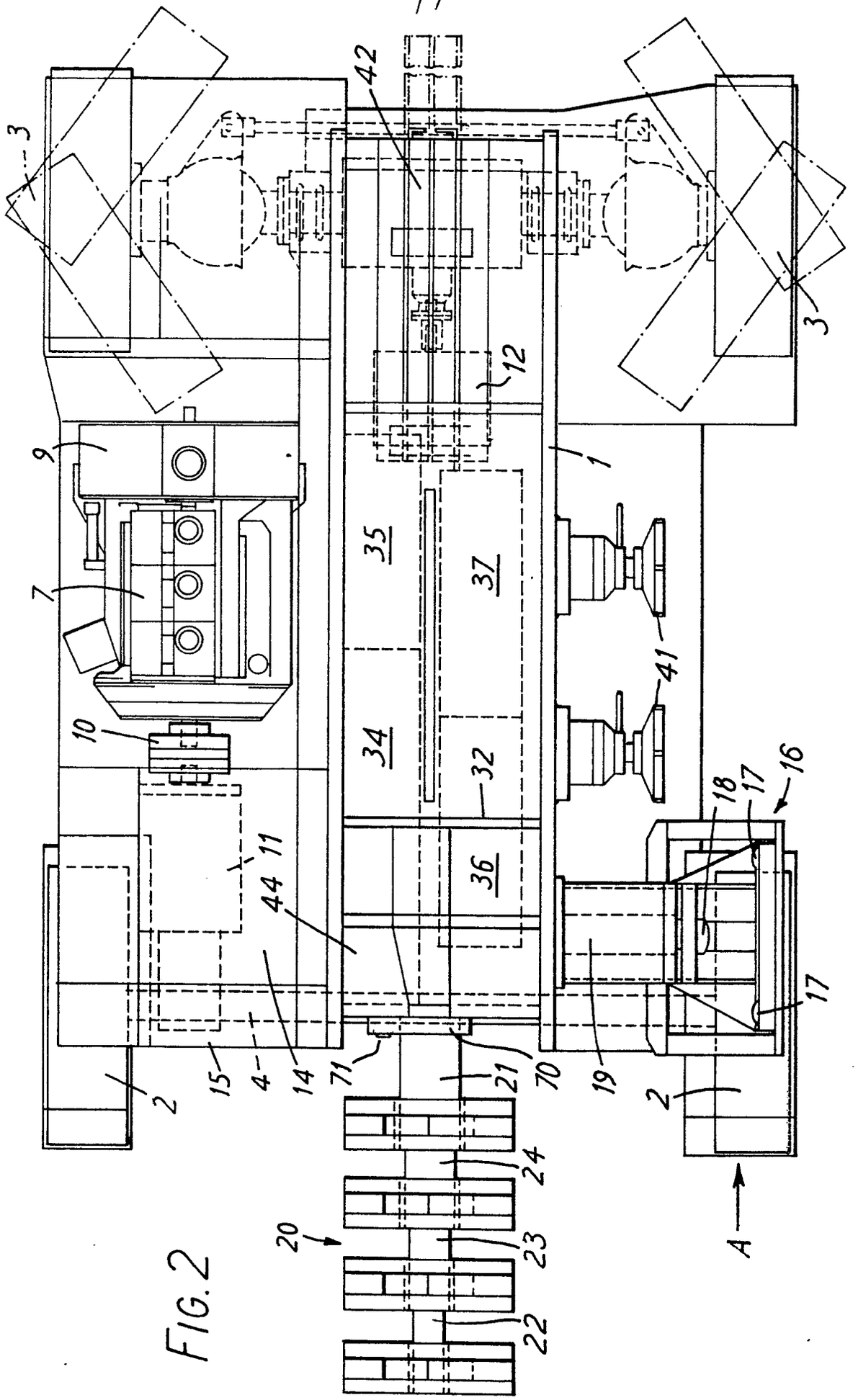

FIG. 2

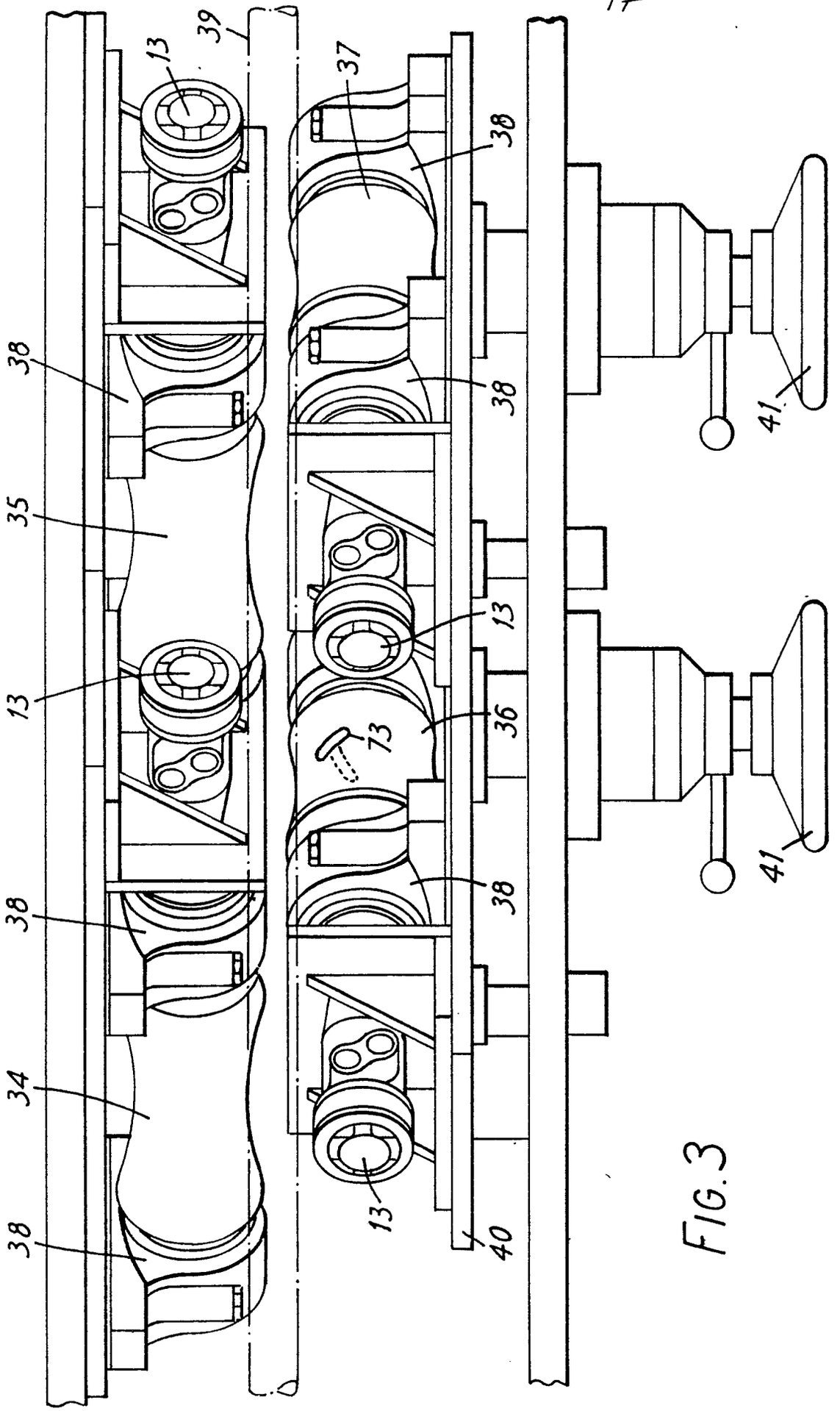

FIG.3

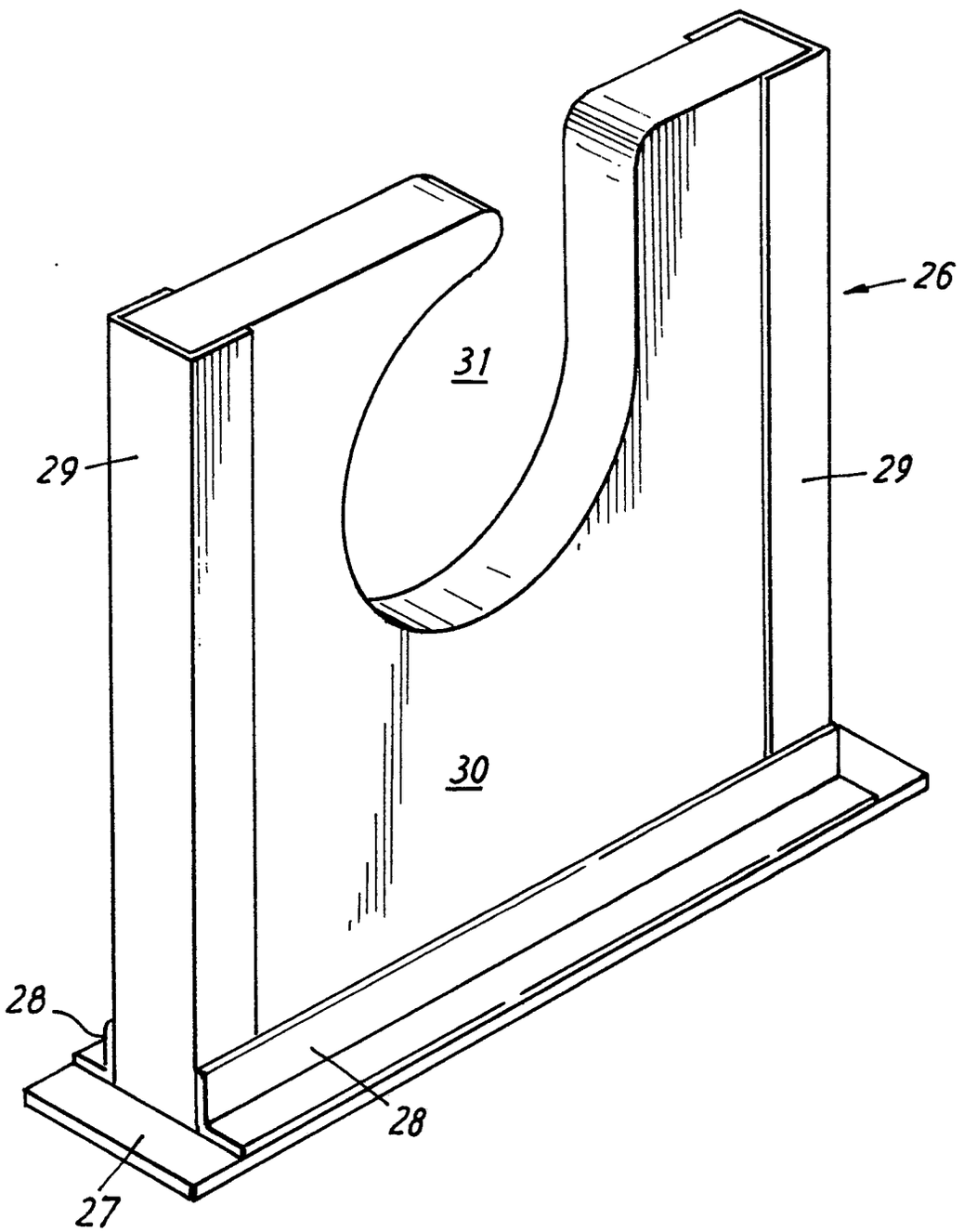

FIG.4

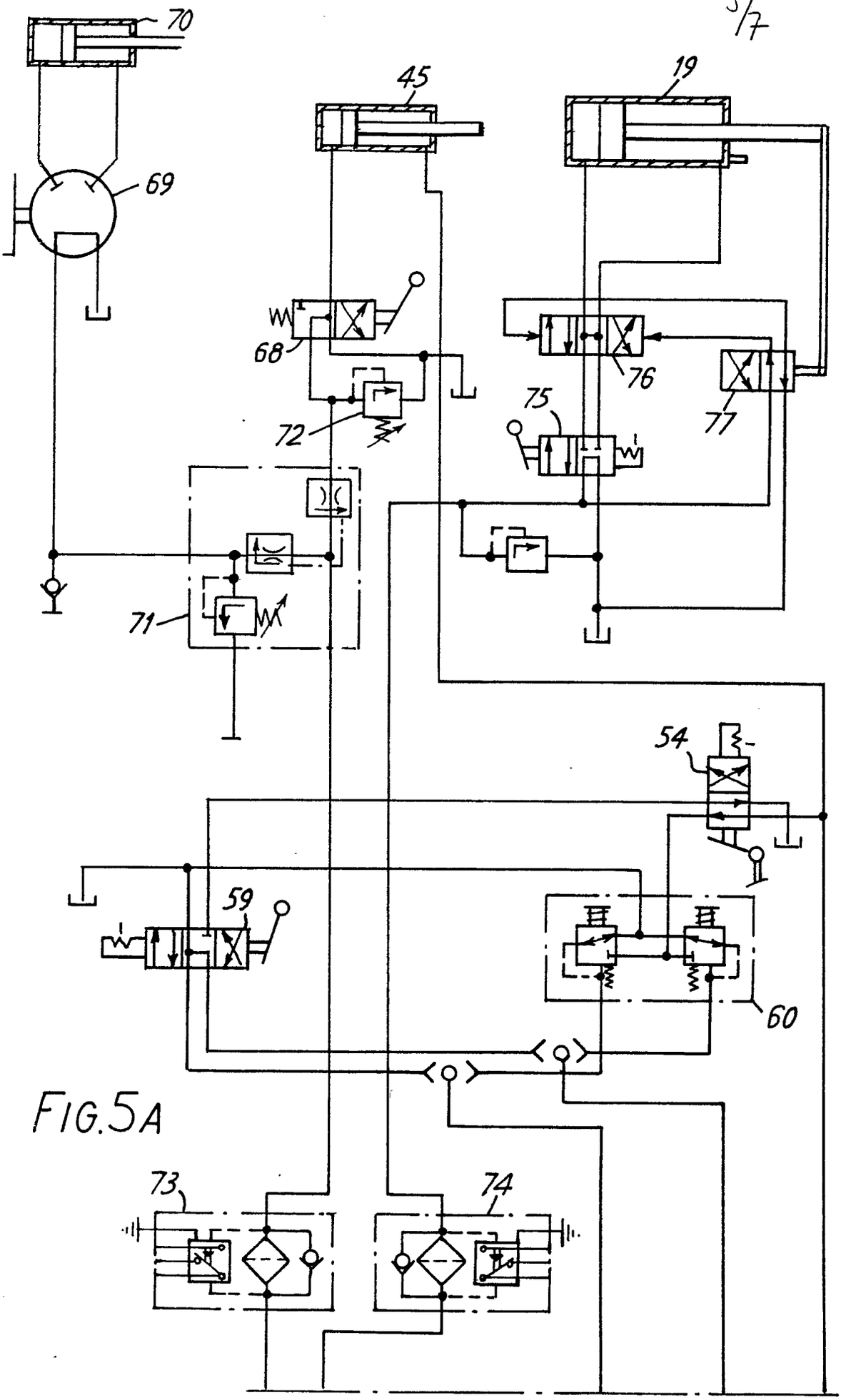

FIG.5A

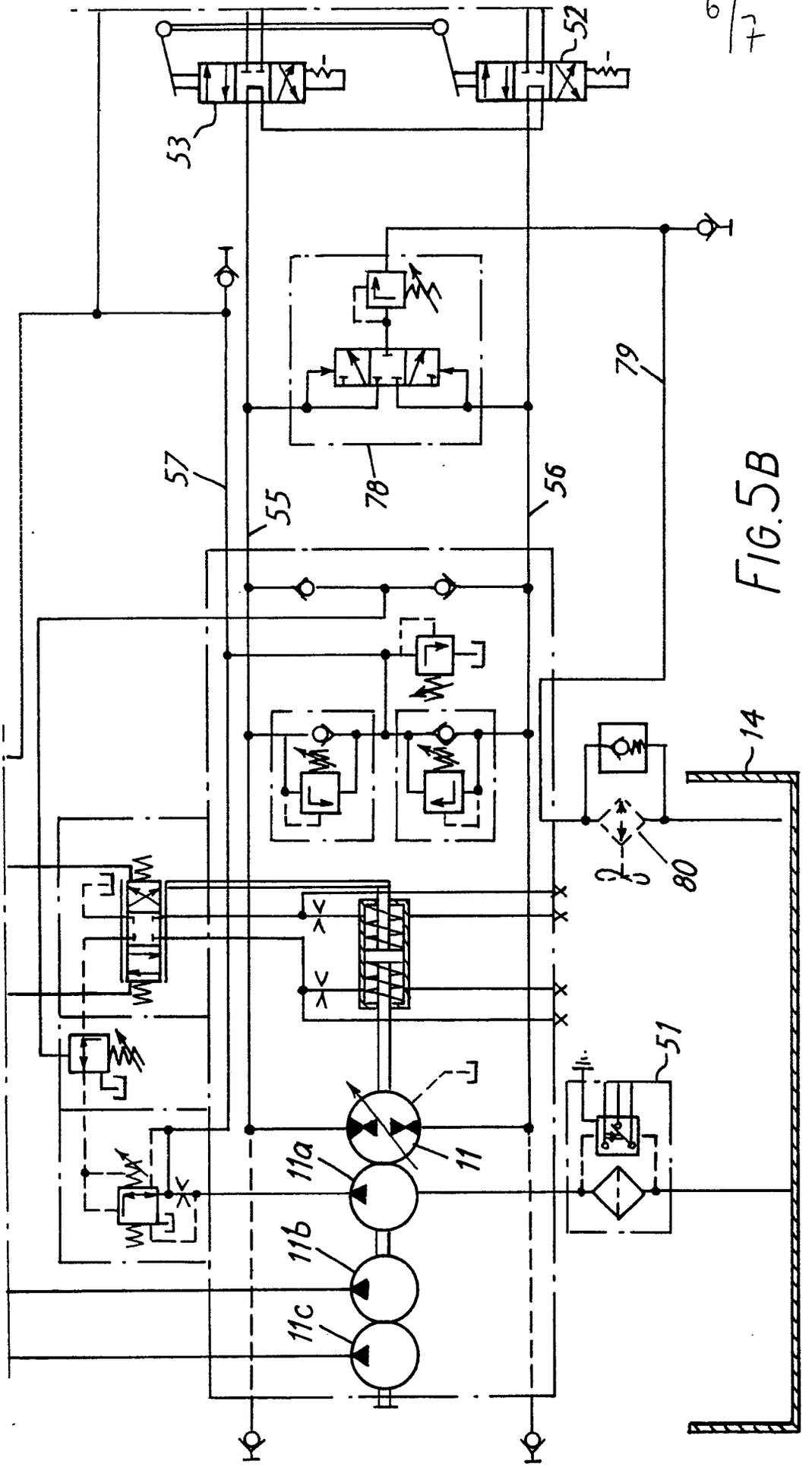

FIG.5B

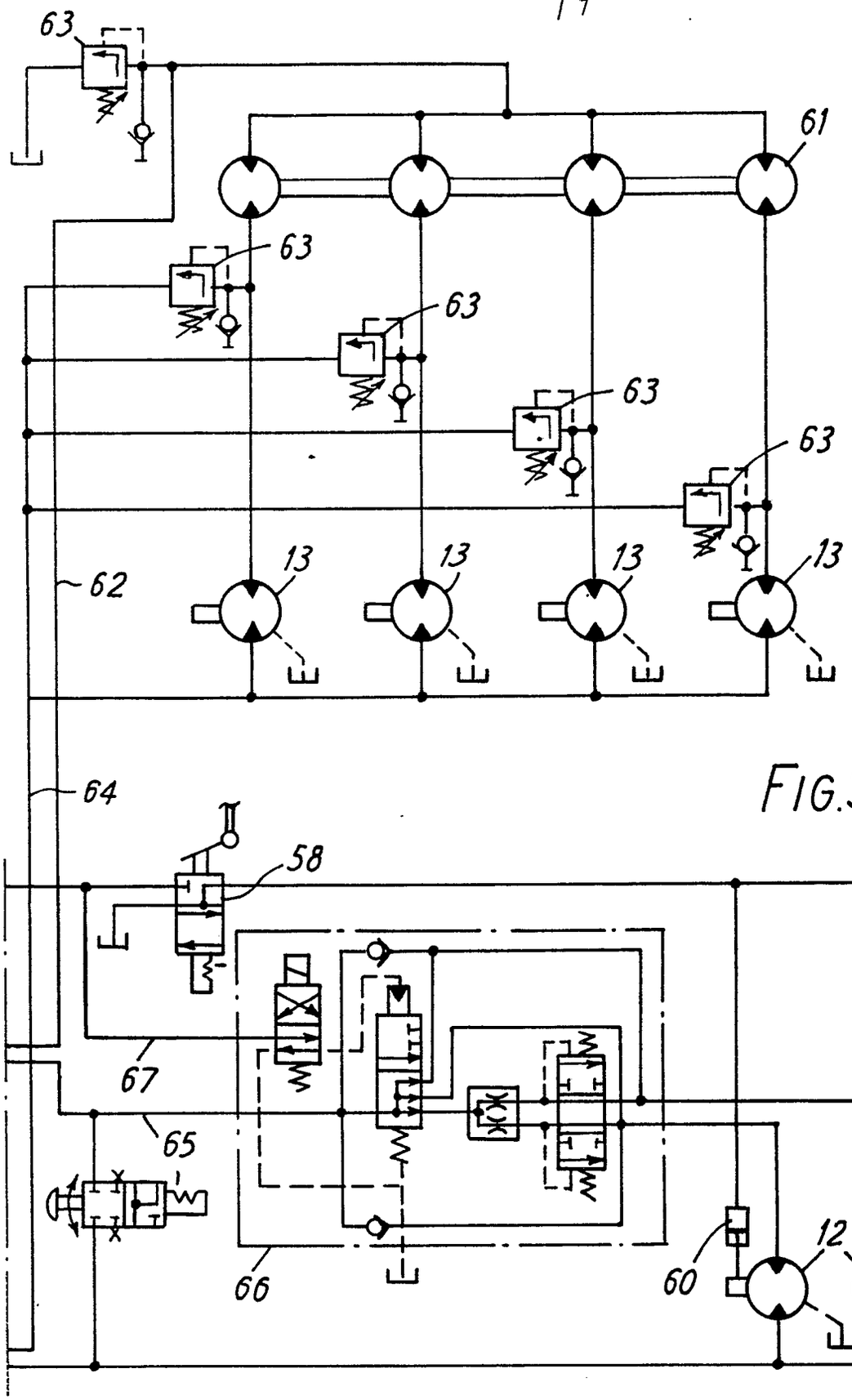

FIG.5C