(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 207 639**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 86304206.5

(22) Date of filing: 03.06.86

(51) Int. Cl.⁴: B 30 B 15/24
F 15 B 11/22

(30) Priority: 03.06.85 GB 8513955

(43) Date of publication of application:
07.01.87 Bulletin 87/2

(84) Designated Contracting States:
DE GB IT

(71) Applicant: SAMCO-STRONG LIMITED
P.O. Box 129 Ross Walk
Belgrave Leicester LE4 5BY(GB)

(84) Designated Contracting States:
GB

(71) Applicant: USM Corporation
426 Colt Highway
Farmington Connecticut 06032(US)

(84) Designated Contracting States:
DE IT

(72) Inventor: Pretty, Frederick Alexander
14 Sycamore Drive
Groby Leicestershire(GB)

(74) Representative: Atkinson, Eric et al,
Emhart Patents Department P.O. Box 88 Ross Walk
Belgrave Leicester LE4 5BX(GB)

(54) **Control device for a hydraulic press.**

(57) A hydraulically operated cutting press of the moving bed type has four piston-and-cylinder arrangements (C1-C4) arranged at or adjacent each corner of the cutting bed (24) and a balancing mechanism (58) including two balancing valves (BV1, BV2) connected across diagonally opposite corners of the bed. The balancing valves (BV1, BV2) are so connected to their associated piston-and-cylinder arrangements (C1-C4) that during a cutting stroke they control the flow of exhaust fluid from said arrangements, while during a return stroke they control the flow of fluid supplied to said arrangements. In addition, the two sides of each piston-and-cylinder arrangement (C1-C4) are connected by a line in which is disposed a valve (CV13, CV23, CV33,CV34) which is closed during a cutting stroke of the press and open during a return stroke of the press, thereby enabling fluid exhausting from the one side of each arrangement during a return stroke to be admitted to the other side thereof.

EP 0 207 639 A1

./...

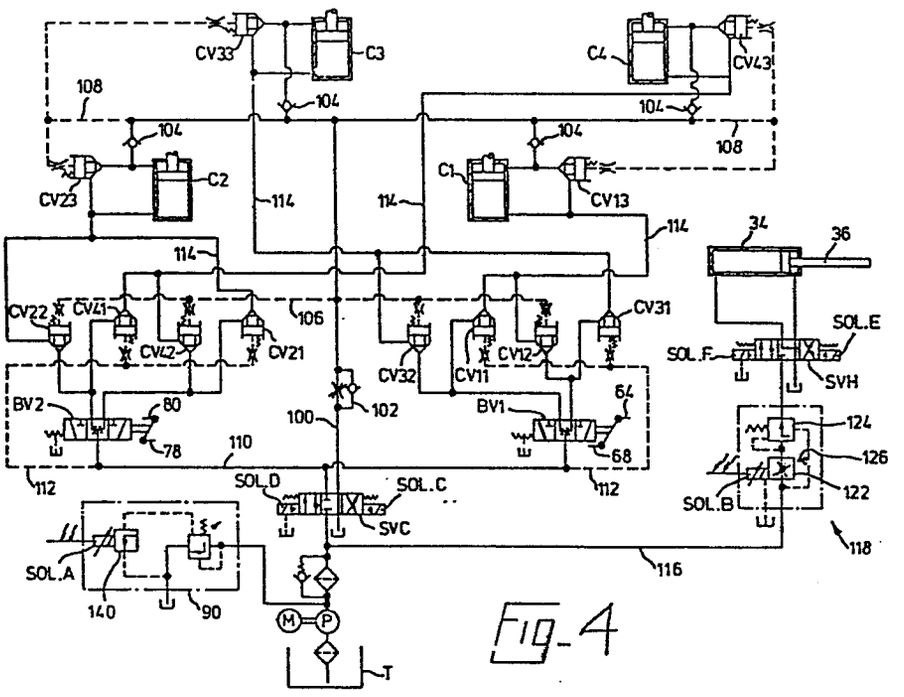
CV33
C3
C4
CV43
108
104
104
104
104
108
C2
CV23
C1
CV13
114
114
114
114
34
36
CV22
CV41
CV42
CV21
106
CV31
CV32
CV11
CV12
SOL.E
SOL.F
SVH
BV2
80
78
100
102
BV1
64
68
110
124
126
122
SOL.B
112
112
SOL.D
SOL.C
SVC
118
116
SOL.A
140
90
M
P
T

Fig_4

TITLE MODIFIED see front page

CUTTING PRESS

This invention is concerned with a cutting press comprising two platens each of which is supported at opposite ends thereof and one of which is movable towards and away from the other to effect cutting and return strokes of the press, hydraulically operated means, including a plurality of piston-and-cylinder arrangements connected at or adjacent opposite ends of the movable platen, for effecting such movement thereof, and a balancing mechanism, including a hydraulic balancing valve, operatively connected to the movable platen and effective to counter any tendency of the movable platen to tilt, and thus to maintain opposed surface of the platens parallel or substantially so, during cutting strokes of the press. One such cutting press is described in GB-A 1597115.

It is the object of the present invention to provide an improved cutting press wherein the provision of a balancing mechanism serves also to enhance certain other performance features of the press.

This object is resolved in accordance with the present invention, in a cutting press as set out in the first paragraph above, in that the balancing valve is so connected to the piston-and-cylinder arrangements that during a cutting stroke of the press it controls the flow of exhaust fluid from said arrangements, while during a return stroke it controls the flow of fluid being supplied to said arrangements to effect such stroke, and further in that the two sides of each piston-and-cylinder arrangement are connected by a line in which is disposed a valve which is closed during a cutting stroke of the press and open during a return stroke thereof.

This arrangement brings a number of advantages. Firstly by utilising said valve disposed between the two sides of each piston-and-cylinder arrangement, it is possible to generate a significantly higher fluid flow into

the 'supply side' of each cylinder during the return stroke, thereby achieving significantly higher return speeds than cutting speeds, without requiring the whole of the circuitry to be able to accommodate the higher fluid flow requirements; that is to say, the majority of the pipe lines conveying fluid may be sufficient to convey the correct fluid flow for a cutting stroke, and only the pipe line which connects the two sides of each piston-and-cylinder arrangement and in which the valve is disposed need be able to cope with the added fluid flow.

The provision of the feature of connecting the two sides of each piston-and-cylinder arrangement, and indeed the utilisation of exhaust fluid in the aforementioned manner, is facilitated by the dual function of the balancing valve as both a flow control on the exhaust fluid during a cutting stroke and a flow-divider of the supply fluid during the return stroke (it being more usual for the balancing valve to operate either on the supply fluid or on the exhaust fluid only during both cutting and return strokes).

In one embodiment of the invention, the hydraulically operated means comprises four piston-and-cylinder arrangements connected one at or adjacent each corner of the movable platen, and the balancing mechanism includes two balancing valves and two linkage arrangements by which said balancing valves are operated, each of said linkage arrangements being connected to diagonally opposite corners of the movable platen and each balancing valve being connected to the two piston-and-cylinder arrangements mounted at or adjacent said corners. A significant advantage is thus achieved in such case, in accordance with the present invention, in that, where the applied load is significantly off-set, that is to say located in a region away from the centre of the press, e.g. towards one of the corners thereof, adjacent one of the piston-and-cylinder arrangements, it is possible, using the balancing valves in the aforementioned manner to control the

exhaust fluid during the cutting stroke, to completely close off the exhaust fluid from the piston-and-cylinder arrangement associated with the opposite corner, with a result that the fluid pressure applied by the other three piston-and-cylinder arrangements co-operate to bring the platen back to a parallel condition. Such an arrangement, it will be appreciated, is not possible where the balancing valves control the supply fluid to the piston-and-cylinder arrangements.

For facilitating the switching of the functions of the or each balancing valve in the cutting press in accordance with the invention, preferably each of the valves disposed in the line connecting the two sides of each piston-and-cylinder arrangement has a pair of further valves associated therewith, said further valves being arranged in parallel in a line which, during the cutting stroke, connects the exhaust side of their associated piston-and-cylinder arrangement with one of the balancing valves. Furthermore, preferably the or each balancing valves has two ports at one side connected in common, when the valve is in equilibrium, to a third port at the other side, the pair of said further valves being connected one to each of said two ports of the balancing valve, and the arrangement being such that in a cutting stroke of the press one of said pair is closed and the other open, while in a return stroke thereof said other is closed and said one open. Conveniently, furthermore, each of said pair of valves is closed as aforesaid by pressure fluid supplied to its associated piston-and-cylinder arrangement.

For enhancing the flow-dividing function of the two balancing valves, in a press wherein the hydraulically operated means comprises four piston-and-cylinder arrangements, furthermore, it is desired that, for effecting a return stroke of the press, the two balancing valves are supplied with pressure fluid from a common line.

In a preferred embodiment of the cutting press in accordance with the invention the upper one of the platens is mounted for movement fore-and-aft of the press between a forward, operative, position, in which it is in opposed relationship with the other, lower, platen, and a retracted position. In addition, in such press wherein hydraulically operated means is provided for effecting fore-and-aft movement of the upper platen, said means and the hydraulically operated means for effecting movement as aforesaid of the movable platen each forming part of a hydraulic circuit which also comprises an electronically controlled relief valve for controlling the operating pressure of the hydraulic circuit according to which of the said hydraulically operated means is in question.

Also in a preferred embodiment of the press in accordance with the invention the movable platen is constituted by the lower of the platens.

There now follows a detailed description, to be read with reference to the accompanying drawings, of one cutting press in accordance with the invention. It will be appreciated that this cutting press has been selected for description merely by way of non-limiting example.

In the accompanying drawings:-

Figure 1 is a left hand side view of the cutting press in accordance with the invention;

Figure 2 is a fragmentary view, taken from the front of the cutting press shown in Figure 1;

Figure 3 is a fragmentary plan view of part of the right hand side of the cutting press shown in Figure 1; and

Figure 4 is a schematic diagram showing a hydraulic circuit of the cutting press in accordance with the invention;

Figure 5 is a schematic diagram showing part of the electrical circuit of the press in accordance with the invention;

Figure 6 is a schematic diagram showing details of a relief valve control arrangement by which the hydraulic pressure in the system is controlled;

Figure 7 is a schematic diagram showing details of a control arrangement for "head forward" and "head retract" movement;

Figure 8 is a schematic view of setting means for determining the limits of travel of the cutting head; and

Figure 9 is a schematic diagram of a light screen connection used in the press in accordance with the invention.

The cutting press in accordance with the invention now to be described comprises a fabricated frame made up of a base structure 10, upstanding leg members 12, cross straps 14 and fore-and-aft straps 16. The various integers of the frame are made up of tubular steel, and the structure is designed to be able to support the weight of the operating parts of the press.

Carried by the frame are two rail members 20 which extend fore-and-aft of the cutting press. The cross sectional shape of each rail member 20 can be seen from Figure 2, from which it can be seen that each member has a re-entrant portion at opposite sides, for purposes to be described hereinafter.

The press in accordance with the invention comprises upper and lower platens constituted by a cutting head 22 and a cutting bed 24. As is conventional, the cutting head 22 is provided on its under-surface with a striker plate 26 and the cutting bed supports a cutting pad 28. For facilitating feeding of material to be cut from a supply (not shown) which may be located at the rear of the cutting press, a tray member 30 is carried by the frame and is pivotally connected at its forward end to the cutting bed 24. The work-supporting surface of the tray lies flush with the upper surface of the cutting pad 28, height adjustment means 32 being provided (see Figure 1) for this purpose.

The cutting head 22 is supported by the rail members 20 for movement fore-and-aft of the cutting press between a forward, operative, position, in which it lies in opposed relationship with the cutting bed 24, and a retracted position. Power means (fluid pressure operated means) for effecting such movement of the cutting head 22 is provided in the form of a hydraulic piston-and-cylinder arrangement a cylinder 34 of which is carried in the cutting head 22 with a rearwardly projecting piston rod 36 connected at its rearward end to a cross strap 14 of the frame. For facilitating the movement of the cutting head 22 on the rail members 20, furthermore, the uppermost surface of each rail member is provided with a slide surface 38 on which a co-operating surface of the cutting head slides, and in addition at the left hand end of the cutting head 22 are provided two rolls 40 which engage opposite sides of the rail member, above the re-entrant portion thereof, said rolls serving to determine the position of the cutting head laterally of the cutting press. The cutting head is in addition held against heightwise movement relative to the rails by projections 42 which are provided on blocks integral with the cutting head and project into the re-entrant portions of the rail members. The projections thus provide abutment surfaces which are urged against shoulders provided by the re-entrant portions on the rail members (see Figure 2) during a cutting stroke of the press and thereby determine the heightwise position of the cutting head.

The rail members 20 are preferably steel forgings which have undergone a heat treatment.

The cutting press in accordance with the invention is a so-called "moving bed press"; that is to say, cutting and return strokes of the press are effected by movement of the cutting bed 24 towards and away from the cutting head 22. For effecting such movement of the cutting bed fluid presure operated means constituted by four

piston-and-cylinder arrangements C1,C2,C3,C4 is provided. More particularly, cylinders 46 of said arrangements are mounted one at or adjacent each corner of the cutting bed 24 with a piston rod 48 of the arrangements extending upwardly. Secured at the upper end of each piston rod 48 is a yoke member 50 which is bifurcated, there being mounted in, and extending across, the leg portions thereof a trunnion pin 52 which passes through a swivel joint arrangement in the form of a spherical (or ball end) bearing 54. For accommodating the bearings 54 each rail member 20 has two integral downwardly depending lugs 56 appropriately spaced along the length thereof and having appropriately shaped recesses formed therein to receive the bearings.

It will thus be appreciated that the cutting bed 24 is suspended from the rail members 20 through the piston-and-cylinder arrangements C1,C2,C3,C4 and the swivel joint arrangements just described, so that the transmission of cutting loads takes place through the rail members 20 only and further the cutting bed 24 is capable of limited tilting movement during a cutting stroke, for reasons referred to later.

The cutting press in accordance with the invention also comprises a balancing mechanism generally designated 58 operatively connected to the cutting bed and effective to counter any tendency of the cutting bed to tilt, and thus to maintain opposed surfaces of the striker plate 26 and cutting pad 28 parallel, or substantially so, during a cutting stroke of the press. The balancing mechanism is generally as described in EP-A 67037, to which reference should be made for further details. Thus, the balancing mechanism of the press in accordance with the present invention comprises, pivotally mounted at the front right hand corner of the cutting bed 24, a link 60 which is pivotally connected in turn to one arm of a bell crank lever 62. The bell crank lever 62 is pivotted on a bracket on the frame and the other arm thereof is connected to a rod 64

(corresponding to the rod (or link) 38 of the mechanism described in EP-A 67037). Thus, through the rod 64 the front right hand corner of the cutting bed 24 is connected to the spool of a first balancing valve BV1 (Figure 4) to which the left hand rearward corner of the cutting bed 24 is also connected, through a further rod 68 (corresponding to the rod (or link) 44 of said EPC application) and a linkage including a pivot shaft 70 extending rearwardly of the press a first lever 22 mounted at the rearward end of said shafts 70, and a second lever 74 pivotally mounted at said left hand rearward corner of the cutting bed 24.

The rearward right hand corner of the cutting bed is similarly connected by a lever (not shown) and a bell crank lever 76 pivotted on a bracket on the frame and through a rod 78 to the spool of a second balancing valve BV2 (Figure 4) to which the forward left hand corner of the cutting bed 24 is also connected, through a rod 80, a forwardly extending pivot shaft 82, a third link 84, and a second link 86 pivotally mounted at said forward left hand corner.

The cutting press in accordance with the invention may also be provided with a stroke control arrangement as described in EP-A 67037.

The operation of the press in accordance with the invention, including the balancing mechanism, is controlled by a hydraulic circuit illustrated in Figure 4. From this Figure it will be seen that pressure fluid is supplied to the whole circuit by means of a single pump P driven by a motor M. An electronically controlled pressure relief valve system generally designated 90 is also provided for controlling the pressure of the fluid in the system. This is achieved by the supply of appropriate signals to the valve system 90 (as will be described later).

The hydraulic circuit also comprises a three-way solenoid valve SVC which, when in its central position (see Figure 4), closes off the four piston-and-cylinder

arrangements C1, C2, C3, C4 from the source of pressure fluid and in addition from tank T.

With the press in its rest position (as shown in Figure 4), actuation of the solenoid valve SVC to move its spool to the left (view in Figure 4) causes pressure fluid to be supplied along line 100, bypassing a restrictor valve arrangement 102 and passing through check valves 104 to the upper end of each of the piston-and-cylinder arrangements. At the same time, pressure fluid passes along a line 106 to each of four cartridge valves CV12, CV32, CV42, CV22 to cause them to be closed and also along branch lines 108 to four further cartridge valves CV13, CV23, CV33, CV43, to close them also, said further valves being disposed each in a line 109 by which the opposite sides of its associated piston-and-cylinder arrangement can be connected, as will be referred to hereinafter. In this condition, therefore, pressure fluid is fed directly to the piston-and-cylinder arrangements. At the same time, exhaust fluid from piston-and-cylinder arrangements C3, C1 is exhausted respectively through further cartridge valves CV31, CV11 to the balancing valve BV1, and exhaust fluid from piston-and-cylinder arrangements C4, C2 is exhausted respectively via cartridge valves CV41, CV21 to balancing valve BV2. While the opposed surfaces of the striker plate 26 and cutting pad 28 remain parallel, the balancing valves remain in an equilibrium state (as illustrated in Figure 4) and thus allow a balanced flow of exhaust fluid therethrough from each of the cartridge valves, such exhaust fluid exhausting through solenoid valve SVC to tank T. In the event that the opposed surfaces become no longer parallel, then through the balancing mechanism 58 the spool of the relevant balancing valve is appropriately shifted, thereby varying the amount of flow of exhaust fluid therethrough such as to overcome the tendency of the cutting bed to tilt and to correct it.

It will be appreciated that, in order for the balancing mechanism to be effective, it is necessary for the cutting bed to be able to tilt, and indeed without binding forces arising which then have to be overcome by the hydraulic system. It is for this purpose that the swivel joint arrangements are provided in the mountings for the piston-and-cylinder arrangements. By using the balancing valves in this manner for controlling the exhaust fluid, furthermore, it is possible, in the case of a very off-set load between the platens, notably when the load is placed closely adjacent to one corner, to completely close off the exhaust fluid from the piston-and-cylinder arrangement associated with the opposite corner of the cutting bed, and at the same time allowing full flow from the piston-and-cylinder arrangement, associated with said one corner, and also while the other two piston-and-cylinder arrangements are operating under normal condition (with their balancing valve in equilibrium), so that effectively there is added to the hydraulic pressure being applied to the piston-and-cylinder arrangement also a mechanical force applied by the other three arrangements through the cutting bed. In this way, therefore, where such an off-set load arises, a pressure greater than the fluid pressure can be applied to the "affected" corner of the cutting bed.

In a return stroke of the cutting bed 24, the function of the balancing valves BV1, BV2 is altered so that they thereby become effectively flow distributor valves, since shifting solenoid valve SVC to the right (viewing Figure 4) is effective to channel the pressure fluid through the balancing valves to the piston-and-cylinder arrangements. In this case pressure fluid is supplied from the pump P along lines 110 to the valves and also through branch lines 112 to cartridge valves CV31, CV11, CV21, CV41 to close them, while switching solenoid valve SVC serves to open cartridge valves CV12, CV32, CV42, CV22. Pressure fluid is thus supplied via cartridge valves CV12, CV32 from

balancing valve BV1 respectively to piston-and-cylinder arrangements C1, C3, and further via cartridge valves CV42, CV22 from balancing valve BV2 respectively to piston-and-cylinder arrangements C4, C2. Any tendency of the cutting bed 24 to tilt is thus again countered by the balancing mechanism 58, but in this case (since heavy loads will not generally arise, and in any event off-set loads present no problem), the balancing takes place using the supply fluid.

In the press in accordance with the invention, furthermore, during the return stroke, the branch lines 108 are exhausted, thereby causing cartridge valves CV13, CV23, CV33, CV43 to open whereby, in conjunction with the check valves 104, which serve to prevent exhaust to tank of the fluid exhausting from the piston-and-cylinder arrangements, the exhaust fluid is thus recirculated through the relevant cartridge valves, and combines with pressure fluid being supplied along the lines 114 connecting the balancing valves with the piston-and-cylinder arrangements, thus to cause enhanced fluid flow to the arrangements and thereby to provide an accelerated return stroke. This feature is of course facilitated by the use of the supply fluid for balancing purposes during the return stroke and clearly would not be able to be provided if balancing were to take place utilising the exhaust fluid (as is the case with the cutting stroke). The system of cartridge valves thus enables the fluid flow paths to be reversed to give accelerated return strokes, while at the same time providing for enhanced cutting pressure (should the need arise in respect of an offset load) during the cutting strokes.

In the press in accordance with the invention the same pump P is used for not only effecting cutting and return strokes of the press, but also fore-and-aft movement of the cutting head 22. To this end, the pump P thus supplies pressure fluid along a line 116, via a control valve arrangement generally designated 118 (to be referred

to hereinafter) to a three-way solenoid valve SVH. In its central position (shown in Figure 4) the valve SVH prevents the flow of fluid to the piston-and-cylinder arrangement 34,36, while shifting the spool of said valve causes movement of the piston of said arrangement in one direction or another, as appropriate.

For controlling the operation of the hydraulic circuit, the press in accordance with the invention comprises an electrical/electronic circuit as shown in Figs. 5 to 9. This circuit has a 110V supply. For safety reasons, the circuit includes a light screen which, in the press being described is a Safety Light Curtain Model LVU, supplied by Erwin Sick. This guard arrangement allows the press to be operated manually, or after a single break of the light screen, or after a double break of the light screen.

When the press is initially switched on, a circuit is made to relay RL9 (Fig.5) through normally closed contacts RL1/1 and RL4/1 (both to be referred to hereinafter), S2 and PB1/1, the latter being contacts of a "start" button. Energising RL9 closes its contacts RL9/1 to form a holding circuit. At this stage, the guard is inoperative and its contacts S1 and S3 are open. Upon operation of the "start" button, contacts PB1/3 are closed thereby rendering the guard arrangement operative whereupon normally closed contacts S2 are opened and normally open contacts S1 and S3 are closed. The guard is now effective to protect the operator, interuption of the light screen returning the various contacts to their rest position. Closing S1 causes relay RL8 to be energised, thereby closing its contacts RL8/1 and preparing a circuit to relay RL5. Closing contacts S3, in combination with closing contacts PB1/2 of the "start" button energises relay RL3 through a circuit including a rear limit relay CR1, which is actuated in response to part of the electronic circuit to be referred

to hereinafter. Energising RL3 serves to energise its contacts RL3/1, thereby creating a holding circuit.

Energising RL3 also closes its contacts RL3/2, thereby energising solenoid SOL E, operating solenoid valve SVH whereby piston-and-cylinder arrangement 34, 36 is actuated to move the head forwards. The control of the speed of head movement will be described hereinafter. Energising RL3 also opens normally closed contacts RL3/3, thereby disabling relay RL1 by which retracting movement of the head is initiated.

When the head moves away from its rear limit, relay CR1 is switched, but RL3 is retained energised through its holding circuit. When the head reaches its front limit position, relay CR4 is energised, thereby energising relay RL2 which in turn, through its contacts RL2/1 is then effective to cause relay RL5 to be energised. Energising RL5 is effective through its contacts RL5/1 to energise solenoid SOL D by which solenoid valve SVC is switched to allow fluid under pressure to the piston-and-cylinder arrangements C1, C2, C3, C4. Energising RL5 also causes its contacts RL5/4 to close, thereby creating a holding circuit in readiness for de-actuation of lower limit relay CR5. SOL D remains energised until upper limit relay CR6 is actuated, whereupon relay RL5 drops out. At this stage the cutting stroke is completed.

When RL5 is energised, contacts RL5/2 are closed, thereby actuating a timer TR which in turn closes its contacts TR/1, thereby energising relay RL6. Energising RL6 causes its normally closed contacts RL6/1 to be opened, thereby disabling relay RL4 by which the lowering of the bed is controlled, and in addition opening contacts RL6/2, disabling "head retract" relay RL1. In addition energising RL6 closes its contacts RL6/3, which is incorporated in a circuit together with relay contacts RL5/3, by which circuit the pressure of hydraulic fluid in the system is controlled, and which will be described in detail hereinafter. At this

stage, it is necessary to point out only that, upon de-energising RL5, the timer TR is effected for a pre-set period (in the illustrative example 0.2 seconds) to maintain RL6 energised, thereby continuing to disable the "head retract" and "bed lower" relays RL1, RL4, while, in combination with now closed relay contacts RL5/3, allowing decompression of the hydraulic fluid in the piston-and-cylinder arrangements C1, C2, C3, C4.

When the timer TR times out, relay RL6 is de-energised, whereupon, through its contacts RL6/1, relay RL4 is energised which in turn, through its contacts RL4/1, cause solenoid SOL C to be energised. Energising SOL C operates solenoid valve SVC to cause the lowering of the head to be initiated, this movement continuing until lower limit relay CR5 is actuated, thereby de-energising relay RL4. De-energising RL4 is effective to return its normally closed contacts RL4/2 and RL4/3 to their initial condition, thereby energising relay RL1 which, through its contacts RL1/1, is effective to energise solenoid SOL F. This latter thereupon operates solenoid valve SVH to initiate return movement of piston-and-cylinder arrangement 34, 36. When the head reaches its rear limit, as determined by actuation of relay CR1, relay RL1 is de-energised and the press comes to rest.

Various other contacts of the relays are provided, as indicated in the drawings, for interlock purposes.

Referring to Fig. 6, the electronic circuit comprises an electronically controlled pressure relief valve system 90 supplied by Abex Denison together with a driver board 130 (their reference number 701 00001-8), which enables different pressure limits to be applied in the hydraulic system according to the type of operation to be effected. To this end, the electronic circuit comprises an electronic control circuit which preferably includes a microprocessor and programmed instructions, which can be exchanged to set the press for the particular operator

requirements. The driver board 130 has eight ports two (131, 132) of which are connected to a 24V supply taken from the main 110V supply, and two (133, 134) of which are connected to solenoid SOL A by which a valve 138 forming part of the valve system 90 is controlled. More particularly, the voltage applied to SOL A controls the size of the orifice of the pressure relief valve 138 so that, by varying the voltage the orifice dimensions are varied, and thus the pressure in the hydraulic system.

For controlling the voltage supplied through ports 133, 134 a sub-circuit is connected across ports 135, 136, 137 of the board. Connected across ports 135, 137 are three variable resistors (potentiometers) 140, 142, 144 in parallel, the pick-up contacts of each of which are connected back to port 136. Thus, by varying the resistances, the voltage applied to SOL A can be varied. Selection of which of the resistors is to be incorporated in the circuit is effected by relay contacts from the main electrical circuit, as will now be described.

The pick-up contact of a first (140) of the resistors is connected to port 136 through normally open relay contacts RL5/7. These contacts are closed when relay RL5 is energised, that is when the bed 24 is being raised, and variable resistor 140 thus controls the pressure in the hydraulic system during the upstroking of the bed. In one embodiment, the voltage is so set that a pressure of 235 bar is achieved in the hydraulic system.

The pick-up contact of a second (142) of the variable resistors is connected to port 136 through normally open contacts RL4/4 or alternatively through the sub-circuit previously referred to incorporating relay contacts RL5/3 and RL6/3. Thus, when relay RL4 is energised, namely when the bed is to be lowered, variable resistor 142 is rendered operative and thus controls the pressure of the hydraulic system during the lowering of the bed. In addition, as previously described, variable resistor 142 is also

operative prior to energising relay RL4, during the period when timer TR is active, thereby allowing decompression of the fluid in the piston-and-cylinder arrangements C1, C2, C3, C4, prior to initiation of the downward movement of the bed. In one embodiment, the voltage achieved through the setting of resistor 142 is such that a pressure of 50 bar is applied through the hydraulic system.

The third variable resistor 144 is connected to port 136 through either normally opened contacts RL1/2 or RL3/4, which respectively are closed upon energising relays RL1, RL3, by which head retracting and head advancing movement is controlled. Thus, resistor 144 controls the pressure in the hydraulic system during head movement; in one embodiment, this is set at 117 bar.

Further interlock relay contact RL5/8, RL1/3, RL3/5, RL4/5, RL6/4, are provided whereby only one variable resistor can be operative at any one time. These are arranged in a line which connects the pick-off contacts of each resistor to port 137.

When none of the resistors is operative, port 136 is shorted to port 137, and in such circumstance the voltage applied to SOL A is such that the pressure of the hydraulic system is sufficient to raise to bed under low pressure only. In one embodiment, this is found to be of the order of 7 bar.

The electrical circuit also includes a further relay RL7 (Fig. 5) which is energisable by operation of a manual switch SS2 and which enables the operator to set the cutting stroke of the press while the press is operating under low pressure. To this end, energising RL7 cause normally closed contacts RL7/1 and RL7/2 to be opened thereby disabling respectively relays RL1, RL4, so that the head cannot be retracted or the bed lowered. In addition, normally open contacts RL7/3 are closed thereby making a circuit between ports 136, 137 of driver board 130 even when relay contacts RL5/8 are opened. Thus, during a low pressure

adjust operation, the pressure in the hydraulic is retained at its idling level, namely in this embodiment 7 bar. Two interlock contacts RL7/3, RL7/4 are also provided, as indicated in the drawings.

Referring to Fig. 7, the control valve arrangement 118 by which fore-and-aft movement of the press head 22 between its retracted and advanced positions is controlled, is supplied by Abex Denison together with a driver board 150 (their reference number 735 10004-2). The driver board 150 has two ports 151, 152 which receive a 110V supply from the electrical circuit, and port 153 which is earthed. Output ports 154, 155 are connected in a circuit incorporating a solenoid SOL B, by which the control valve arrangement 118 is operated. The arrangement 118 is a two-port pressure-compensated proportional flow control valve, arrangement and comprises a variable restrictor valve 122, the restriction in the through-flow passage of which is varied according to the control signal (voltage) received by SOL B, and a pressure-compensating valve 124 which has inputs connected both "upstream" and "downstream" of the restrictor valve 122 and serves to ensure that a constant flow of fluid takes place through the valve arrangement 118. A mechanical stop member 126 is also provided on the spool of the restrictor valve 122, which member prevents the valve from closing completely and thus serves to determine a "creep" speed for the piston-and-cylinder arrangement 34, 36. The screw is adjustable so as to be able to vary the creep speed. Thus, by varying the voltage supplied to SOL B, the supply of fluid to piston-and-cylinder arrangement 34, 36 through solenoid valve SVH can be controlled, and thus the speed of travel and also the distance travelled.

The driver board 150 enables both the speed of travel (maximum velocity) of the head in each direction, and also its acceleration and deceleration in each direction to be separately controlled. Thus, for speed control ports 156, 157, 158 are connected to a sub-circuit comprising two

variable resistors 160, 162 connected in parallel across ports 156, 158, while the pick-off contact of each resistor is connected back to port 157. More specifically, the circuit incorporating resistor 160 includes normally open relay contacts RL3/6 and normally closed relays contacts RL1/4, so that the resistor is rendered operative during "head forward" movement and thus controls the speed of such movement, through the control valve arrangement 118, while the circuit incorporating resistor 162 also includes normally open relay contacts RL1/5 and normally closed relay contacts RL3/7, so that resistor 162 is operative only during "head retracts" movement, and thus controls the speed of such movement.

Associated with the resistors 160, 162 are respectively control relays CR3, CR2 which, when actuated, connect the pick-up contacts of the resistor to port 157, but when de-actuated disconnect the pick-up contacts; in this latter case the voltage applied to SOL B is then controlled by the circuit through port 158 and provides the "creep" speed referred to above. Actuation of relays CR2, CR3 will be described hereinafter in detail.

The driver board 150 as supplied by Abex Denison has five trimmer potentiometers two of which, designated "Fall" and "Rise", are removed in the present application to enable acceleration and deceleration in both directions to be achieved. Thus, "Fall" potentiometer is replaced by two variable resistors 170, 172 in parallel, resistor 170 being connected in a circuit including normally closed relay contacts RL1/6 and resistor 170 in a circuit including also normally open relay contacts RL1/7. Thus, variable resistor 172 is rendered operative when RL1 is energised, and thus has a control function during "head retract" movement, while resistor 170 is otherwise rendered operative, that is to say during "head forward" movement. Similarly, the "Rise" potentiometer is replaced by variable resistors 174, 176 which are likewise rendered operative respectively, through

normally closed relay contacts RL1/8 and normally open relay contacts RL1/9, to exercise a control function during "head forward" and "head retract" movement.

Thus, in the operation of the flow control valve arrangement 118 variable resistors 174, 176 are rendered operative to control acceleration respectively during head forward and head retract movement, while resistors 170, 172 are respectively rendered operative to control deceleration during head forward and head retract movement. It will thus be appreciated that by this arrangement the conventional control provided by the "Fall" and "Rise" potentiometers has been replaced by separate controls for acceleration and deceleration in each direction.

In operation, upon energising relay RL3, initially the acceleration, speed and deceleration of the "head forward" movement is pre-set by resistors 174, 160, 170 respectively, while similarly, upon energising relay RL1, acceleration, speed and deceleration in the "head retract" movement is pre-set respectively by resistors 176, 162, 172.

The press in accordance with the invention also comprises setting means whereby the operator can select the retracted position to which the cutting head 22 is moved, said setting means comprising a linear potentiometer 120 (Fig. 3) which is mounted on the right hand side rail 20 and is operatively connected to the cutting head 22 whereby its output voltage varies according to the position of the cutting head 22 along the rail members 20. In addition, the setting means comprises four reference potentiometers (variable resistors) 180, 182, 184, 186 (Fig. 8) mounted on a printed circuit board on which also are mounted control relays CR1, CR2, CR3, CR4, together with a comparator circuit by which the output of the linear potentiometer is compared under microprocessor control with the pre-set outputs of each of the reference potentiometers, the arrangement being such that the control relays CR1, CR2, CR3, CR4 are energised respectively when the output of

potentiometers 180, 182, 184, 186 match the output of the linear potentiometer 120.

Reference potentiometer 186 is set so as to determine the front position of the cutting head 22 and potentiometer 184 is pre-set to control the initiation of deceleration of the "head forward" movement at a rate controlled by variable resistor 170 and to provide for a final "head forward" movement at the "creep" speed. Since it is desirable that the front limit position of the head is fixed, the potentiometer 186 will not normally be accessible to the operator. Similarly, since the deceleration and the "head forward" speed will normally be fixed also, resistors 160, 168 will also not normally be accessible to the operator.

It may be desirable, in using the press in accordance with the invention, to vary the rear limit position of the cutting head 22 according to the size of knife being utilised. Thus, the "rear limit" potentiometer 180 is preferably accessible to the operator. Furthermore, since deceleration should take place at a distance spaced from the rear limit position, which distance is determined according to the speed of travel and rate of deceleration (determined respectively by resistors) 162, 176 the two potentiometers 180, 182 are connected and operable by a common tuning knob (not shown).

In the operation of the press, upon actuation of the "start" button PB1, the head is accelerated from its rear limit position forwards up to the speed as set by resistor 160. This movement continues until control relay CR3 is actuated, whereupon control of the "head forward" movement is transferred to the head forward deceleration resistor 170, which reduces the speed to the "creep" speed, until relay CR4 is actuated, terminating the head forward movement. Similarly, at the end of the cutting operation the head retract movement is initiated upon energising relay RL1, acceleration being under the control of resistor 176,

up to the speed as set by resistor 162, such head retract movement continuing until relay CR2 is actuated to bring the movement to the "creep" speed, which continues until actuation of relay CR1, which terminates the head retract movement. It will of course be appreciated that actuation of CR4 is effective, by energising relay RL2 and consequent opening of its contacts RL2/2, thus de-energising RL3, to terminate head forward movement. Similarly, CR1 is effective to de-energise RL1, thereby terminating the head retract movement.

It will thus be appreciated that, using the reference potentiometer 180, the retracted position of the cutting head can be set at any desired distance from the front position thereof. Preferably, however, pre-set end positions are provided using conventional microswitches.

The light guard arrangement is provided with a selector switch SS1 for selecting "manual", "single break" and "double break" modes of operation. Where operating the guard in either of the "break" modes, the self-checking of the guard arrangement takes place when the break, or the second break is effected, replacing the operation of push button PB1, and thereafter the operation of the press takes place as described above.

Claims:

1. Cutting press comprising two platens (22,24) each of which is supported at opposite ends thereof and one (24) of which is movable towards and away from the other (22) to effect cutting and return strokes of the press, hydraulically operated means, including a plurality of piston-and-cylinder arrangements (C1,C2,C3,C4) connected at or adjacent opposite ends of the movable platen (24), for effecting such movement thereof, and a balancing mechanism (58), including a hydraulic balancing valve (BV1;BV2), operatively connected to the movable platen (24) and effective to counter any tendency of the movable platen to tilt, and thus to maintain opposed surface of the platens (22,24) parallel or substantially so, during cutting strokes of the press, characterised in that the balancing valve (BV1;BV2) is so connected to the piston-and-cylinder arrangements (C1,C3;C2,C4) that during a cutting stroke of the press it controls the flow of exhaust fluid from said arrangements, while during a return stroke it controls the flow of fluid being supplied to said arrangements to effect such stroke, and further in that the two sides of each piston-and-cylinder arrangement (C1,C2,C3,C4) are connected by a line (109) in which is a disposed a valve (CV13,CV23,CV33,CV43) which is closed during a cutting stroke of the press and open during a return stroke thereof.

2. Cutting press according to Claim 1 characterised in that each of said valves (CV13,CV23,CV33,CV43) disposed in a line (109) connecting the two sides of the piston-and-cylinder arrangements (C1,C2,C3,C4) has a pair of further valves (CV11,12;CV21,22;CV31,32;CV41,42) associated therewith, said further valves being arranged in parallel in a line (114) which, during the cutting stroke, connects the exhaust side of their associated piston-and-cylinder arrangement

(C1,C2,C3,C4) with the balancing valve (BV1;BV2), and in that the balancing valve has two ports at one side connected in common, when the valve is in equilibrium, to a third port at the other side, the pair of said further valves (CV11,12;CV21,22;CV31,32;CV41,42) being connected one to each of said two ports of the balancing valve, and the arrangement being such that in a cutting stroke of the press one (CV12;CV22;CV32;CV42) of said pair is closed and the other (CV11;CV21;CV31;CV41) open, while in a return stroke thereof said other is closed and said one open.

3. Cutting press according to Claim 2 characterised in that each of said pair of valves (CV11,12;CV21,22;CV31,32;CV41,42) is closed as aforesaid by pressure fluid supplied to its associated piston-and-cylinder arrangement (C1,C2,C3,C4).

4. Cutting press according to any one of the preceding Claims wherein the hydraulically operated means comprises four piston-and-cylinder arrangements (C1,C2,C3,C4) connected one at or adjacent each corner of the movable platen (24), and wherein the balancing mechanism (58) includes two balancing valves (BV1,BV2) and two linkage arrangements (64,68;78,80) by which said balancing valves are operated, each of said linkage arrangements being connected to diagonally opposite corners of the movable platen (24) and each balancing valve (BV1;BV2) being connected to the two piston-and-cylinder arrangements (C1,C2;C3,C4) mounted at or adjacent said corners, characterised in that in a return stroke of the press the two balancing valves (BV1,BV2) are supplied with pressure fluid from a common line (110).

5. Cutting press according to any one of the preceding Claims wherein control means (90) is provided whereby the pressure of the hydraulic fluid can be varied

between pre-set values according to whether a cutting stroke or a return stroke is being effected or the press is in idling condition, pressure setting means (130,140,142,SOL A) being provided for pre-setting such values, and characterised in that the control means (90) comprises means (RL5) whereby, at the end of a cutting stroke and prior to initiation of a return stroke, the pressure is switched from its pre-set "cutting" value to a lower pre-set value.

6. Cutting press according to Claim 5 characterised in that the pressure setting means (130,140,142,SOL A) comprises a plurality of variable resistors (potentiometers) (140,142) each of which, when rendered operative, controls a voltage output from a circuit containing it, and in that the control means (90) includes a solenoid-operated pressure relief valve (138) the solenoid (SOL A) of which is arranged to receive said voltage output and, in response thereto, sets the size of a pressure relief orifice of said valve (138).

7. Cutting press according to Claim 6 wherein the upper one (22) of the platens (22,24) is mounted for movement fore-and-aft of the press between a forward, operative, position, in which it is in opposed relationship with the other, lower, platen (24), and a retracted position, and wherein hydraulically operated means (34,36) is provided for effecting fore-and-aft movement of the upper platen (22), characterised in that said pressure relief valve (138) also controls the pressure of the fluid supplied to hydraulically operated means (34,36).

8. Cutting press according to Claim 7 wherein setting means (120,180,182) is provided for setting the retracted position of the upper platen (22), characterised in that said means (120,180,182) comprises a linear potentiometer (120), the output voltage of which varies with

the position of the upper platen, and an operator-settable reference potentiometer (180;182), and in that the setting means forms part of an electronic control circuit which also comprises a flow control valve (118) which operates in response to signals generated by the setting means (120,180-186) and also by which the rate of acceleration and deceleration of the cutting head (22) and its maximum velocity during fore-and-aft movement is controlled.

9. Cutting press according to Claim 8 characterised in that in response to a signal generated by the setting means (120,180-186) the fore-and-aft movement of the upper platen (22) is first decelerated to a 'creep' speed under the control of the flow control valve (118) and is thereafter terminated by the operation of a further valve (SVH) also forming part of the control circuit.

0207639

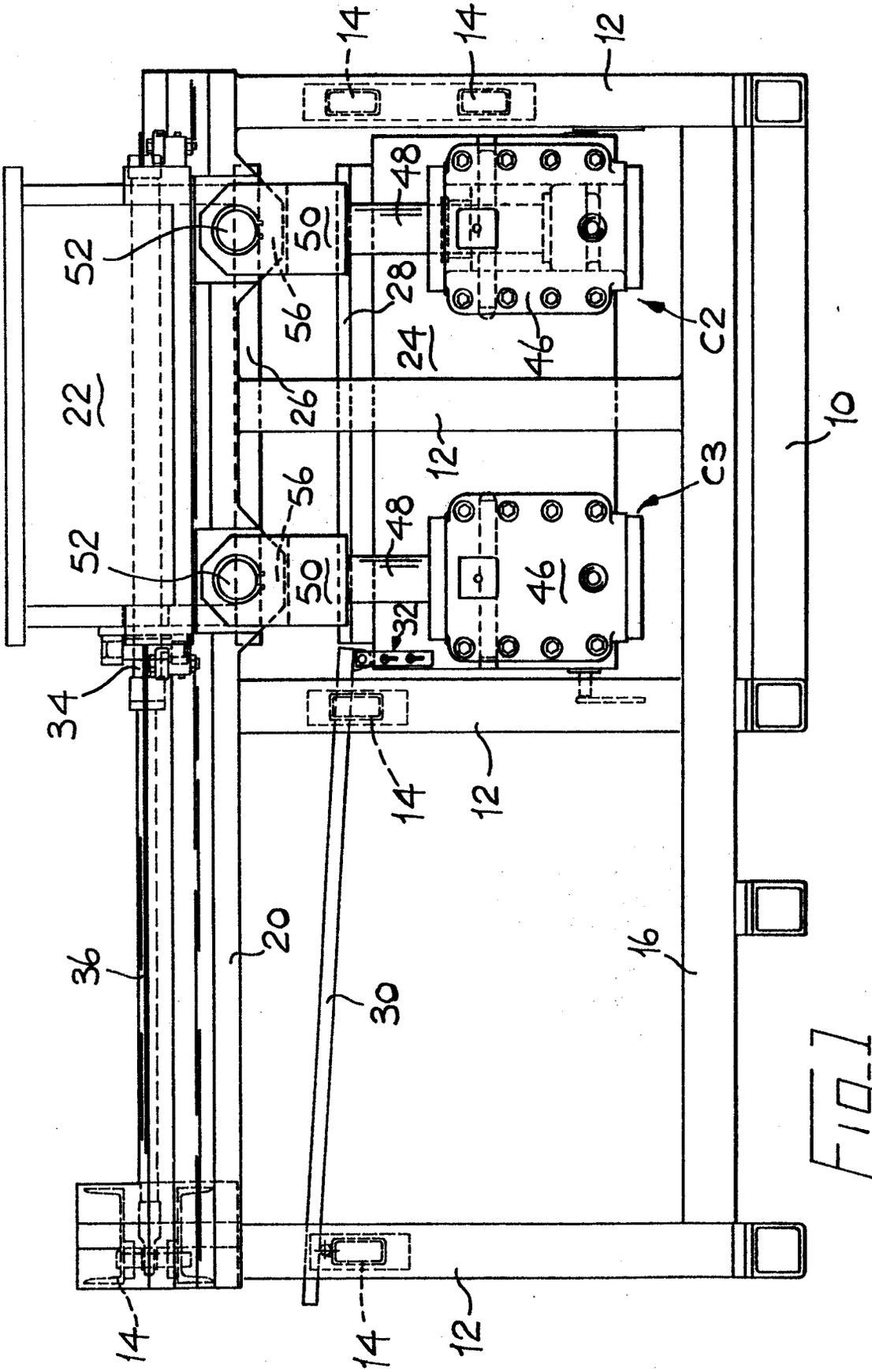

FIG-1

0207639

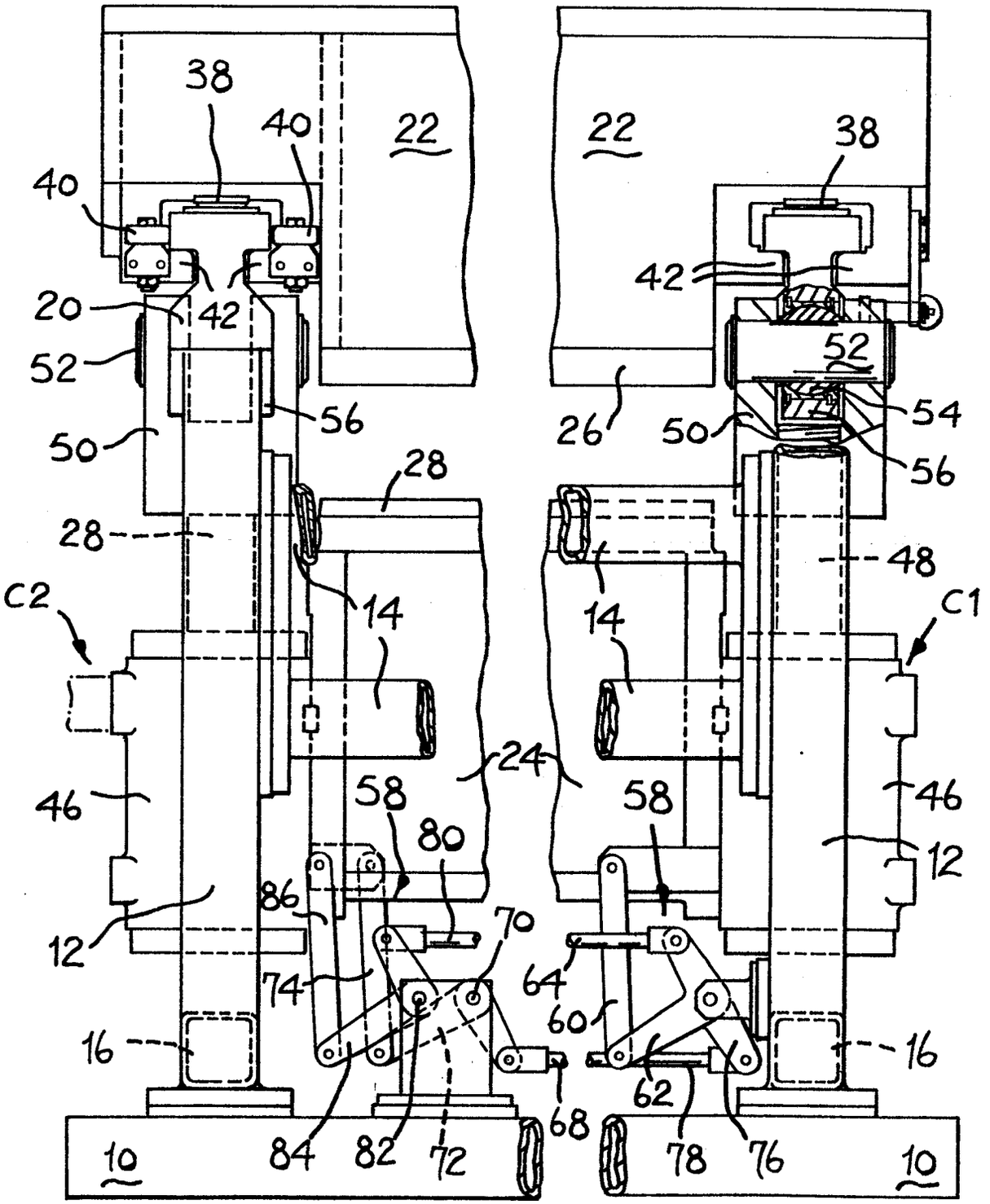

Fig_2

0207639

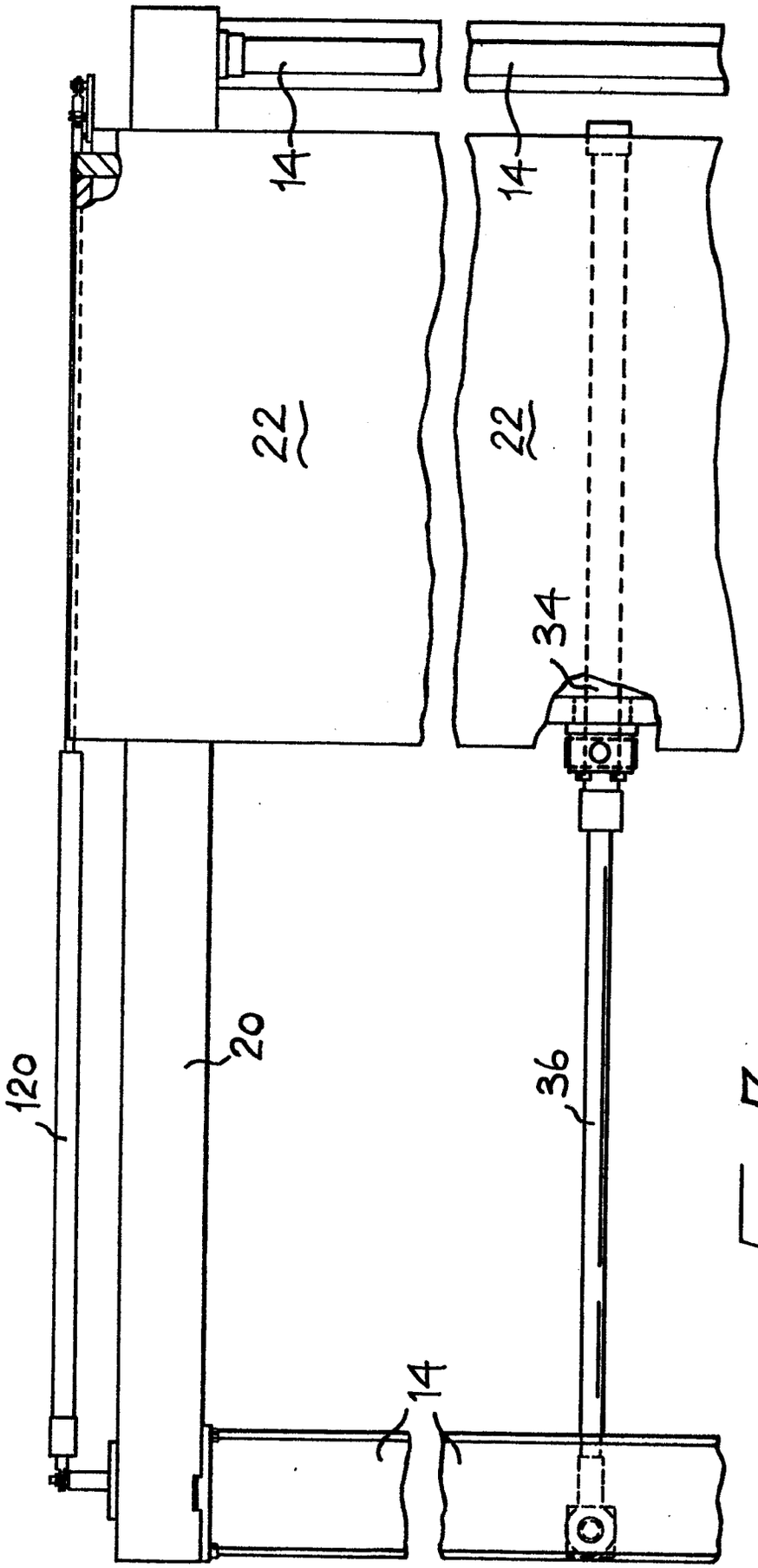

Fig 3

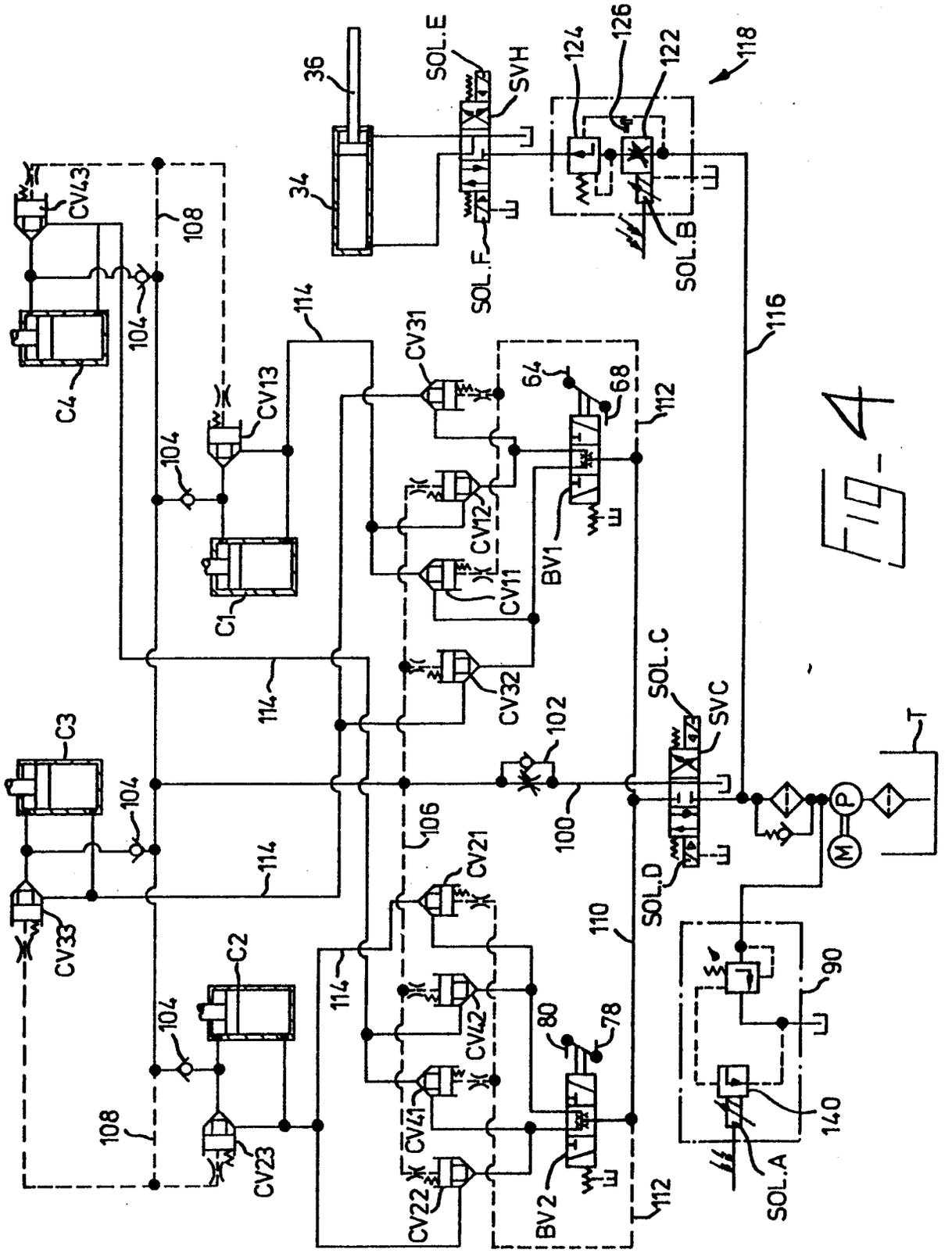
36
34
SOL.E
SVH
SOL.F
124
126
122
118
SOL.B
116
CV43
108
104
C4
CV13
C1
114
CV31
64
68
112
CV12
CV11
BV1
CV32
102
SOL.C
SVC
T
C3
CV33
106
100
CV21
SOL.D
110
C2
CV42
80
78
90
CV41
CV23
CV22
BV2
140
SOL.A

FIG-4

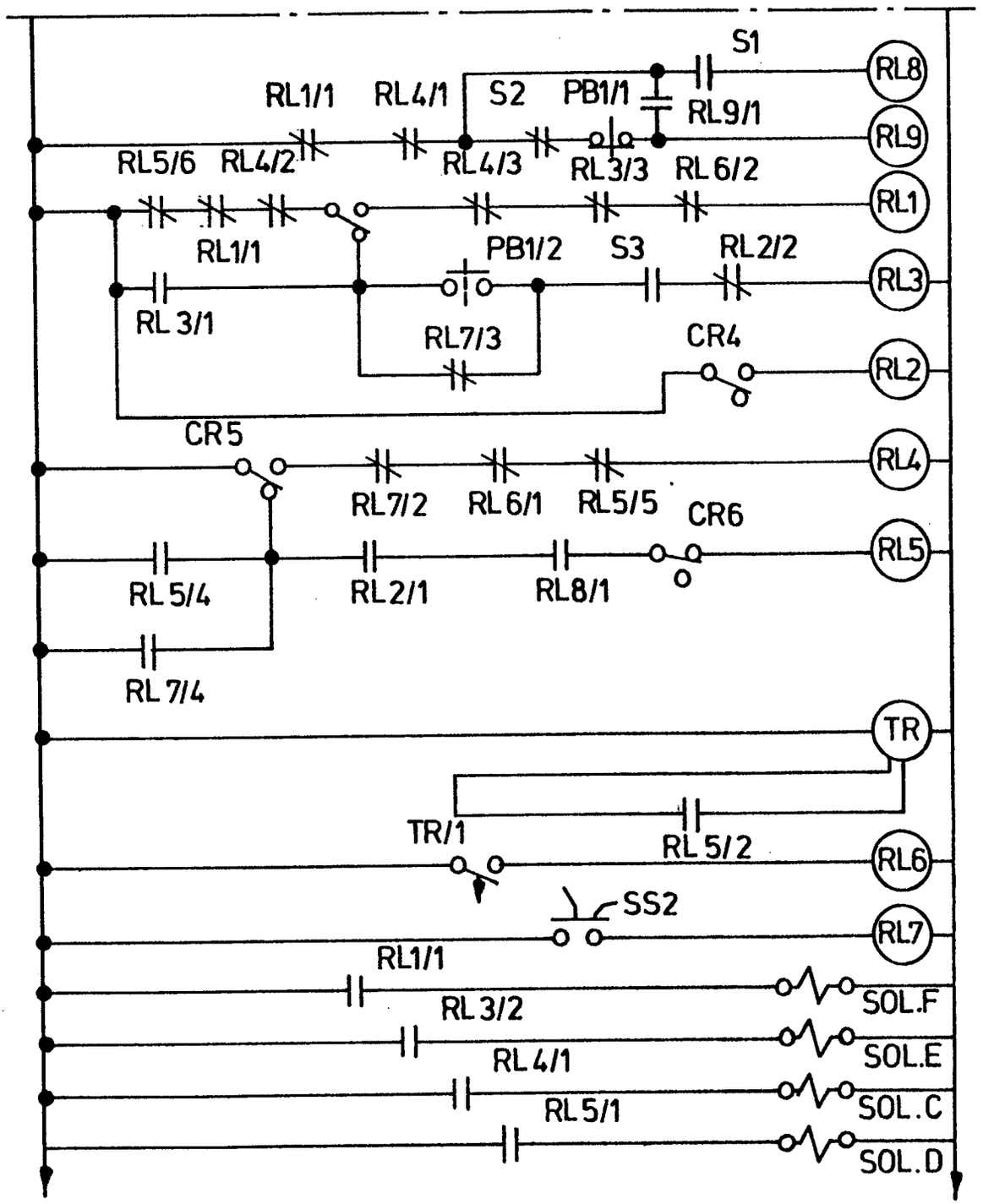
S1
RL8
RL1/1
RL4/1
S2
PB1/1
RL9/1
RL9
RL5/6
RL4/2
RL4/3
RL3/3
RL6/2
RL1
RL1/1
PB1/2
S3
RL2/2
RL3
RL 3/1
RL7/3
CR4
RL2
CR5
RL4
RL7/2
RL6/1
RL5/5
CR6
RL5
RL5/4
RL2/1
RL8/1
RL7/4
TR
TR/1
RL5/2
RL6
SS2
RL7
RL1/1
RL3/2
SOL.F
RL4/1
SOL.E
RL5/1
SOL.C
SOL.D

Fig-5

0207639

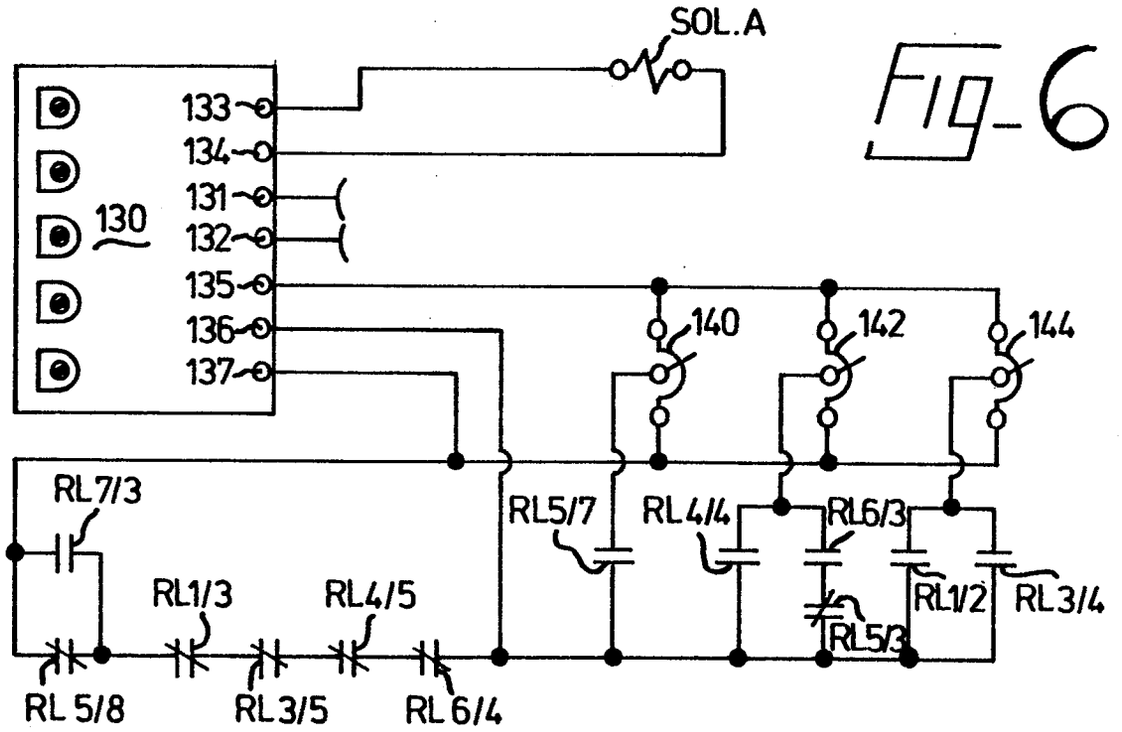

Fig_6

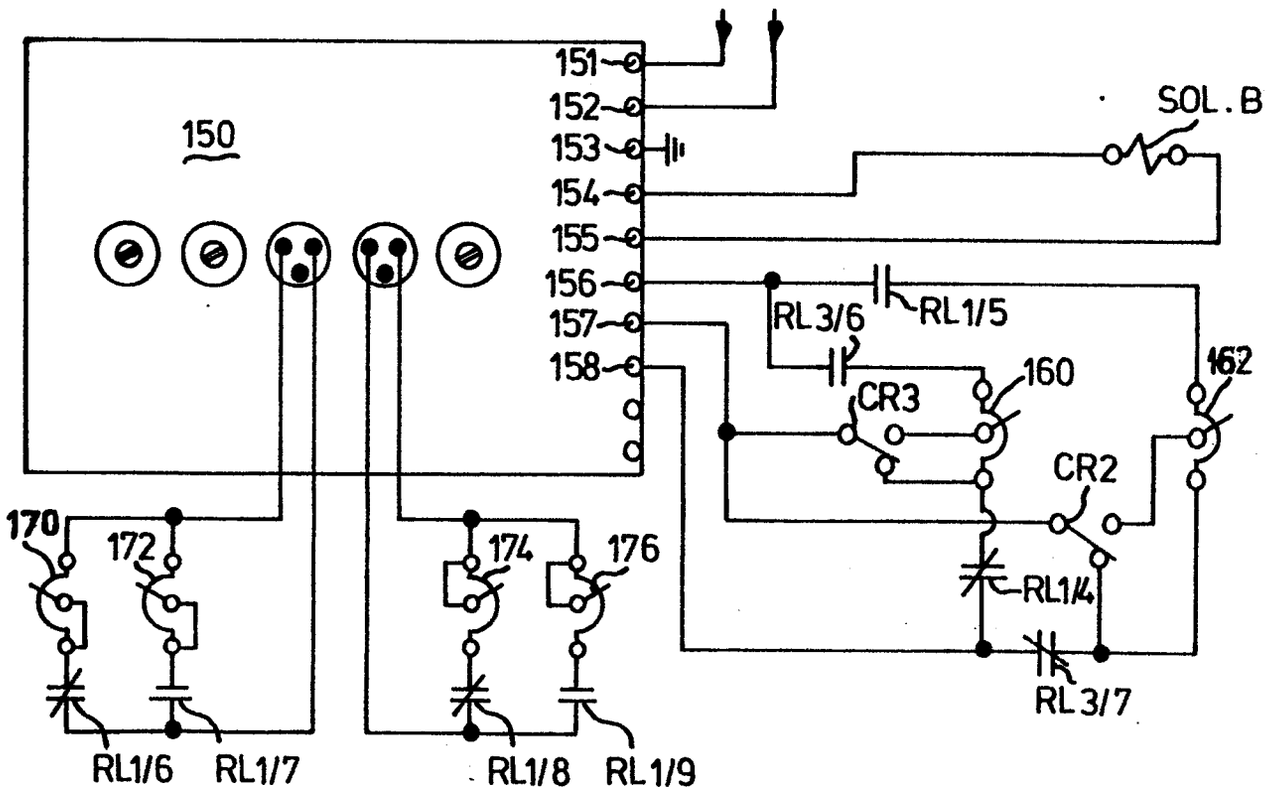

Fig_7

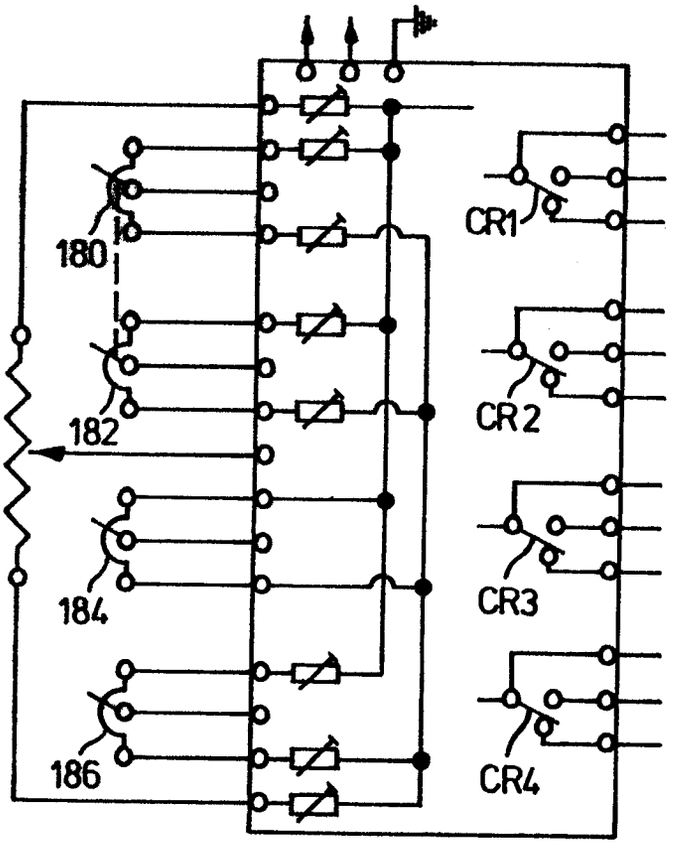

Fig_8

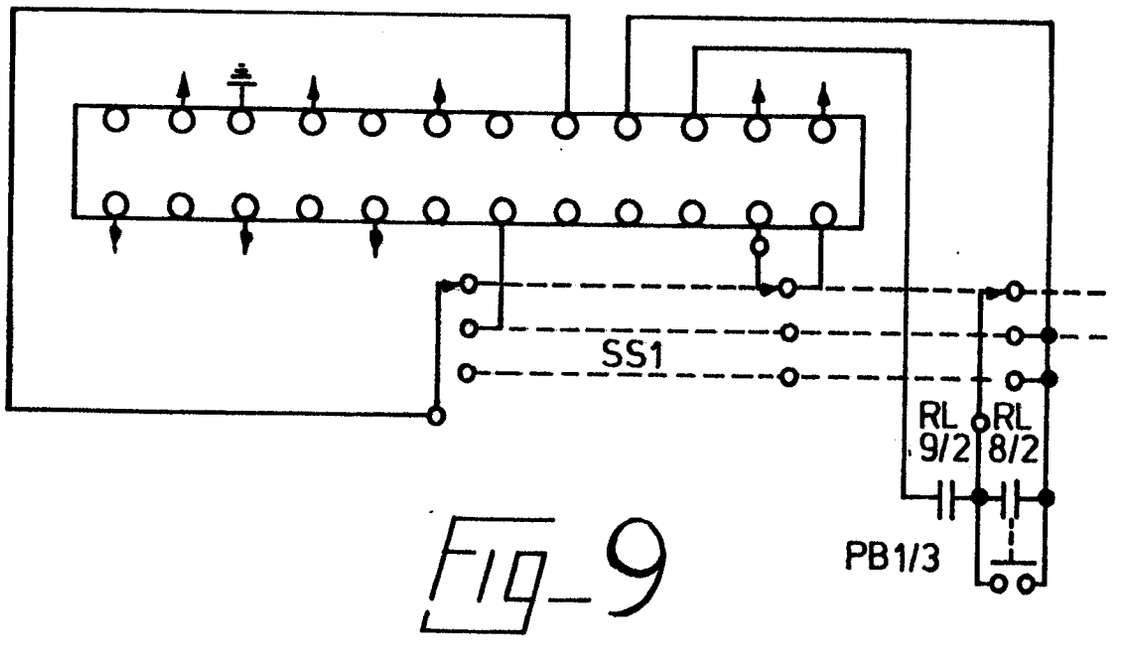

Fig_9

European Patent Office

EUROPEAN SEARCH REPORT

Application number 0207639

DOCUMENTS CONSIDERED TO BE RELEVANT

EP 86304206.5

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	FR - A - 2 082 710 (CHAPIUS) * Fig. 2 * --		B 30 B 15/24 F 15 B 11/22
A	GB - A - 1 128 716 (PACIFIC) * Fig. 1 * --		
A	GB - A - 1 274 082 (NIAGARA) * Fig. * --		
A	US - A - 3 464 320 (RICHARDSON) * Fig. 1 * --		
A	FR - A - 2 196 861 (USM) * Fig. 8 * ----		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 21 D
B 23 D
B 26 F
B 30 B
F 15 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	04-09-1986	GLAUNACH

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503 03 82