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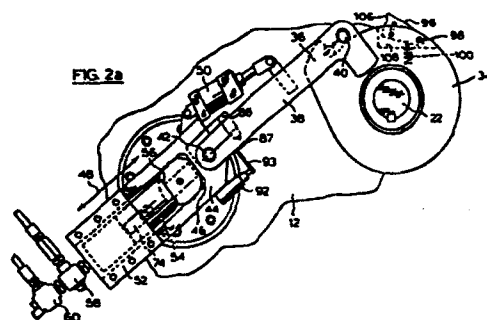
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54 Safety devices for mechanically operated apparatus such as punch presses.

57 A safety device for mechanically-operated apparatus, such as a flywheel-driven punch press, consists of a hook-providing coupling member (34,36) for mounting on the press crank shaft (22), and a cooperating coupling member (38,40) for connection to the apparatus body via a power-absorbing member (52-60). The coupling members (38,40) rest in the coupled position and are moved momentarily to the uncoupled position upon initiation of an operation by the operator. If therefore the movable member (20) of the press continues to move after the normal termination of the cycle the coupled members (36,40) connect the movable member (20) to the power-absorbing member (52-60) so that the movable member (20) is brought to a stop before the press die parts can close. The power-absorbing member (52-60) preferably is a hydraulic piston (54) and cylinder (52) device connected between one coupling member and the press body, the liquid in the cylinder interior becoming pressurised and discharging via a pre-set relief valve or calibrated orifice (58,60) when the device is operative.



- 1 -

SAFETY DEVICES FOR MECHANICALLY
OPERATED APPARATUS SUCH AS PUNCH PRESSES

The present invention is concerned with safety devices for mechanically-operated apparatus of the kind where an operating member is intermittently driven to perform a work operation by actuation of a clutch linking it to a drive means. An example is
5 a punch press which has as immediate drive means a flywheel acting as energy-storage means.

There have been numerous proposals hitherto for many different kinds of safety devices for manually-operated apparatus of the kind specified,
10 such as presses and guillotines, all with the purpose of attempting to ensure the safety of the operator. For example, it is common to provide two spaced pushbuttons that must operate simultaneously to
15 initiate operation of the apparatus, so that the operator's hands must be removed from the danger area for this purpose. Other proposals involve the use of guards which are interposed between the operator and the danger area while the apparatus is in operation.

Such apparatus almost invariably consists of a movable member driven from a power-storage drive means, such as a motor-driven flywheel, via a clutch and brake combination that is effective to clutch
5 together the drive means and the movable member for operation of the latter, and to brake the movement of the member when the clutch is disengaged. A particularly dangerous malfunction can occur if the clutch should fail to disengage upon termination of a
10 cycle of operation, perhaps due to wear or jamming of the clutch plates, or the brake should fail to engage, since the movable member will then continue its movement with maximum momentum, at a time when the operator is not expecting such movement, and
15 may have placed a hand or hands into the path of the member.

It is an object of the present invention to provide a new safety device for mechanically-operated apparatus that will positively stop motion of the
20 moving parts of the press and thus protect the operator thereof.

It is a more specific object to provide a new safety device for mechanically-operated apparatus that is effective by absorbing the power of the moving parts
25 of the apparatus upon malfunction that may endanger the operator.

For these purposes coupling parts are provided in a safety device which can act so as to engage with each other. One is associated with the drive means such
30 as the flywheel, and may rotate with it about the same

axis, a second coupling part anchored to the body of the apparatus via an energy-absorbing device. If the parts become engaged at a time when operation of the apparatus is not intended the power from the drive means is absorbed by the energy-absorbing device and the work operation is not carried out. This allows the capacity of the energy-absorbing device to be calculated or regulated so as to be compatible with the characteristics of the apparatus.

10 Disengagement of the parts is effected only deliberately by the operator of the machine using (for example) pre-existing spaced control buttons.

To allow one of the coupling parts to be associated with rotating drive means a disc form for this part is particularly appropriate since a discontinuity in or on it, e.g. a hook on its periphery, may engage with a catch on the other coupling part; and that other part may straddle the edge of the disc so that it is guided and supported by the wheel.

20 It will then execute generally radial movements to allow it to engage with or go clear from the discontinuity.

The energy absorbing device will be one which alters its length during traction exerted between the coupling parts and the body of the apparatus. Collapsible links may be used, but clearly are one-time only; a fluid cylinder may obviously be reusable especially if linked to a fluid reservoir so as to recycle fluid expelled on operation. In either case the anchoring to the body can be carried out in such a way that the

30 anchor becomes an abutment of last resort if the energy

of the drive should exceed the capacity of the energy-absorbing device.

Furthermore the deliberate disengagement movement of the coupling parts may be used to signal electrically that such disengagement has occurred and allow the initiation of the mechanical work operation; then it is only as a result of later malfunction either of the clutch or of the main brake of the apparatus that the safety device can be called upon to act.

In some cases it may be that the energy transfer is so great that the apparatus will rebound and work in reverse. This would be dangerous, and to prevent it a third coupling part may be associated with the coupling part associated with the drive means. This third part is a unidirectional latch or non-return device acting to prevent rotation in a sense opposite to that in which the second coupling part (when engaged) would prevent rotation.

A safety device for a punch press, which device is a particularly preferred embodiment of the invention, will now be described, by way of example, with reference to the accompanying diagrammatic drawings, showing the device installed on the punch press, wherein:-

Fig.1 is a general perspective view of the press with a safety device of the invention installed thereon,

Fig.2a is a side elevation of the safety device of Fig.1, showing it in operative position ready to brake movement of the press operating member,

Fig.2b is a similar view to Fig.2a showing the safety device in inoperative position upon initiation of

an operation of the press,

Fig.2c is a similar view to Figure 2a showing the safety device having operated successfully and braked the press operating member,

Figs. 3a and 3b are plan views of the safety device corresponding respectively to Figs. 2a and 2c,

FIGURE 4 is a schematic diagram of the part of the press hydraulic and pneumatic circuits pertinent to this invention, and

FIGURE 5 is a schematic diagram of the part of the press electric circuit pertinent to this invention.

The punch press shown in Figure 1 is of a well-known type consisting of a massive base 10 to which a vertically-extending body 12 is pivoted at 14 and clamped at 16, so that the body can be tilted back when required, e.g. to facilitate removal of parts from the die. The body has a horizontal platen 18 to which the lower fixed die part is fastened, while the vertically-movable upper platen 20 for the other die part is connected to the crank shaft 22 by a pitman 24 mounted on shaft 22. In this press a power-storing means for driving the press include the shaft 22 and a flywheel 26 driven by any of the many known arrangements from an electric motor mounted on the press body. The shaft 22 is driven from the flywheel 26 via a controllable clutch 28 disposed behind the flywheel as seen in Figure 1, this clutch being usually of the so-called "part-revolution" type, which may be engaged or released during any part of a cycle. In single-cycle mode it will stay engaged for one revolution and then automatically disengage, so that it must be re-engaged for each stroke of the press. The safety device of the invention may also be employed with the so-called "full" revolution type of clutch which, when once engaged, cannot be released until the end of each complete cycle. The clutch has associated therewith a brake 30 which is released as the clutch 28 is actuated, and is re-applied as the clutch disengages so as to brake the movement of the platen 20. In the embodiment illustrated the clutch is of the air-operated type engaged by application of air under pressure and

and is spring-released, and vice versa for the brake, although for example an electrically operated clutch and/or brake could be employed instead.

Operation of the press is initiated by the operator pushing two spaced pushbuttons 32 simultaneously. The safety device is operative as will be described below if for any reason the clutch should fail to disengage, for example, if the clutch plates should jam or bind in their engaged position, perhaps because of wear or the presence of a solid foreign body between them, and/or the brake should fail to engage because of some corresponding failure.

Turning now also to Figures 2 and 3, the safety device includes a first coupling member consisting in this embodiment of a disc 34 mounted on the shaft 22 and rotatable therewith about its longitudinal axis, the disc having a radially-outwardly-extending hook portion 36. A second coupling member cooperating with the first member in this embodiment consists of two spaced parallel L-shaped arms 38 that embrace the disc on either side thereof and carry between them a coupling pin 40 for engagement with the hook portion 36. The two arms are pivoted at 42 to a frame 44 mounted on and embracing a stop bar 46 rigidly fastened to the body and extending parallel to the shaft 22, the frame being movable on this bar in the direction of the arrows 48.

The coupling member arms 38 move by the positive action of a double-acting air motor 50 to a coupling position shown in Figures 2a and 2c, in which the pin 40 must engage the hook portion 36 as the disc 34 rotates, and are moved to a non-coupling position shown in Figure 2b by the operation of the motor 50, which is connected between the arms and the frame 44. The end of the frame further from the pivot 42 is formed as a

hydraulic cylinder 52 in which is mounted a piston 54 that engages a flat axially-extending surface 56 on the stop bar 46. The interior of the cylinder 52 is connected via a one-way valve 58 to a relief valve 5 60, the setting of which is controllable by the operator. Alternatively the valves 58 and 60 may be replaced by a calibrated orifice. A suitable operating fluid, such as an oil, is fed to the cylinder 52 from an air/oil tank 62 (Figure 4), to which oil discharged 10 from the valve 60 is returned. The interior of the tank 62 is pressurised by supply of air thereto through a regulator 64. The pressurised air from the regulator 64 is also fed via a solenoid-operated four-way valve 66 to the cylinder of pneumatic motor 50, the air that 15 escapes from the valve passing to atmosphere through a silencer 68.

Referring now also to Figure 5, electric power is fed to the control circuit from a transformer 70 via panel on-off switch 72 and micro-switch 74 (Figures 3a 20 and 3b), the latter being mounted on the frame 12 and engagable by the cylinder 52 if the safety device becomes operative, as illustrated by Figure 3b. The drive motor 76 is started by closure of start switch 78 and held in operation by hold-in contacts 80 until 25 stopped by opening of stop switch 82; in commercial practice the motor will usually be of three-phase type though a single-phase arrangement is shown for simplicity of illustration. The safety device is not required for continuous non-attended operation of the press, and can 30 at such times be disabled by closing a switch 84. A micro-switch 86 is mounted on the frame 12, and is operated by a member 87 on the arms 38 the switch having a pair of contacts 86a in series with respective contacts 32a of the pushbuttons 32, and another normally-open

pair 86b which are in series with contacts 32b of the pushbuttons 32 and also with the windings of solenoid valves 88 and 90 controlling respectively the clutch 28 and the brake 30. Another micro-switch 92 mounted on the frame 44 is operated by a member 93 on the arms 38. The function of switches 86 and 92 will be described below.

The closing of the pushbuttons 32 will not produce operation of the press unless the arms 38 are in the position shown in Figure 2a, when contacts 86a and 92 are closed; when contacts 86a are closed contacts 86b are open, and vice versa. A variable time delay relay 94 now operates closing its contacts 94b so that power is supplied to solenoid relay 66 to operate air motor 50. The arms now lift to the uncoupling position of Figure 2b opening switch 92 and contacts 86b, so that power is now supplied to solenoid valves 88 and 90 engaging the clutch and releasing the brake. The downwardly-extending portions of the L-shaped arms ensure that they will remain embracing the disc 34 in the uncoupled position. After a preset time delay contact 94a of the relay open and solenoid 66 operates motor 50 to force the arms downward back to the engaging position, closing contacts 86a and switch 92, and opening contacts 86b. This predetermined period is such that the hook portion of disc 34 rotates beyond the position in which it can be engaged by the pin 40 when the arms return to their coupled position.

If the press is functioning normally the clutch will disengage and the brake will engage in time for the shaft 22 and disc 34 to come to rest in the position shown in Figure 2a, ready for the next cycle of operation. If however the clutch fails to disengage and/or the brake is not operative then the disc will continue its rotation

with hook portion 36 and pin 40 in coupled position, so that frame 44 is pulled to the right as seen in the Figures, forcing the piston 54 into the cylinder 52 against the reaction of the stop member 46. The action
5 of the piston 54, cylinder 52 and stop valve 60 (or the above-mentioned calibrated orifice) is to provide a cushioned power-absorbing, safety braking of the downwardly-moving platen 20, the hydraulic system being rated to stop the downward movement before the die parts
10 on the respective platens come close enough to one another to injure the operator whose hands may be in the die area. This corresponds to the position in which the piston 54 reaches the end of the cylinder 52, in which case the bar 46 would provide a final positive stop.

15 Preferably, the hydraulic system is rated to stop the crank shaft 22 in about 30° or less of its rotation. It will be appreciated that owing to the large amount of power stored in the flywheel this may rotate through considerably more than 30° by over-running
20 the clutch and the brake, but this is immaterial as long as the downward movement of the platen is stopped in good time. The movement of the frame 44 to the Figure 2c position opens switch 92 to stop the press entirely until the cause of the failure has been checked
25 and the system reset.

It may be found that, if the safety device has been applied upon failure of the press brake, there may be enough energy stored in the safety device to cause the crankshaft to reverse its rotation and the platen
30 to reverse its movement and move downwards sufficiently to injure the operator. This possibility is prevented by the provision of a third coupling member consisting of a reverse stop latch 96 which is pivoted to the disc 34 about an axis 98 and is urged radially outward by a

compression spring 100, the radially outermost position of the latch being determined by a pin 102 engaged in an arcuate slot 104. The nose 106 of the reverse stop latch faces in the opposite direction to that of the disc hook portion 36, and engagement of the latch nose 106 with the coupling pin 40 while the disc is rotating normally merely moves the latch radially inwards out of the path of the pin and against the action of the spring 100 into a recess 108 in the disc. However, any reverse rotation of the disc after engagement of the hook portion 36 and pin 40 is prevented by engagement of the latch nose 106 and pin 40. Other equivalent constructions can of course be employed.

A power-absorbing hydraulic system is in general commercial practice the most satisfactory, since it is compact and capable of immediate re-setting once the device has operated successfully, so that output can be maintained. An equivalent pneumatic system would require the use of a much larger cylinder 52 and piston 54, and also the use of high pressure air, owing to the much higher compressibility of air. It is contemplated that the cylinder 52 and piston 54 could be replaced by a crushable power-absorbing element, as used for example in automobile steering columns; such an element must be replaced each time that the safety device is operative, but that is relatively infrequently, and such a structure is very much cheaper to manufacture than the above-described hydraulic system, so that it may be preferred in certain installations.

CLAIMS:

1. A safety device for use in combination with mechanically-operated apparatus with an operating member driven to perform a work operation through a clutch from a drive means, characterised in that the safety device
5 comprises a first coupling member (34,36) adapted for connection with the drive source to be movable therewith; a second coupling member (40) normally positionable in a coupling position for coupling engagement with the said first coupling member; means (50) for moving one of the
10 coupling members (34,36; 40) to an uncoupling position upon initiation of actuation of the clutch, the thus-moved coupling member returning to the said coupling position before completion of a work operation; and a power-absorbing member (52-60) for connection to the
15 second coupling member (40) and adapted to brake the movement of the operating member upon failure of the coupling members to uncouple.
2. A safety device as claimed in claim 1, wherein the said first coupling member (34,36) is a radially-
20 extending hook member (36) adapted to be mounted on a shaft (22) for rotation therewith, and said second coupling member (40) includes an arm (38) pivoted to the said power-absorbing member (52-60) for movement between the said coupled and uncoupled positions.
- 25 3. A safety device as claimed in Claim 2 wherein means (50) for moving the said arm (38) between coupling and uncoupling positions include a pneumatic motor (50) connected to the arm and operable upon operation of the apparatus to move the arm to the said uncoupling position for a predetermined period.

4. A safety device as claimed in Claim 2 or Claim 3, wherein the said power-absorbing member (52-60) comprises a piston (54) and cylinder (52) to one of which the said arm (38) is pivoted (42), and a relief valve or calibrated orifice (58,60) connected to the cylinder interior and adapted to relieve the fluid contents of the cylinder (52) upon operation of the device.

5. A safety device as claimed in Claim 4, wherein the said piston (54) and cylinder (52) are operative between the said arm (38) and a stationary member (46), the member (46) providing a positive abutment stop for the safety device after maximum power absorption by the power-absorbing member (52-60).

6. A safety device as claimed in Claim 4 or Claim 5, wherein the said cylinder (52) comprises a frame embracing a or the stationary member (46), the said arm (38) being pivotally connected to the frame, and the piston (54) being operative between the cylinder and the stationary member (46) so as to enter the cylinder (52) for power absorption upon operation of the safety device.

7. A safety device as claimed in any one of Claims 4 to 6, and including a liquid reservoir (62), means (64) for pressurising the reservoir interior, pipe means connecting the reservoir to the cylinder (52) for supply of the liquid thereto, and a duct connecting the relief valve (58) and the reservoir interior upon operation of the safety device.

8. A safety device as claimed in any one of the preceding claims, wherein the said first coupling member (34,36) is a disc (34) having a radially-extending hook

portion (36), and the said second coupling member (40) includes a pair of spaced arms (38) one at each face of the said disc (34) and having a bridging member (40) connecting the arms for engagement with the said hook portion (36), the said spaced arms (38) being pivoted (42) to the power-absorbing member (52-60).

9. A safety device as claimed in Claim 8 wherein said arms (38) are of L-shape, with respective legs thereof extending radially of the disc (34) to extend respectively over at least a marginal portion of the faces of the disc during their movement between coupled and uncoupled positions.

10. A safety device as claimed in any one of the preceding claims wherein the drive source includes an electric motor (76), and the device includes an electric switch (92) adapted for engagement by the said second coupling member (38,40) upon operation of the safety device and operable upon such engagement to stop the supply of power to the said electric motor.

11. A safety device as claimed in Claim 10, wherein means for operating the said pneumatic motor (50) comprise a solenoid-operated valve (66) supplying operating air to the motor, a time delay relay (94) connected to supply electric current to the solenoid-operated valve, an operator-controlled-electric switch (32) connected to the time delay relay to initiate operation thereof, and another electric switch (86) operated by the said coupling member that is moved to the uncoupling position for permitting operation of the operator-controlled switch, whereby operation of the operator-controlled switch (32)

operates the time delay relay (94) to operate the solenoid valve (66) to operate the motor (50) to move the coupling member (38,40) to uncoupled position, the relay (94) after a predetermined time delay operating the solenoid valve (66) to operate the motor (50) to move the coupling member (38,40) back to the uncoupled position.

12. A safety device as claimed in any one of the preceding claims, and including an electric switch (86) adapted for engagement by the said second coupling member (38,40) in the said uncoupling position and operable only upon such engagement to permit actuation of the clutch.

13. A safety device as claimed in any one of the preceding claims, and including a third coupling member (96) positioned for coupling engagement with the said second coupling member (40) to brake the movement of the operating member (20) upon reverse movement of the operating member.

14. A safety device as claimed in Claim 13, wherein the said third (96) coupling member is a radially-extending, radially-movable unidirectional latch member.

15. A safety device as claimed in Claim 14, wherein the said third coupling latch member (96) is spring-urged (100) for radial movement into engagement with the second coupling member upon reverse movement of the operating member, the spring (100) permitting movement of the third coupling member (96) out of the path of the second coupling member (40) upon forward movement of the operating member.

16. A mechanically operated apparatus such as a power press, which has an operating member driven to perform a work operation through a clutch from a drive means, equipped with a safety device as claimed in any one of the preceding claims.

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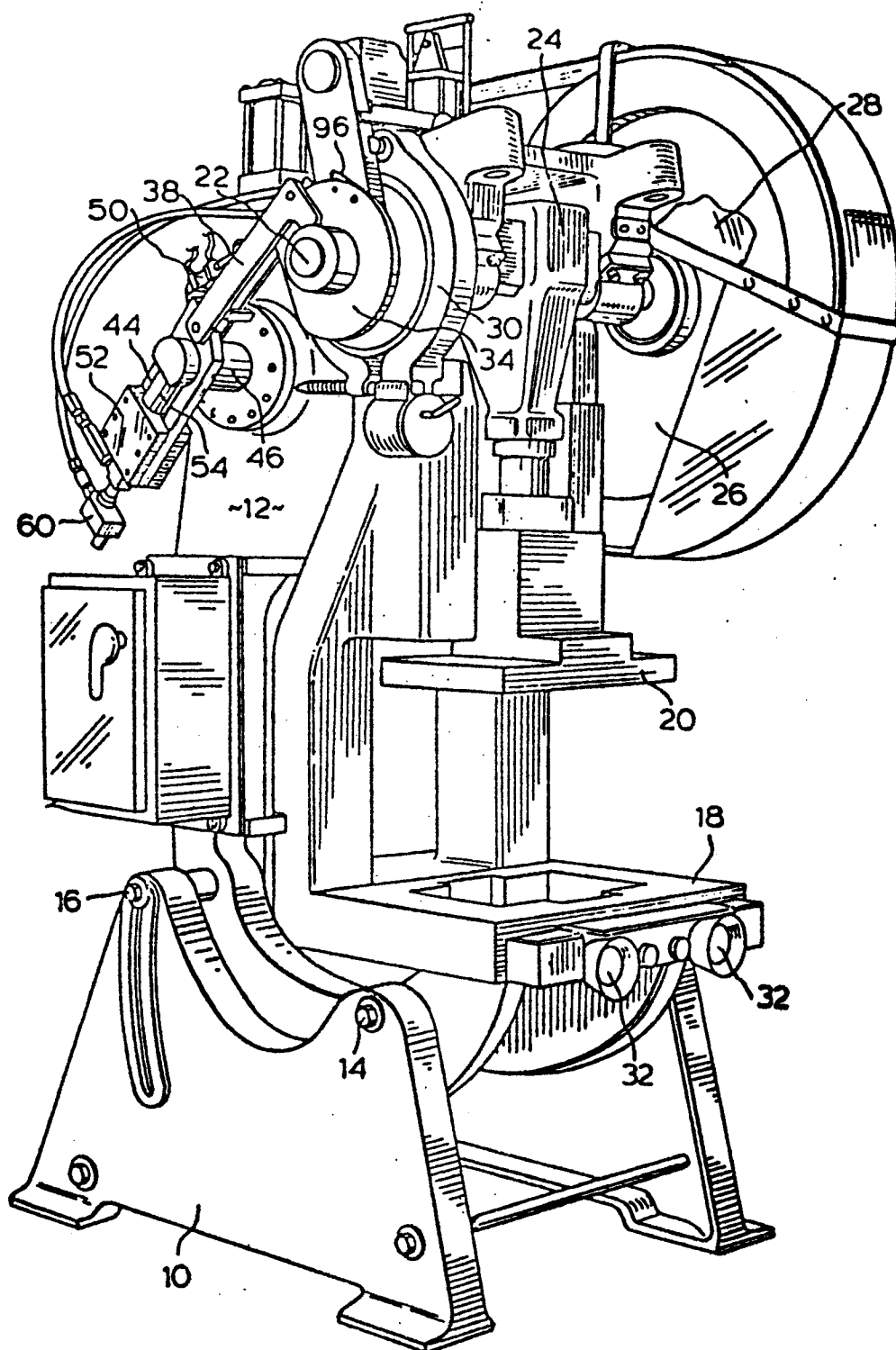


FIG. 1

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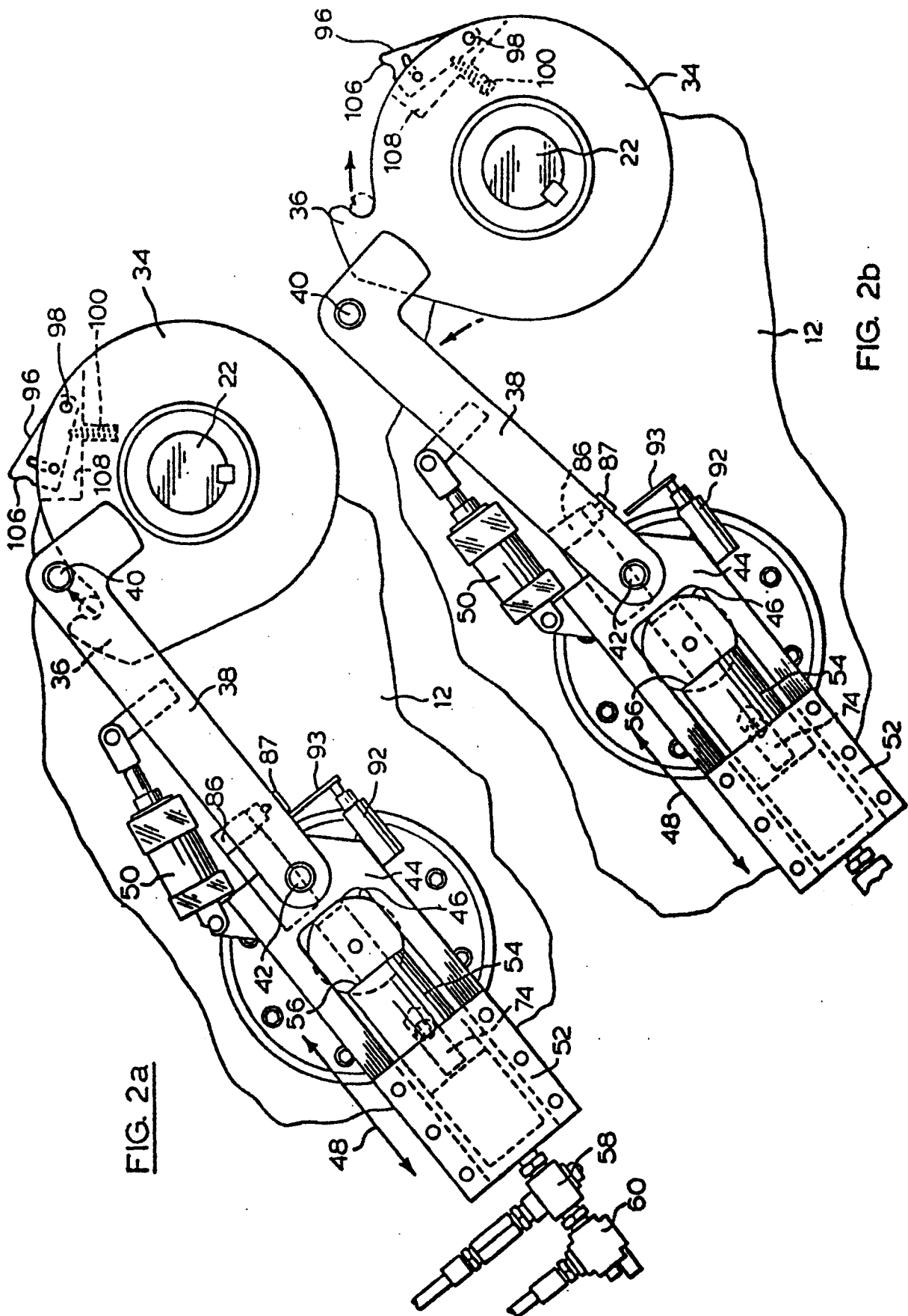
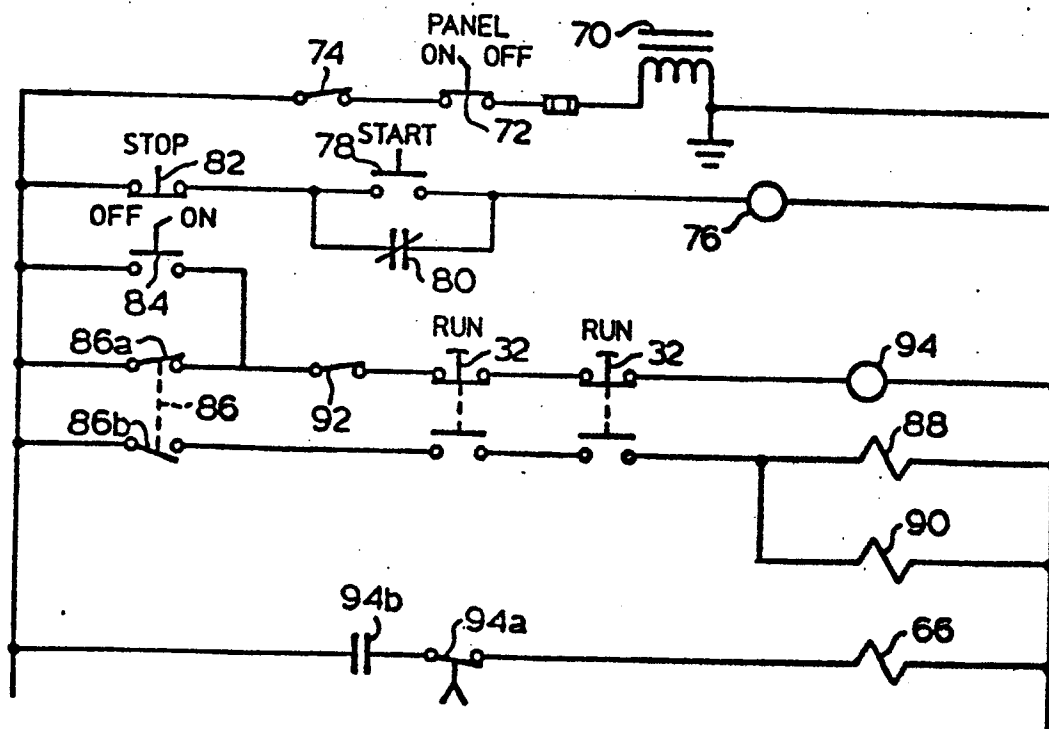
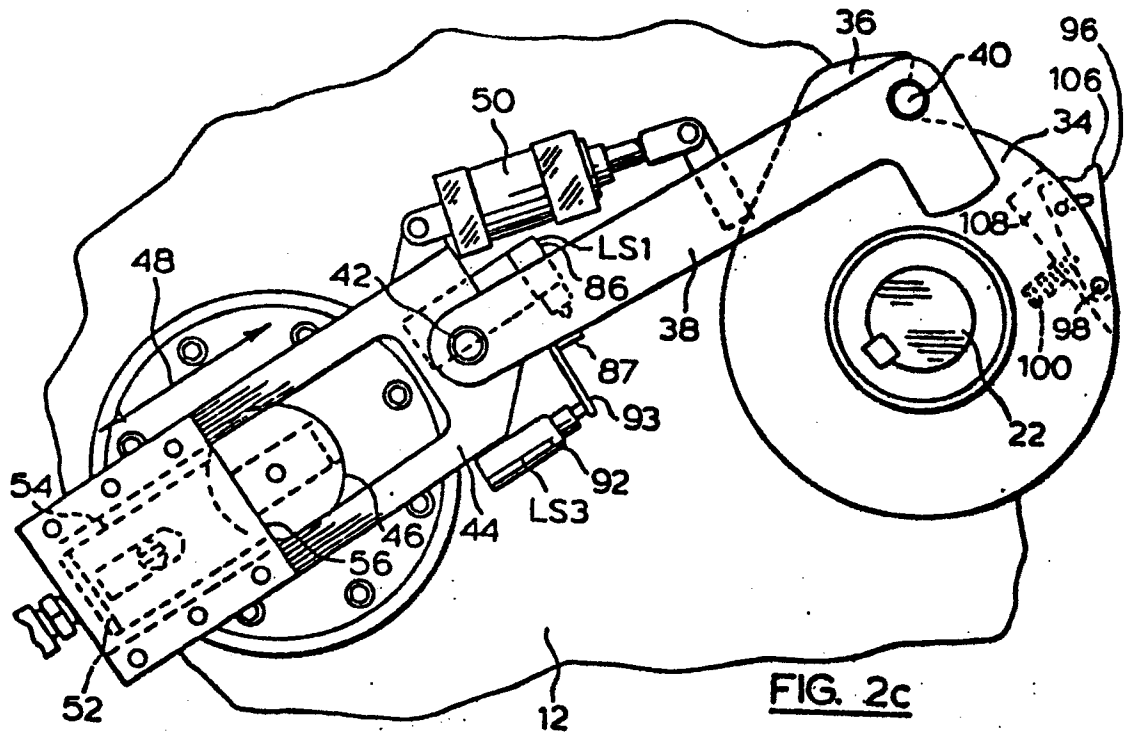


FIG. 2a

FIG. 2b

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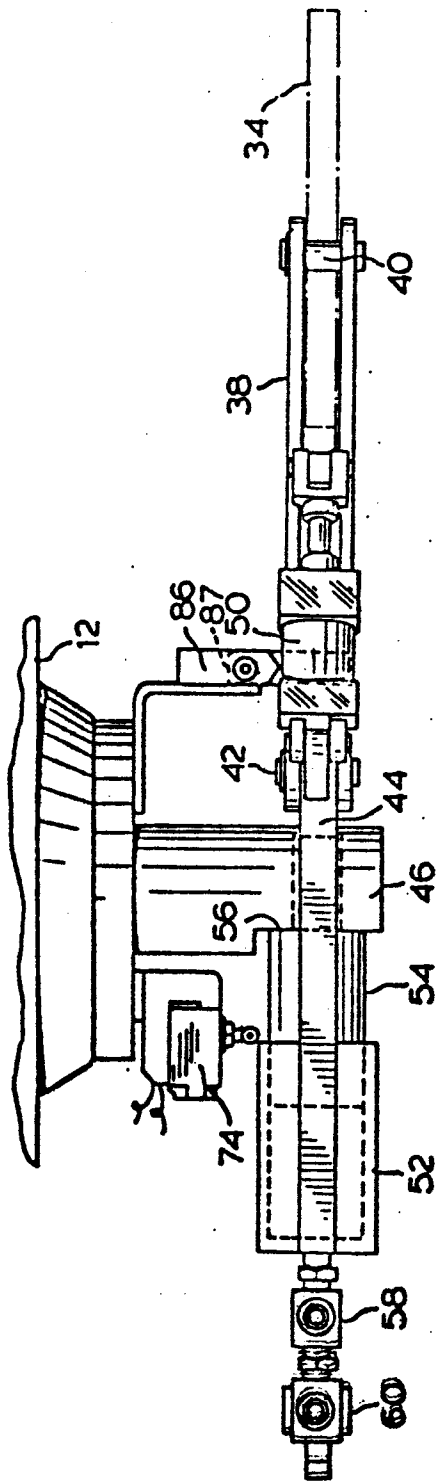


FIG. 3a

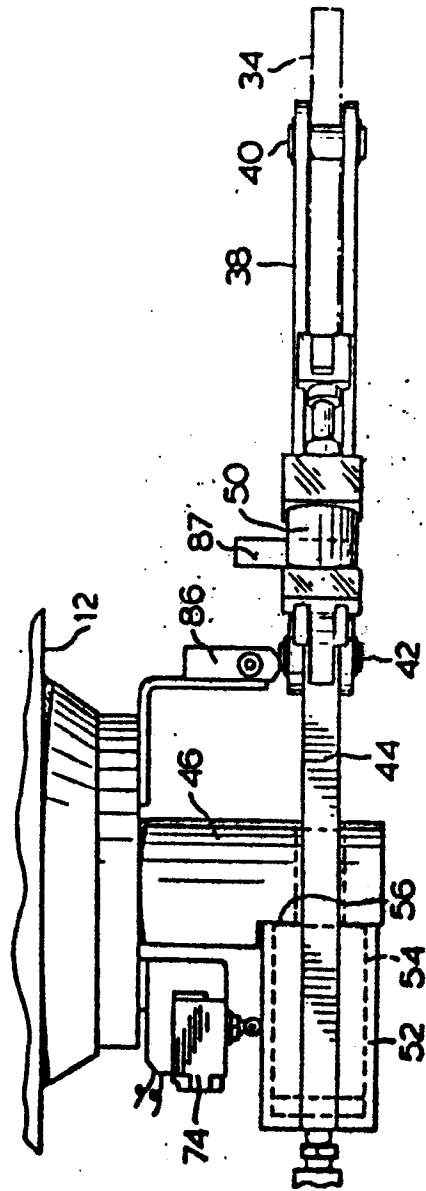


FIG. 3b

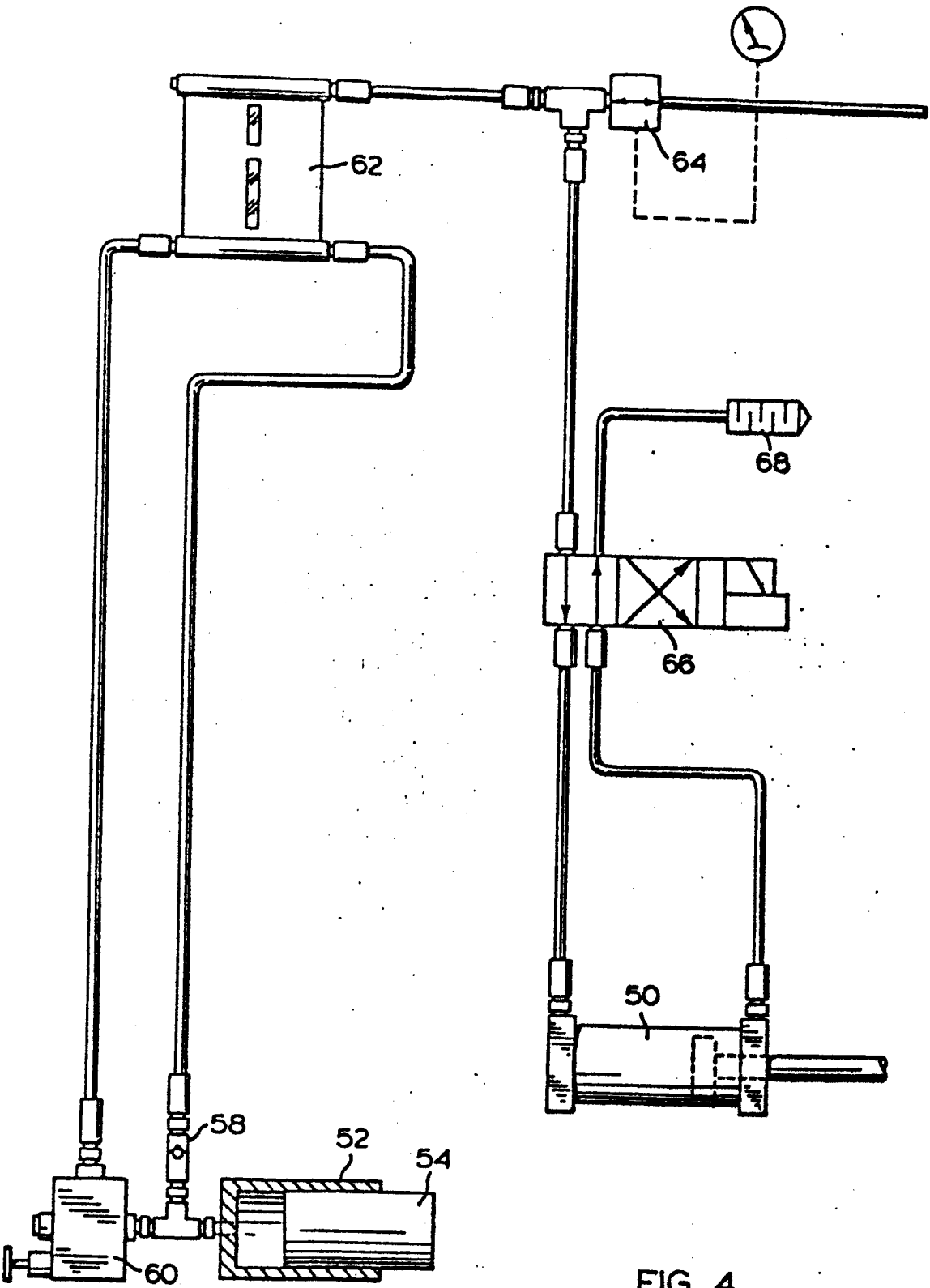


FIG. 4



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EUROPEAN SEARCH REPORT

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Application number

EP 79 30 0872

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	<u>DE - A - 2 612 599</u> (LEINHAAS) * Page 9, line 4 - page 11, line 18; figure * --	1-4, 7, 10, 12, 16	B 30 B 15/28
	<u>GB - A - 1 270 654</u> (BROUGHTON ENGINEERING) * Page 3, line 53 - page 4, line 9; figures 1-3, 8 * --	1, 2, 4, 7, 10, 16	
	<u>FR - A - 2 003 031</u> (A/S DANSK PRESSEFABRIK) * The whole document * --	1, 2, 3, 12, 16	TECHNICAL FIELDS SEARCHED (Int. Cl.) B 30 B
	<u>FR - A - 2 343 593</u> (AIDA ENGINEERING) * The whole document * --	1-4, 10, 12, 16	
	<u>GB - A - 1 139 156</u> (MAY-PRESSENBAU) * The whole document * --	1-3, 10, 12, 16	
	<u>DE - A - 2 452 751</u> (WEINGARTEN) * Pages 8 and 9; figures 1-6 * --	1, 2, 10, 12, 16	CATEGORY OF CITED DOCUMENTS X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
	<u>DE - A - 2 527 716</u> (GEBR. EDELHOFF) * The whole document * -- ./.	1, 12, 16	
☒ The present search report has been drawn up for all claims			&: member of the same patent family, corresponding document
Place of search The Hague		Date of completion of the search 13-08-1979	Examiner BOLLEN



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EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	<u>BE - A - 465 322 (A.E.R.E.M.)</u> * Claims 1-4; figures * -----	13	
			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)