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Gregorovich et al.

[11] **3,797,623**

[45] **Mar. 19, 1974**

[54] **MECHANICAL PRESS AND METHOD OF OPERATION**

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[73] Assignee: **The Minster Machine Company,** Minster, Ohio

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[21] Appl. No.: **297,442**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 238,166, March 27, 1972, abandoned.

[52] **U.S. Cl.** ..... **192/146,** 192/4 R, 192/18 A, 74/661

[51] **Int. Cl.** **F16d 67/04**

[58] **Field of Search** ..... 192/4 R, 12 R, 12 C, 12 D, 192/18 R, 18 A, 18 B, 146; 74/661; 100/273

[56] **References Cited**

UNITED STATES PATENTS

2,789,672	4/1957	Forkner	192/146 X
2,789,437	4/1957	Longfield	192/146 X
1,545,116	7/1925	Ashworth	192/146
2,246,673	6/1941	Glasner et al.	192/4 R X
2,771,790	11/1956	Munschauer	192/12 C X
2,856,044	10/1958	Koenig et al.	192/12 C X
2,983,348	5/1961	Ott	192/17 A X
3,318,425	5/1967	Dorp et al.	192/12 C X
3,720,296	3/1973	Ohno	192/4 R

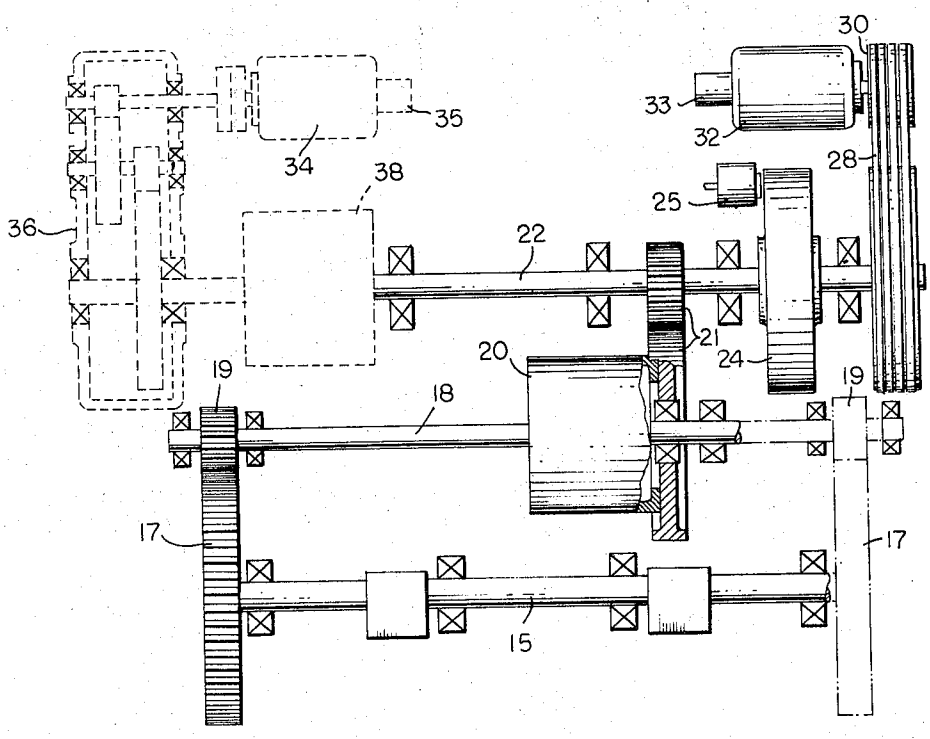
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[57] **ABSTRACT**

A mechanical press having a conventional speed drive and particularly characterized in the provision of a slow speed drive arrangement which can be made selectively effective and a control arrangement for inching the press when it is actuated by the conventional drive and also when it is actuated by the slow speed drive. Interlocks are provided to prevent either of the drives from becoming effective when the other drive is in effective condition.

20 Claims, 9 Drawing Figures



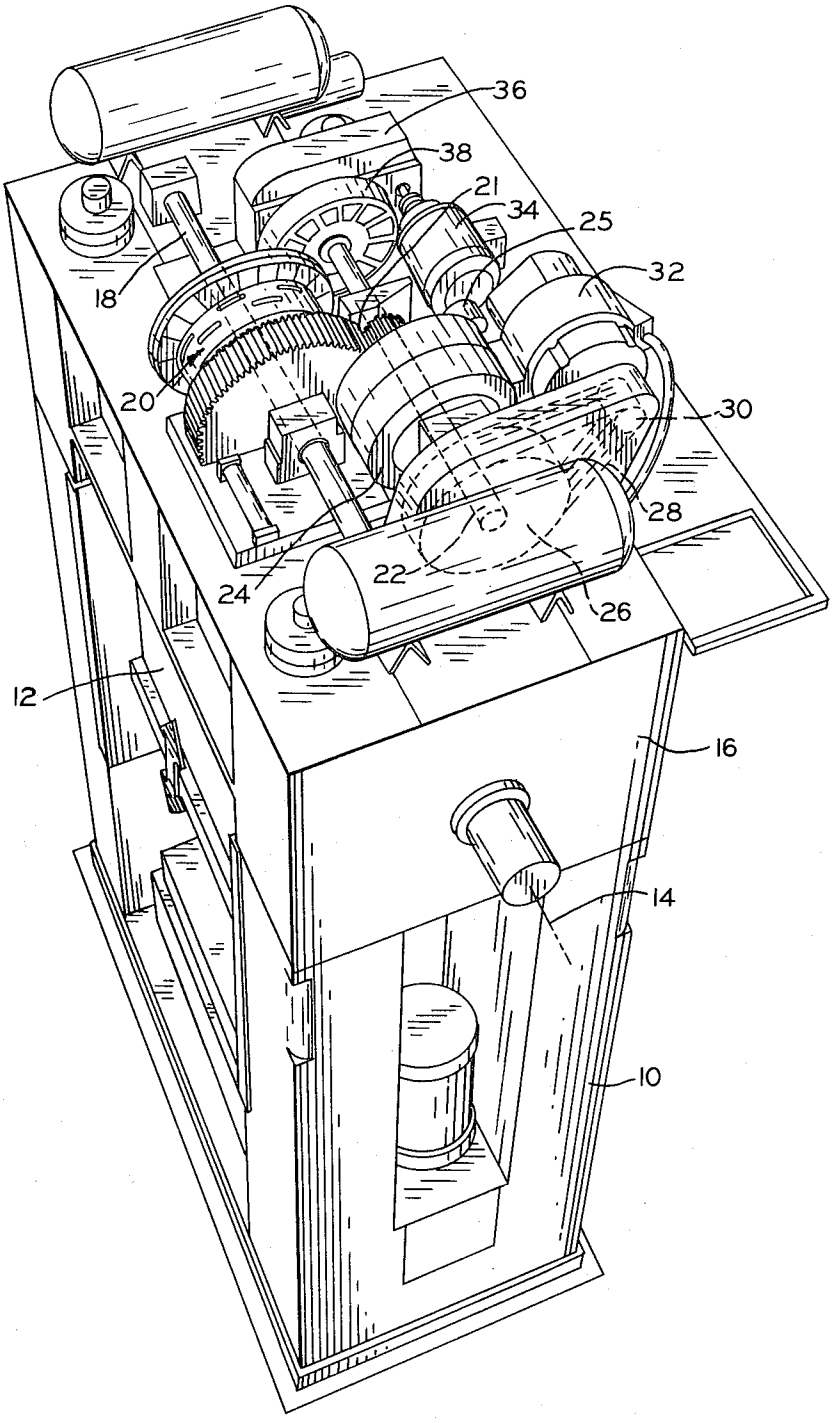


FIG 1

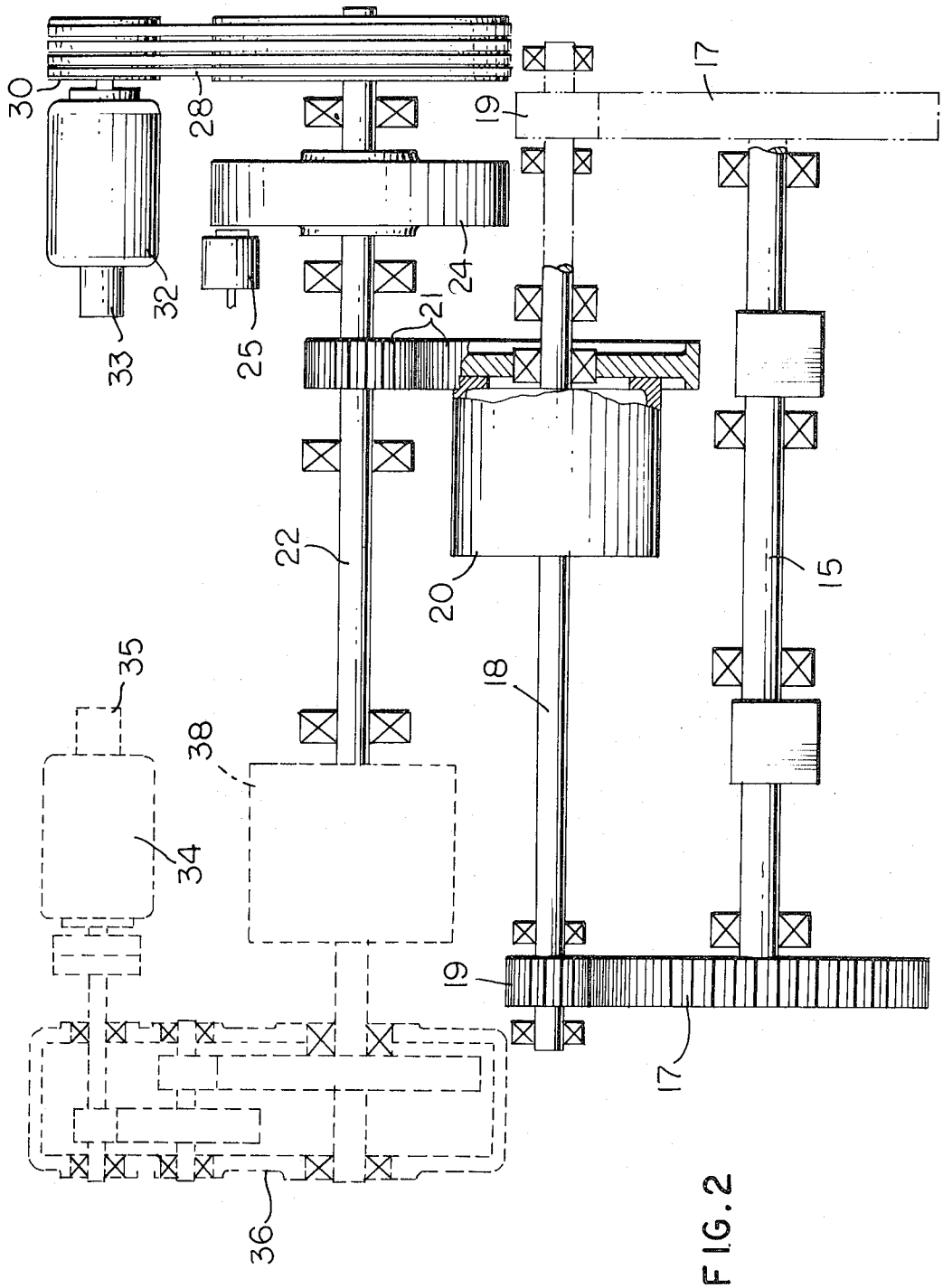


FIG. 2

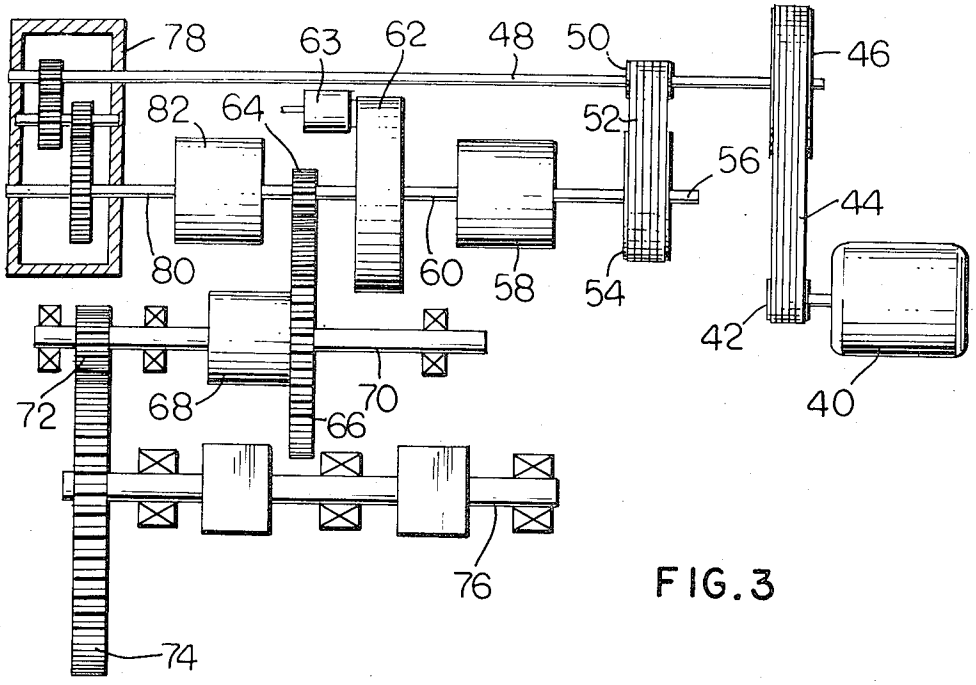

78
63
62
48
50
46
82
64
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44
80
60
58
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76
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FIG. 3

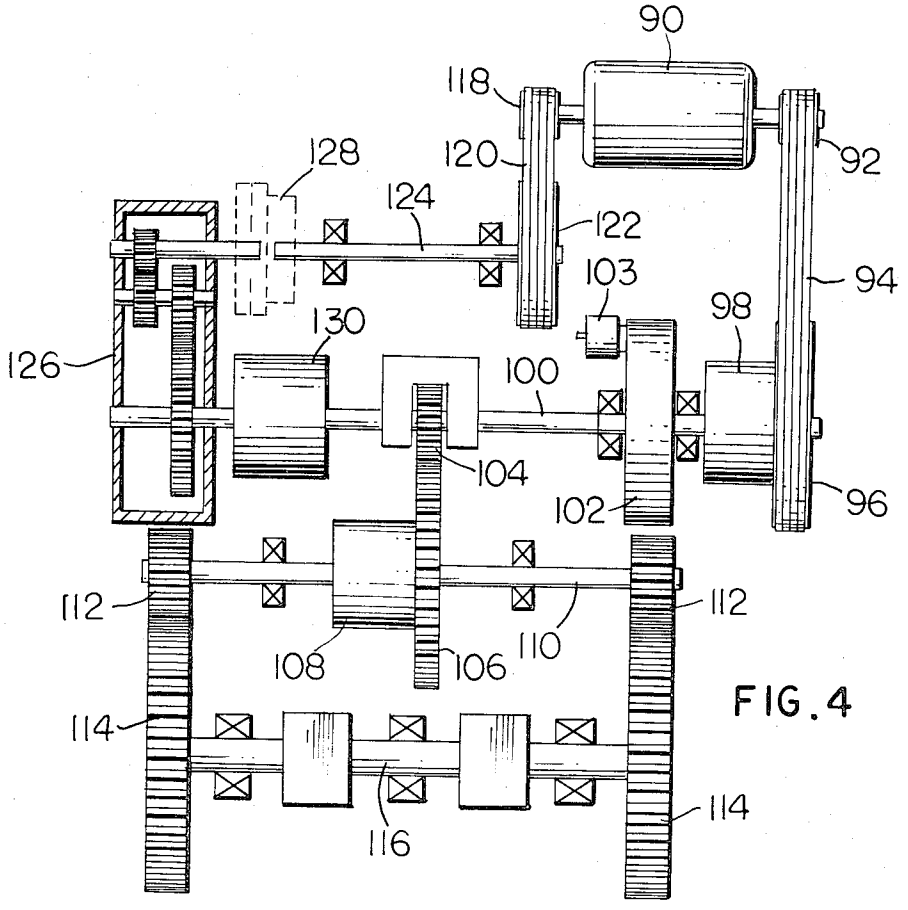

90
118
92
128
120
124
122
103
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98
130
126
100
104
102
96
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112
108
106
110
114
114
116

FIG. 4

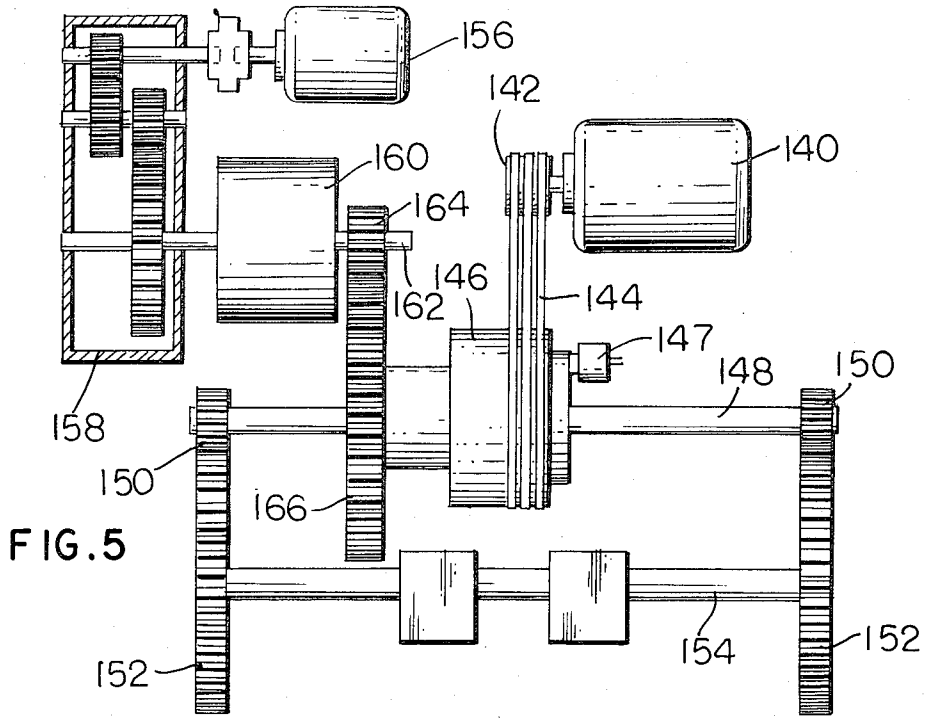

156
142
140
160
164
146
162
144
147
148
150
158
150
166
152
154
152

FIG. 5

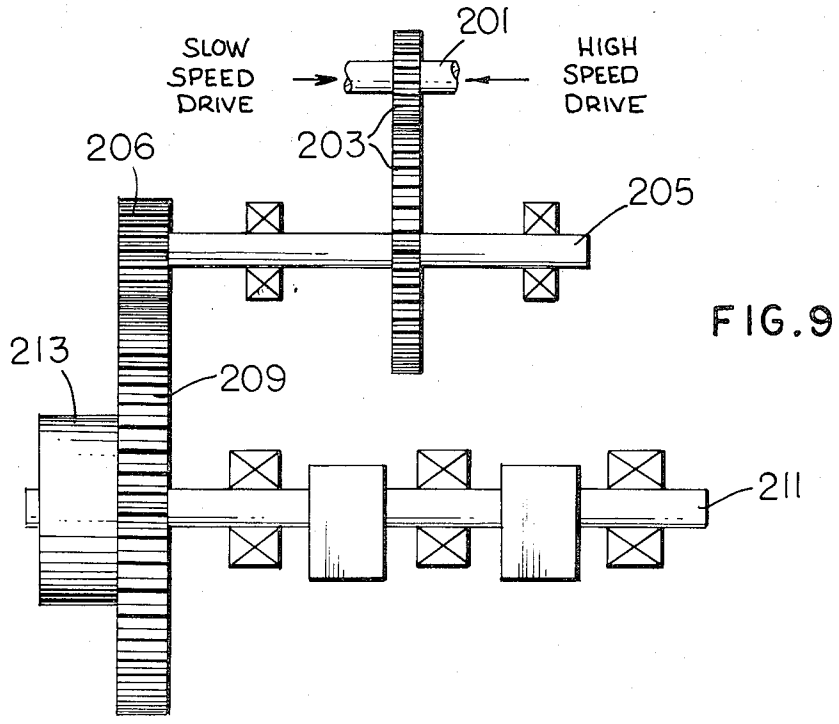

201
SLOW SPEED DRIVE
HIGH SPEED DRIVE
206
203
205
213
209
211

FIG. 9

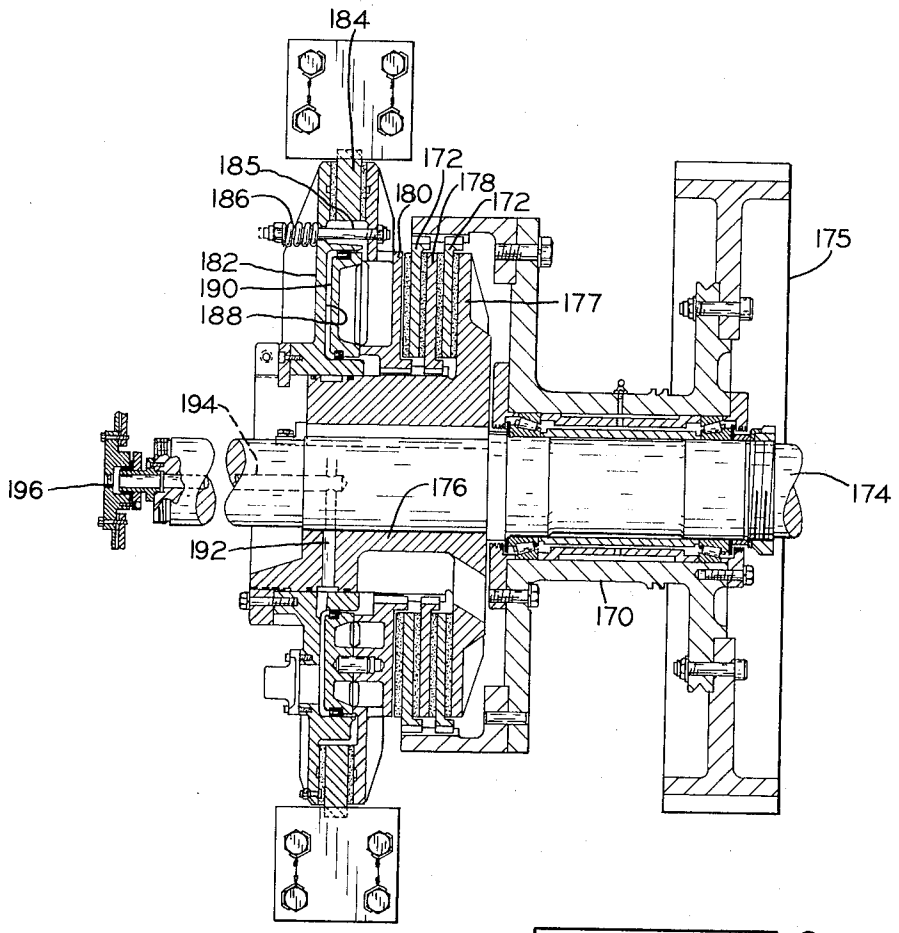

184
185
186
172
180
178
172
175
182
190
188
177
194
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176
174
192
170

FIG. 6

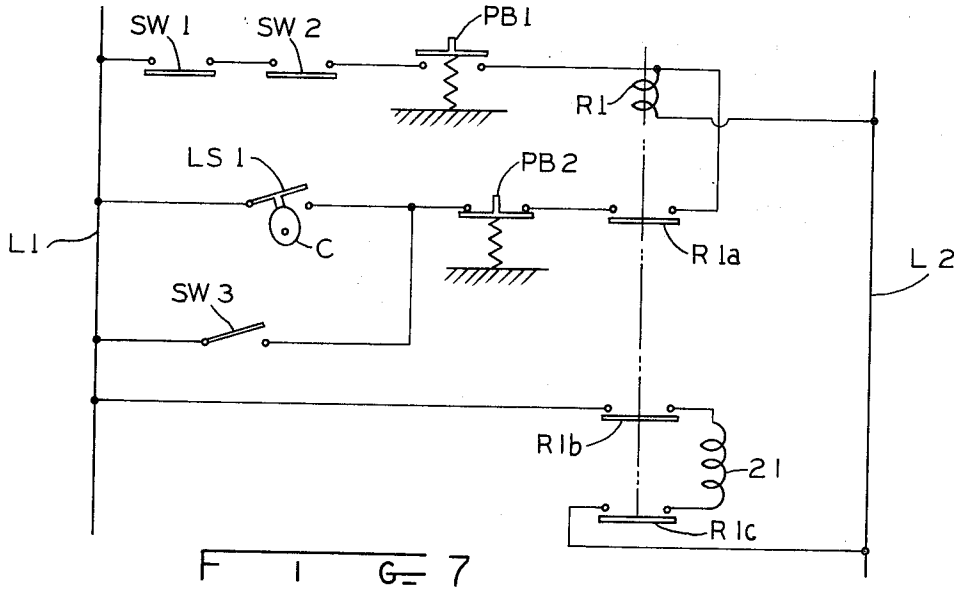
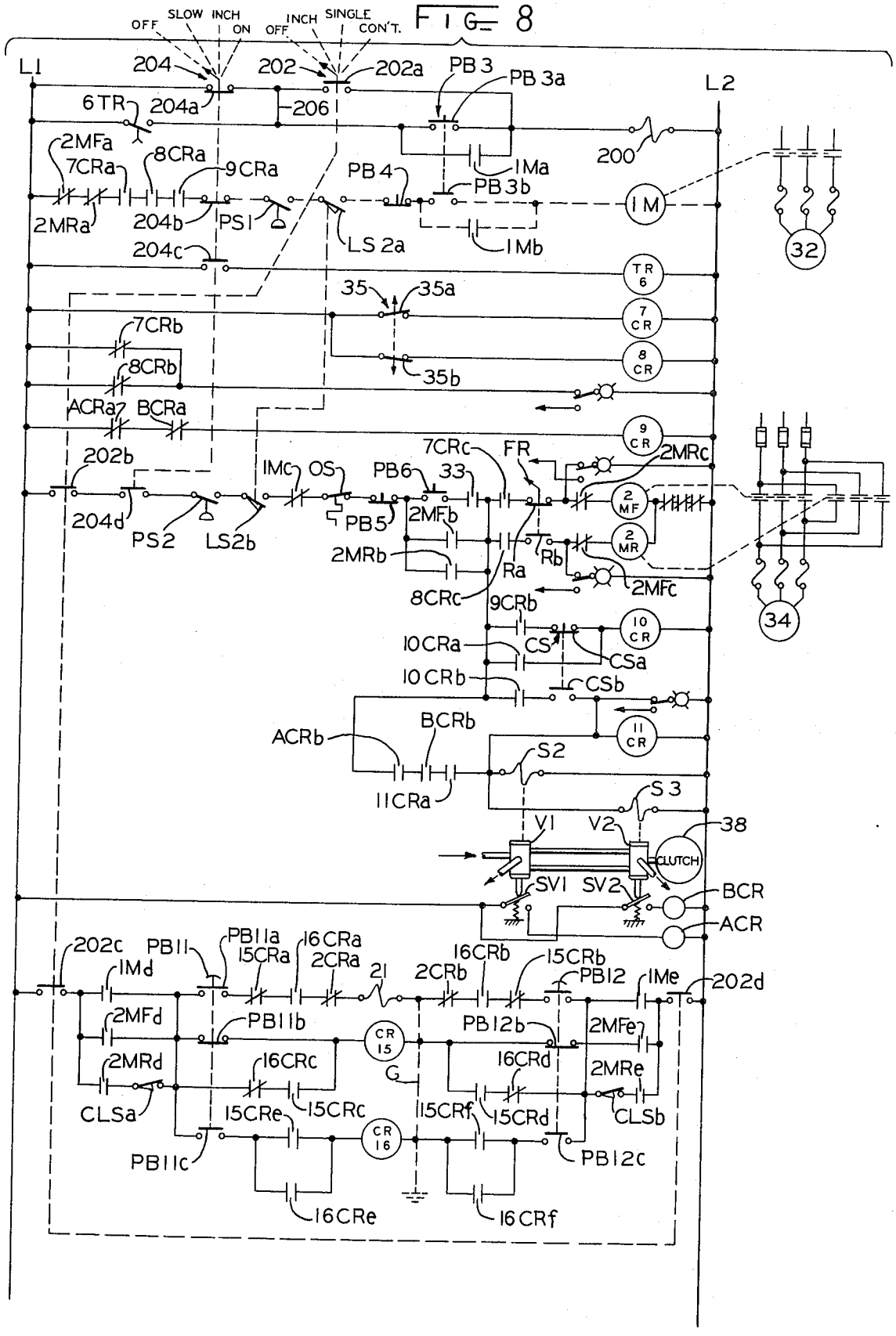

SW 1
SW 2
PB 1
R 1
LS 1
PB 2
L 1
C
R 1a
L 2
SW 3
R 1b
21
R 1c

FIG. 7

FIG 8


OFF
SLOW INCH
ON
OFF
INCH
SINGLE
CON'T.
L1
L2
204
202
202a
PB 3
PB 3a
6TR
204a
206
200
2MFa
7CRa
8CRa
9CRa
PB 4
1Ma
PB 3b
1M
2MRa
204b
PS1
LS 2a
1Mb
32
204c
TR 6
35
35a
7CR
7CRb
8CR
8CRb
35b
ACRa
BCRa
9 CR
202b
7CRc
FR
2MRc
IMc
OS
PB6
33
2 MF
204d
PS2
LS2b
PB5
2MFb
2 MR
2MRb
Ra
Rb
2MFc
8CRc
9CRb
34
10 CR
10CRa
CS
CSa
10CRb
CSb
ACRb
BCRb
11 CR
S2
11CRa
S3
V1
V2
38
CLUTCH
SV1
SV2
BCR
ACR
202c
PB11
PB11a
15CRa
16CRa
2CRa
21
2CRb
16CRb
15CRb
PB12
1Me
202d
1Md
2MFd
PB11b
CR 15
PB12b
2MFe
2MRd
16CRc
G
16CRd
2MRe
CLSa
15CRc
15CRe
15CRf
15CRd
CLSb
CR 16
PB11c
PB12c
16CRe
16CRf

MECHANICAL PRESS AND METHOD OF OPERATION

RELATED APPLICATION

The present invention relates to mechanical presses and is particularly concerned with an improved arrangement for inching a press, and especially at slow speed, and is a continuation-in-part of our prior application, Ser. No. 238,166, filed March 27th, 1972, and now abandoned, and entitled: MECHANICAL PRESS AND METHOD OF OPERATION.

Inching controls for presses of the nature referred to are well known and are employed when setting the tool in the press and for adjustment of feed and transfer mechanisms. In checking out tooling, feeding equipment, and transfer mechanisms, it is frequently important to be able to operate the press at extremely slow speed but, under conditions of full load, so that an actual work cycle can be carred out and the operation of all components can be properly observed.

The extreme differences in speed between a normal press operating speed and the reduced press operating speed which is necessary for carrying out the foregoing checking and observing operations is so great, however, that it is normally an impracticality to attempt to accomplish both speeds of operation with a single drive mechanism. Auxiliary drive mechanisms have, heretofore, been employed but these have been so expensive or have been so difficult to control as to starting and stopping that many problems were encountered therewith and such auxiliary drive arrangements have never been employed to any great extent or with any degree of success.

With the foregoing in mind, a primary objective of the present invention is the provision of a press, especially a mechanical press, which incorporates an extremely slow speed drive and controls therefor to provide for slow speed operation of the press, including inching thereof.

Another object is the provision of a slow speed inching drive and a control arrangement therefor in a press which is highly efficient in operation and which can be precisely controlled so that the inching of the press can be accomplished without any substantial coasting of the press parts.

Still another object of this invention is the provision of a slow speed inching control for a press, especially a mechanical press, which can be incorporated in a press structure at minimal cost and which is substantially trouble free in operation.

The foregoing objects as well as still other objects and advantages of the present invention will become more apparent upon reference to the following detailed specification taken in connection with the accompanying drawings in which:

FIG. 1 is a perspective view showing a mechanical press provided with a slow speed inching drive according to the present invention.

FIG. 2 is a schematic plane view looking down on top of the crown of the press and showing the arrangement thereon of the several components making up the regular high speed drive for the press and the slow speed inching drive for the press.

FIG. 3 is a view similar to FIG. 2 but showing a modified arrangement of the drive in whch a single motor provides power to both the high speed drive and the low speed drive.

FIG. 4 is a view similar to FIGS. 2 and 3 but showing another arrangement of the drive employing only a single motor for supplying power to both drives.

FIG. 5 is a view similar to FIGS. 2 through 4 showing another arrangement in which two motors are provided, one for each of the two drives for the press.

FIG. 6 is a schematic sectional view showing a combined clutch and brake unit for the press.

FIG. 7 is a schematic fragmentary view of a control system that could be employed for conventional operation of the press.

FIG. 8 is a schematic representation of that portion of the electrical control circuit for the press which is directly concerned with the inching arrangement, especially for the modifications of FIGS. 1 and 2.

FIG. 9 shows a modification with a clutch on the crankshaft.

BRIEF SUMMARY OF THE INVENTION

In this application, a mechanical press is illustrated having a drive motor which drives through a drive train to a crankshaft which is operatively connected with the press slide so that when the crankshaft is driven in rotation by the motor, the press slide will reciprocate. The drive from the motor to the crankshaft includes energy storage means in the form of a flywheel, and a main clutch and brake arrangement is interposed between the flywheel and the crankshaft.

The press includes controls so that the crankshaft can be driven continuously in rotation and so that it can be caused to rotate one revolution on each cycle and the controls also provide for intermittent operation of the crankshaft to permit inching of the press slide for set up and checking operations.

The present invention proposes to provide the press with an extremely slow speed drive arrangement which can be connected to the crankshaft to provide for extremely slow speed rotation of the crankshaft whereby the press slide can be caused to move slowly, or to inch slowly, and thereby provide the optimum conditions for set up and checking.

According to one modification, the press has a main drive motor for conventional press operation and a second drive motor is provided which drives through a speed reducing arrangement to the shaft on which the aforementioned main clutch and brake is mounted and with a second clutch interposed in the drive from the second motor so that it can be made selectively effective and ineffective.

In another modification, a single drive motor is provided which drives through a first speed reducer to a flywheel and then through the main clutch to the crankshaft and through a second speed reducer and a second clutch to the flywheel and then through the main clutch to the crankshaft. The two speed reducers differ greatly in drive ratio and, in this manner, both a high speed and a low speed drive can be obtained from a single drive motor.

A control system is provided which controls the inching of the slide when either of the aforementioned drives are effective and the control system includes, when two separate drive motors are supplied, zero speed switches interlocking the motor energizing circuits so that neither motor can be energized while the other thereof is rotating.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings somewhat more in detail, the press shown in FIG. 1 comprises a frame 10 in which a slide, or platen, 12 is reciprocably guided. The slide is connected by one or more connecting rods to a crankshaft rotatable on an axis of rotation indicated at 14 and which is disposed in the crown 16 of the press frame. The crankshaft carries gears, preferably one at each end, and these gears are engaged by pinions mounted on a transverse shaft 18 carried by press crown 16.

Preferably, shaft 18 has mounted thereon a clutch-brake arrangement generally indicated at 20 for selectively braking the shaft 18 to a halt and holding it in halted position or for connecting shaft 18 to a source of power. In the arrangement shown in FIG. 1, the clutch part of clutch-brake 20 is connected by gearing 21 to a further shaft 22 and on which further shaft there is mounted a flywheel 24.

Shaft 22 also carries a pulley 26 connected by belts 28 to a smaller pulley 30 on the output shaft of a first motor 32, which is the main drive motor of the press. During normal operation of the press, the drive motor 32 is energized and runs, driving flywheel 24. Also, the driven part of the clutch portion of clutch-brake 20 is connected thru gearing 21 to shaft 22 which is in turn coupled to flywheel 24. When the press slide is idle at the top of the stroke, shaft 18 and the crankshaft are held against rotation by the brake portion of the clutch-brake 20 which frictionally connects shaft 18 to the press frame, but when the brake is released, the clutch portion is engaged and connects shaft 18 through gearing 21 to the flywheel and shaft 18 is thereby driven and the press crankshaft is also driven in rotation.

According to the present invention, the press crown also mounts a second electric motor 34, which is reversible, and which drives through a speed reducer 36 into one part of a clutch 38, the other part of which is fixed to shaft 22. Actuation of clutch 38 to engaged position will, thus, cause shaft 22 to be driven by motor 34 via speed reducer 36 and at which time shaft 22 will rotate at a speed greatly reduced over the speed it has when driven by motor 32.

A schematic representation of the dirve referred to above will be seen in FIG. 2, and wherein the press crankshaft is indicated by reference numeral 15, while the gears on the ends thereof are represented by reference numerals 17. The pinions on the ends of shaft 18 meshing with gears 17 are indicated at 19. The other parts of the drive arrangement have been referred to in connection with FIG. 1 and carry the same reference numerals. The clutch-brake arrangement 20, as well as the clutch arrangement at 38 comprise interleaved plates which are relatively rotatable when the clutch is disengaged, but which are clamped together, as by fluid pressure, when the clutches are actuated into engaged position.

Each of the motors 32 and 34 in FIG. 2 has mounted on the shaft thereof a zero speed switch, as indicated at 33 and 35, respectively. Motor 32 runs in only one direction so that the zero speed switch 33 pertaining thereto is merely a single set of switch contacts which open when the motor turns and close when the motor halts, whereas motor 34 is reversible and the zero speed switch 35 connected thereto has two sets of contacts, both of which close when the motor is halted and with a respective set of the contacts opening for each direction of rotation of the motor.

Adjacent flywheel 24 is a flywheel brake 25 which is operable, as will be seen hereinafter, to act on the flywheel when, preparatory to going to slow speed drive, the main drive motor is deenergized. The brake is operable to reduce the flywheel speed quickly to prevent delay when going from high speed press operation to slow speed press operation.

In the drive arrangement shown in FIG. 3, a single drive motor 40 is provided which drives a pulley 42 that is connected by belts 44 to a larger pulley 46 mounted on a shaft 48. Shaft 48 carries a further pulley 50 connected by belts 52 with a pulley 54 on still another shaft 56.

Shaft 56 is connected via a clutch 58 with a shaft 60 on which a flywheel 62 is mounted and which shaft also carries a pinion 64 meshing with a gear 66 that drives one part of the clutch portion of clutch-brake arrangement 68, the other part of which is mounted on a shaft 70 that carries a pinion 72 meshing with gear 74 fixed to a crankshaft 76.

The aforementioned shaft 48 also forms the input shaft for a geared speed reducer 78, the slow speed output shaft 80 of which is connected by a clutch 82 with shaft 60.

It will be seen that, in respect of FIG. 3, motor 40 is operable for driving shaft 60 at a higher speed when clutch 58 is engaged and clutch 82 is released and at a lower speed when clutch 82 is engaged and cluch 58 is released and that, when shaft 60 is driven at either high or low speeds, gear 66 will be driven and, through clutch-brake arrangement 68, will be able to rotate crankshaft 76 at either high speed or low speed.

As in connection with the arrangement of FIG. 2, a brake 63 is positioned adjacent flywheel 62 to act thereon.

In the arrangement of FIG. 4, a single motor 90 is provided, which is a double ended motor, and which, on one end, carries a pulley 92 connected by belts 94 to a pulley 96 connected to one part of a clutch 98, the other part of which is fixed to a shaft 100 on which flywheel 102 is mounted. Brake 103 is located adjacent flywheel 102 to act thereon. Shaft 100 also carries a pinion 104 meshing with a gear 106 fixed to one part of the clutch portion of a clutch-brake arrangement 108, the other part of which is carried by a shaft 110 that has pinions 112 on the ends thereof meshing with gears 114 carried by the crankshaft 116.

The other end of motor 90 carries a pulley 118 connected by belts 120 to a pulley 122 mounted on shaft 124 that is connected to the input member of a geared speed reducer 126. Shaft 124 can form the input shaft for the geared speed reducer or it may be connected to the input of the speed reducer by way of a coupling 128.

The output shaft of the geared speed reducer 126 is connected to one part of a clutch 130, the other part of which is fixed to the aforementioned shaft 100.

In the above described FIG. 4 arrangement, motor 90 will drive shaft 100 at a higher speed when clutch 98 is engaged and clutch 130 is released and will drive shaft 100 at a much lower speed when clutch 130 is engaged and clutch 98 is released.

In FIG. 5, a main drive motor 140 is provided which drives a pulley 142 connected by belts 144 with the

flywheel portion and one part of the clutch portion of a combined clutch and brake and flywheel arrangement **146** which is adapted, when the clutch is engaged, to drive a shaft **148** having pinions **150** on the ends meshing with gears **152** on the crankshaft **154.** A brake **147** is positioned to engage the flywheel when actuated.

A second drive motor **156** drives the input side of the geared speed reducer **158,** the slow speed output shaft of which is connected to one part of a clutch **160,** the other part of which is connected to shaft **162** carrying a pinion **164** that meshes with a gear **166** adapted, through the clutch-brake arrangement **146,** to be coupled to the aforementioned shaft **148.**

In the above described modification of FIG. **5,** when motor **140** is energized, and motor **156** is deenergized, and clutch **160** is released, motor **140** will drive shaft **148** at high speed and when motor **156** is energized, and motor **140** is deenergized, and clutch **160** is engaged, shaft **148** will be driven at greatly reduced speed.

In each of the aforementioned cases, where two motors are employed, the motors are never energized simultaneously, but are only energized singly. When the slow speed drive is effective, it is not necessary to disconnect the high speed drive because the motor can be turned at low speed by the belt leading thereto without any substantial loss of power. The low speed drive is, however, disconnected from the drive train when the high speed drive is to be energized, due to the speed reducer acting as a speed increaser when driven from the opposite side.

When a single motor drives both the high speed and low speed drive train, each drive train is interrupted near the flywheel by a suitable clutch when the other drive train is to be made effective.

FIG. **6** schematically illustrates a combined clutch-brake unit such as is employed in each of the modifications interposed between the flywheel and the crankshaft or between the flywheel and the intermediate shaft which drives the crankshaft.

FIG. **6** shows a clutch-brake arrangement which is typical of those that have been referred to above and which, when the clutch is engaged and the brake disengaged, connects the press crankshaft to a driven shaft and, when the brake is engaged and the clutch disengaged, connects the crankshaft brakingly to the press frame.

In FIG. **6, 174** is a shaft which is drivingly connected by gearing to the press crankshaft and **175** is a flywheel or gear which is driven by the drive motor of the press at one of the above referred to higher or lower speeds.

Flywheel or gear **175** has a housing **170** connected thereto which is concentric with and journaled on shaft **174.** Housing **170** has a pair of plates **172** slidably keyed thereto. A clutch sleeve **176** fixed to shaft **174** has a plate **177** fixed thereto on one side of the pair of plates **172,** a plate **178** slidably keyed thereto and disposed between plates **172,** and a pressure plate **180** slidably keyed thereto on the other side of the pair of plates **172.** A further cylinder plate **182** is fixed to sleeve **176** in spaced relation to pressure plate **180** on the opposite side thereof from plates **172.** A brake plate **184** slidably keyed to the press frame is disposed between pressure plate **180** and cylinder plate **182.**

Bolts **185** extend axially through plates **180** and **182** radially inwardly from brake plate **184** and springs **186** thereon urge plates **180** and **182** toward braking engagement with brake plate **184.**

Cylinders **188** in cylinder plate **182** receive pistons **190** which operatively engage pressure plate **180** whereby pressure supplied to the cylinder will overcome springs **186** and move plate **182** to disengage the brake of the unit and engage the clutch. Release of pressure from the cylinders will, of course, release the clutch and permit the springs **186** to engage the brake.

Fluid pressure is supplied to cylinders **188** via radial passage **192** in clutch sleeve **176** and axial passage **194** in shaft **174** which leads to a rotary connector **196.**

In FIG. **6,** the housing **170** has a gear connected thereto which is driven by a motor driven pinion in mesh therewith. Such an arrangement is shown in FIGS. **2, 3, 4,** and **9.** The gear may be massive enough to serve as a flywheel but the flywheel may be separate from the gear as shown in FIGS. **2, 3** and **4.**

In FIG. **5,** the housing of the clutch-brake device is connected to a flywheel about which is entrained motor driven belts.

The opposed faces of the several plates referred to have friction material interposed therebetween to enhance the frictional engagement thereof. Such material is normally applied to only one of a pair of opposed faces.

A clutch-brake unit of the type shown in FIG. **6** is the unit normally employed for controlling the press during conventional operations and is also employed during the inching of the press when either the high speed drive or the low speed drive is effective. When the press is operating in conventional manner, it is customary for the crankshaft to make one rotation on each cycle and to stop with the slide in fully retracted position, or for the crankshaft to rotate continuously.

The schematic circuit shown in FIG. **7** provides for the aforementioned conventional operation. In FIG. **7,** a relay R**1** has an energizing coil and has blades R**1***a*, R**1***b* and R**1***c*, all of which close when the relay coil is energized. Blades R**1***b*, and R**1***c* are serially connected with a valve solenoid **21** between power line L**1** and L**2.** Valve solenoid **21** controls a valve that controls the supply of fluid and the exhausting of fluid fro connections from leading to cylinder means **196.**

The blade R**1**a forms a holding circuit for the actuating coil of the relay.

The coil of the relay is connected between lines L**1** and L**2** in series with selector switch blades SW**1** and SW**2** which are closed during conventional press operation and with a normally open start pushbutton PB**1.** When blades SW**1** and SW**2** are closed and switch PB**1** is closed, relay R**1** will be energized and will hold through its blade R**1***a*. When the press is set for single cycle operation, the holding circuit through blade R**1***a* extends through normally closed stop pushbutton PB**2** and through the blade of a limit switch LS**1** to line L**1.**

A cam C rotates in synchronism with the crankshaft and opens limit switch LS**1** when the crankshaft is at the top of the stroke so that each time PB**1** is closed, and then released, the crankshaft will make a single revolution and come to a halt with the press slide retracted.

When a selector switch blade SW3 is moved to its lower position, the holding circuit through relay blade R1a passes through the normally closed stop pushbutton PB2 and switch blade SW3 to line L1 and, under these conditions, whenever the relay is energized, the crankshaft will continue to run until switch PB2 is actuated, or until switch blade SW3 is opened.

FIG. 8 is a schematic representation of the control circuit employed when the press is to be inched when either the conventional high speed drive or the slow speed drive is operating.

In FIG. 8, the power lines are indicated at L1 and L2 and connected therebetween are the components making up the control circuit.

The several aforementioned brakes positioned adjacent the press flywheels in the several modifications are all fluid operated and are provided with a control valve having an actuating solenoid indicated at 200 in FIG. 8. This solenoid, when energized, releases the respective brake and when deenergized, causes energization of the brake, whereby the brake will act on the respective flywheel.

Solenoid 200 on one side is connected to line L2 and on the other side is connected to one side of blade PB3a of a normally open pushbutton PB3, the other side of which is connected through a normally open timer blade 6TR with L1. Pushbutton PB3 is bypassed by normally open blade 1M*a* of a relay 1M which, when energized, causes the main press drive motor to be energized.

The side of blade PB3*a* connected to solenoid 200 is also connected to one side of blade 202*a* of a multiple position selector switch 202, one blade of which has been indicated at SW1 in FIG. 7. The other side of blade 202*a* is connected to one side of blade 204*a* of a further two position selector switch 204, one blade of which has been indicated at SW2 in FIG. 7. The other side of blade 204*a* is connected to power line L1. A jumper 206 is connected to the line between blades 202*a* and 204*a* at one end and between blade 6TR and pushbutton PB3 at the other end.

Switch 202 is a four position switch, having an "off" position, wherein the blade 202*a* is open and having three further positions indicated as "inch", "single" and "continuous". Blade 202*a* is closed only in "inch" position. Blade SW1 of switch 202, seen in FIG. 7, closes in the "single" and "continuous" positions of the switch.

Switch 204 is a two position switch and has an "off" position where its blade 204*a* is closed and an "on" position where the said blade is open.

The coil of the relay 1M which controls the energization of the main motor has one side connected to power line L2 and the other side connected to one side of a second normally open blade PB3*b* of pushbutton PB3. This last mentioned blade is also bypassed by a normally open blade 1M*b* of relay 1M.

Between the last mentioned blade PB3*b* and power line L1, there is arranged in series a normally closed stop switch PB4, a limit switch blade LS2*a* which is closed when the brake pertaining to solenoid 200 is released, an an air pressure switch PS1 which closes when there is an adequate supply of pressure for actuating the clutch-brake unit associated with the flywheel, a further blade 204*b* of switch 204 which is closed in the "off" position of the switch and open in the "on" position thereof, normally open blades 7CR*a*, 8CR*a*, 9CR*a* of correspondingly numbered relays and normally closed blades 2MF*a* and 2MR*a* also of correspondingly numbered relays.

Blade 6TR is under the control of a timer TR6 which has one side connected to power line L2 and the other side connected to power line L1 through a still further blade 204*c* of switch 204 which is open when the switch is in "off" condition and closed when the switch is in "on" position.

Relay 7CR, which controls blade 7CR*a*, has one side connected to power line L2 and the other side connected through a blade 35*a* of the zero speed switch 35 pertaining to the slow speed drive motor with power line L1.

Relay 8CR is similarly connected through blade 35*b* of the zero speed switch 35 between power lines L1 and L2. Relay 7CR pertains to the forward direction of rotation of the slow speed motor and switch blade 35*a* therefore opens only when the motor is going in reverse direction, whereas blade 35*b* opens when the slow speed motor is going in forward direction.

Normally closed blades 7CR*b* and 8CR*b* are connected in parallel with each other and in series with an indicator between lines L1 and L2.

A further relay 9CR is connected between power lines L1 and L2 in series with normally closed blades ACR*a* and BCR*a* pertaining to relays under the control of valve solenoids pertaining to the slow speed clutch to be referred to hereinafter.

The slow speed motor control and the control of the clutch pertaining to the slow speed motor and which, in the case of the preferred embodiment, is clutch 38, includes a blade 202*b* of selector switch 202 which is closed when selector switch 202 is in the "inch" position, blade 204*d* pertaining to 204 which closes when switch 204 is in "on" position, a pressure swtich PS2 which closes when ample air pressure is supplied to the clutch, a normally open limit switch blade LS2*b* which closes when the flywheel brake is released, a normally closed blade 1M*c* of the main motor control relay 1M, an overload switch OS and a normally closed pushbutton switch PB5.

The last mentioned siwtches are connected in series with one end of the serially connected switches connected to line L1. At the other end, the serially connected switches are connected through a normally open start pushbutton PB6 and the main motor zero speed switch 33. Connected in parallel with switch PB6 and zero speed switch 33 are normally open blades 2MF*b* pertaining to the relay 2MF for forward rotation of the slow speed motor and normally open blades 2MR*b* pertaining to relay 2MR for reverse rotation of the slow speed motor.

Relay 2MF has one side connected through temperature sensitive switch blades with line L2 and through normally closed blades 2MR*c* of relay 2MR and a blade R*a* of the forward reverse selector switch FR for the slow speed motor and normally open blades 7CR*c* of relay 7CR with zero speed switch 35.

Relay 2MR is similarly connected in series with normally closed blades 2MF*c* and a second blade R*b* of the forward and reverse selector switch FR and normally open blades 8CR*c* with zero speed switch 35. The selector switch FR selectively closes blade R*a* for forward rotation of the slow speed motor and blade R*b* for reverse rotation thereof and, once the motor is started in

one direction, the interlocks provided prevent energization of the motor in the opposite direction.

For controlling the clutch **38** previously referred to, a clutch switch CS is provided having a normally closed blade CSa and a normally open blade CS*b*. Blade CS*a* is connected serially with a relay **10**CR and normally open blades **9**CRb of relay **9**CR between power line L2 and zero speed switch **33.** The blades **9**CR*b* and blade CS*a* are bypassed by a holding circuit consisting of normally open blade **10**CR*a* of relay **10**CR.

Depressing of switch CS will close its blade CS*b* which is serially arranged with normally open blades **10**CR*b* and relay **11**CR between power line L2 and zero speed switch **33.** Blade CS*b* and **10**CR*b* are bypassed by blades ACRb and BCR*b* and **11**CR*a*.

Further, connected in parallel with relay **11**CR are the solenoids S2 and S3 pertaining respectively to valves V1 and V2 which control the supply of actuating fluid to the aforementioned clutch **38.** Valves V1 and V2 are so arranged that both must be in actuated position to establish a supply of pressure fluid to clutch **38** while the return of either thereof from actuated position will exhaust the clutch.

Valve V1 controls a switch SV1 which closes when the valve goes to actuated position and energizes relay ACR. Similarly, valve V2 controls a switch SV2 which closes when the valve goes to actuated position and energizes a relay BCR. The relays ACR and BCR control the blades ACR*a*, ACR*b*, BCR*a* and BCR*b* and provide that, if either valve fails to return from its shifted position, relay **9**CR will be prevented from becoming energized and, similarly, provide that, if either valve moves from its shifted position, relay **11**CR will become deenergized as will both of the valve solenoids S2 and S3.

At the bottom of FIG. **8,** there is shown the control for the solenoid **21** for the main clutch. The solenoid referred to, and which has been also identified at **21** in FIG. **7,** is connected between power lines L1 and L2 in series, on the one side of blade **202***c* of switch **202** which closes only when the switch is in "inch" position, a normally open blade **1**M*d* of the main motor control relay, a normally open blade PB**11***a* of one manually operated inch pushbutton identified as PB**11,** a normally closed blade **15**CR*a* of a relay CR**15,** a normally open blade **16**CR*a* of a relay CR**16,** and a normally closed blade **2**CR*a* of a relay which is under the control of a relay, not shown, which is energized when selector switch **202** is in either its "single" or "continuous" position. Thus, in either of the "single" or "continuous" positions of switch **202,** the manual control of solenoid **21** is made ineffective. In the "single" position of selector switch **202,** the crankshaft rotates one revolution when the solenoid **21** is energized and in "continuous" position the crankshaft runs continuously; the aforementioned modes of operation having been described in connection with FIG. **7.**

On the other side, the valve solenoid **21** is in circuit with corresponding blades forming a mirror image of those described and with the inch pushbutton identified as PB**12.**

Connected in parallel with blade **1**M*d* are normally open blades **2**MF*d* and **2**MR*d* with the latter serially arranged with a blade CLS*a* of a limit switch which is closed from top dead center to a crank rotation position 170° after top dead center when moving in the advancing direction. Reverse inching or slow speed movement of the press slide in the reverse direction can thus take place only when the press slide is in the advancing portion of slide movement between top dead center to about 170° beyond top dead center.

Connected between the sides of the blades PB**11***c* and PB**12***c* nearest the respective power lines L1 and L2 is a first branch consisting of normally closed blade PB**11***b* in series with a coil or relay CR**15** and the normally closed blade PB**12***b*. Blade PB**11***b* is bypassed by a branch containing normally closed blade **16**CR*c* and normally open blade **15**CR*c* and blade PB**12***b* is similarly bypassed by corresponding contacts.

A further branch contains a normally open blade PB**11***c*, normally open blade **15**CR*e*, the coil of relay CR**16,** normally open blade **15**CR*f*, and the blade PB**12***c*. Blade **15**CR*e* is bypassed by a normally open blade **16**CR*e* and blade **15**CR*f* is bypassed by a normally open blade **16**CR*f*.

The circuit described above is specifically designed for the modification of FIG. **2** with the main clutch solenoid **21** controlling main clutch **20** and with the valves V1 and V2 controlling the clutch **38.**

The same circuit arrangement could be employed for the modification of FIG. **3** with solenoid **21** controlling clutch **68** and valves V1 and V2 controlling clutch **82** and with an additional control for clutch **58,** so that whenever clutch **82** was energized, clutch **58** would be deenergized and vice versa.

For the modification of FIG. **4,** the same circuit could be employed with solenoid **21** controlling clutch **108** and valves V1 and V2 controlling clutch **130** and with clutch **98** being controlled so that, whenever clutch **130** was actuated, clutch **98** would be released and vice versa.

In the modification of FIG. **5,** the described circuit could be employed with solenoid **21** controlling clutch **146** and with valves V1 and V2 controlling clutch **160.**

To operate the press having the circuit according to FIG. **8,** to inch the press at slow speed, switch **202** is moved to its "inch" position. With switch **202** in "inch" position, blades **2**CR*a* and **2**CR*b* close and blade SW1 opens and solenoid **21** goes under manual control. At this time the main drive motor is still operating and slide movement is at high speed, even during "inching".

Thereafter, switch **204** is turned to its "on" position. If, at this time, the main drive motor is running, the movement of switch **204** to its on position will interrupt the energizing circuit to relay **1**M and simultaneously energize delay relay TR**6.** Also, solenoid **200** is deenergized so that the flywheel brake becomes effective to act on the flywheel and slow it down. After a predetermined length of time, blade **6**TR will close and energize solenoid **200** to disengage the flywheel brake and this will close the flywheel brake limit switch blades LS**2***a* and LS**2***b*.

At that time, pressure switch PS2 is closed if the pressure is sufficient, blade **202***b* is closed, blade **204***d* is closed, blade **1**Mc is closed, switch OS is closed and pushbutton PB**5** is closed. Switch PB**6** can then be closed to energize one of relays **2**MF and **2**MR depending on the position of the forward-reverse selector switch FR. In this connection, the last mentioned relay will energize through zero speed switch **33** which is closed when the main motor comes completely to a halt.

Switch CS is now actuated and this will cause the slow speed clutch to engage and it will remain engaged until the slow speed motor is halted by opening manual stop switch PB5.

The press is now prepared for slow speed operation and inching of the press is accomplished by manually closing switches PB11 and PB12. As long as these switches are held depressed, the press will move but will stop immediately upon release of the switches.

During reverse operation of the slow speed motor, the circuit to main valve solenoid 21 is made through the blades of limit switch CLS so that the reverse motion of the slide can take place only before the slide has reached its lower dead center position during forward motion of the crankshaft.

it will be noted that the inching circuit at the bottom of FIG. 8 is effective during operation of the high speed press motor and at which time the circuit to the solenoid 21 will be completed through blades 1M*d* and 1Me of the main motor starting relay.

It will be noted that relay CR15 is energized when both of the inching pushbuttons are released and that blades under the control of relay CR15 maintain the relay energized until the pushbuttons are depressed and bring about energization of relay CR16 at which time relay CR15 is deenergized. Releasing of the switch will again deenergize relay CR16 while simultaneously energizing relay CR15. The interlock provided by relays CR15 and CR16 is a safety feature providing for two-hand operation of the press when under manual control.

The circuitry containing solenoid 21 and the coils of relays CR15 and CR16 can be simplified somewhat by connecting one side of the coils and the solenoid to ground and elminating the switches and relay blades on the same side. This modification is shown by the dot-dash line G in FIG. 8. In this case, PB12 is placed in the circuit adjacent to and in series with PB11 to provide for safe two-hand operation of the press.

FIG. 9 shows how the high and low speed drives could come together at a shaft 201, under the control of clutches as in FIG. 3 or 5. Shaft 201 is connected by gears 203 to an intermediate shaft 205. Pinion 206 on shaft 205 drives gear 209 on crankshaft 211. A clutch brake unit 213 is operable for selectively braking crankshaft 211 to the press frame or clutching it to gear 209.

Modifications may be made within the scope of the appended claims.

What is claimed is:

1. In a press having a frame and a slide reciprocably mounted therein and a crankshaft rotatable in the frame and operatively connected to the slide for reciprocation of the slide upon rotation of the crankshaft, a rotatable flywheel in the frame operatively associated with said crankshaft, said press having a main clutch operatively interposed between said crankshaft and said flywheel and normally deenergized and a main brake operatively interposed between said crankshaft and said frame and normally energized; high speed drive means operatively connected to said flywheel and operable when effective to drive said flywheel at a predetermined higher speed, low speed drive means operatively connected to said flywheel and operable when effective to drive said flywheel at a predetermined lower speed, motor means operatively connected to said drive means to supply power thereto, first control means operable for making said high speed drive means selectively effective and ineffective, second control means operable for making said low speed drive means selectively effective and ineffective, third control means operable for energizing said main clutch while simultaneously deenergizing said main brake and including manual means operable when actuated to effect said energization of said main clutch and simultaneous deenergization of said main brake, and interlock means interconnecting said first and second control means and responsive to the making effective of either of said high speed drive means and low speed drive means for preventing the other thereof from becoming effective.

2. A press according to claim 1 which includes brake means operatively associated with said flywheel, and means responsive to making high speed drive means ineffective for actuating said brake means for a predetermined time period thereby to slow down said flywheel preparatory to making said low speed drive means effective.

3. A press according to claim 1 in which said motor means comprises a first drive motor operatively connected to said high speed drive means and a second drive motor operatively connected to said second drive means.

4. A press according to claim 1 which includes clutch means in said low speed drive means near the flywheel end thereof.

5. A press according to claim 1 in which said motor means comprises a single drive motor, said low speed drive means including a speed reducer having a high speed input shaft connected to said drive motor and having a low speed output shaft, first clutch means operatively interposed between said output shaft of speed reducer and said flywheel, and second clutch means operatively interposed between said flywheel and said drive motor.

6. A press according to claim 1 which includes gear means fixed to said crankshaft, pinion means meshing with said gear means, a shaft supporting said pinion means, said main clutch and main brake being mounted on said shaft, said main clutch having a first part fixed to said shaft and a second part rotatable on the shaft and engageable with said first part, said flywheel being drivingly connected to said second part of said clutch portion, said main brake comprising a part fixed to said frame and engageable with said first part of said main clutch when the latter is disengaged from the said second part of said main clutch.

7. A press according to claim 6 which includes a gear on said second part of said main clutch, a further shaft having a pinion meshing with said gear, said flywheel being fixed to said further shaft.

8. A press according to claim 7 which includes a first drive motor connected to said further shaft, a geared speed reducer having an output shaft aligned with said shaft, a clutch having one part on said output shaft and one part on said further shaft and energizable for drivingly interconnecting said output shaft and said further shaft, said speed reducer having an input shaft, and a second drive motor connected to said input shaft.

9. A press according to claim 7 which includes a geared speed reducer having an output shaft aligned with said further shaft, a clutch having parts connected to said output shaft and further shaft and energizable for drivingly interconnecting said output shaft and said

further shaft, said speed reducer having an input shaft, a drive motor connected to said input shaft, an auxiliary shaft drivingly interconnected to said motor and aligned with said further shaft on the side of said flywheel facing away from said output shaft, and a further clutch having a part connected to said further shaft and a part connected to said auxiliary shaft and energizable for drivingly interconnecting said further shaft and said auxiliary shaft.

10. A press according to claim **1** in which said motor means comprises a single drive motor operatively connected to both said high speed drive means and said low speed drive means, first clutch means interposed between said drive motor and said flywheel, second clutch means interposed between said low speed drive means and said flywheel, an energizing circuit for said first clutch means under the control of said first control means, an energizing circuit for second clutch means under the control of said second control means, brake means adjacent said flywheel and normally deenergized, means operable in response to actuation of said first control means to interrupt the energizing circuit for said first clutch means for actuating said brake means into engagement with said flywheel for a predetermined timed period, and switch means connected to said second control means and operable for making said second control means ineffective during the period of actuation of said brake means.

11. A press according to claim **1** in which said motor means comprises a first drive motor operatively connected to said high speed drive means and a second drive motor operatively connnected to said low speed drive means, an energizing circuit for said first motor under the control of said first control means, an energizing circuit for said second motor under the control of said second control means, brake means operatively associated with said flywheel and normally deenergized, means operable in response to actuation of said first control means to interrupt the energizing circuit to said first drive motor for actuating said brake means into engagement with said flywheel for a predetermined timed period, and switch means connected to said second control means and operable to make said second control means ineffective during the period of actuation of said brake means.

12. A press according to claim **11** in which the energizing circuit for each said motor includes switch means operated into open position by rotation of the other of said motors and operable when open to prevent energization of the motor pertaining to the respective energizing circuit.

13. A press according to claim **11** in which said third control means includes manual means controlling the energization and deenergization of said main clutch and main brake, a multiple position selector switch connected to said first and second control means and having "OFF", "INCH", "SINGLE", and "CONTINUOUS" positions, energization of said first and second motors being prevented by said switch in the "OFF" position thereof, said switch in the "INCH" position thereof making said manual means effective, and said switch in said "SINGLE" and "CONTINUOUS" positions thereof making said first and third control means effective and said second control means and said manual means ineffective.

14. A press according to claim **13** which includes a further selector switch having "ON" and "OFF" positions and also connected to said first and second control means, said further selector switch when moved to its "ON" position interrupting the energizing circuit to said first motor and making said first control means ineffective and initiating said timed period of energization of said brake means and making said second control means effective, and when moved to its "OFF" position making said second control means ineffective and making said first control means effective.

15. A press according to claim **11** in which said second motor is reversible and the energizing circuit therefor includes direction selector means selectively adjustable for predetermining the direction of rotation of said second motor.

16. A press according to claim **15** which includes a switch under the control of said crankshaft connected in circuit with said manual means and preventing operation thereof when said second motor is running in the reverse direction and when said crankshaft has already passed through the lower dead position thereof.

17. In a press having a frame and a slide reciprocably mounted therein and a crankshaft and flywheel rotatably in the frame and operatively connected to the slide for reciprocation of the slide upon rotation of the crankshaft, said press having a main clutch operatively interposed between said crankshaft and said flywheel and normally deenergized and a main brake operatively interposed between said crankshaft and said frame and normally energized; that method of selectively operating the press slide at a predetermined higher speed or at a predetermined lower speed which comprises; energizing a high speed drive connected to said flywheel and operating said main clutch and main brake for controlling the movement of the slide at high speed, energizing a slow speed drive connected to said flywheel and operating said main clutch and main brake for controlling the movement of the slide at low speed, and interlocking said drives so that energization of each thereof is prevented during energization of the other.

18. The method according to claim **17** which includes braking said flywheel for a timed period immediately following deenergization of said high speed drive and prior to energization of said slow speed drive.

19. The method according to claim **17** which includes powering each of the said high speed drive and low speed drive by an individual motor, and effecting said interlocking of the said drives by preventing energization of either motor while the other thereof is rotating.

20. The method according to claim **17** which includes powering each drive by an individual motor, braking said flywheel for a timed period immediately following deenergization of the motor pertaining to said high speed drive, and preventing energization of either motor while said flywheel is being braked.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,797,623 Dated March 19, 1974

Inventor(s) Charles J. Gregorovich and Robert W. Adams

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 19, "carred" should be --- carried ---.

Col. 1, line 59, "plane" should be --- plan ---.

Col. 2, line 5, "still" omitted after "showing"

Col. 5, line 28, "belt" should be --- belts ---.

Col. 6, line 47, "fro" should be --- from ---.

Col. 6, line 48, "from" should be --- 198 ---.

Col. 8, line 36, "switch" omitted between "to" and "204"

Col. 10, line 58, "that" should be --- this ---.

Col. 10, line 58, "air" omitted between "the" and "pressure"

Col. 11, line 16, "it" should be --- It ---.

Col. 11, line 26, "switch" should be --- switches ---.

Col. 11, line 35, "elminating" should be --- eliminating ---.

Col. 12, line 17 (Claim 2) "said" omitted between "making" and "high"

Col. 14, lines 27 and 28 (Claim 17) "rotatably" should be --- rotatable ---

Signed and sealed this 6th day of August 1974.

(SEAL)
Attest:

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