April 23, 1957 W. F. LONGFIELD 2,789,437

DRIVE APPARATUS

Filed May 11, 1955 3 Sheets-Sheet 1

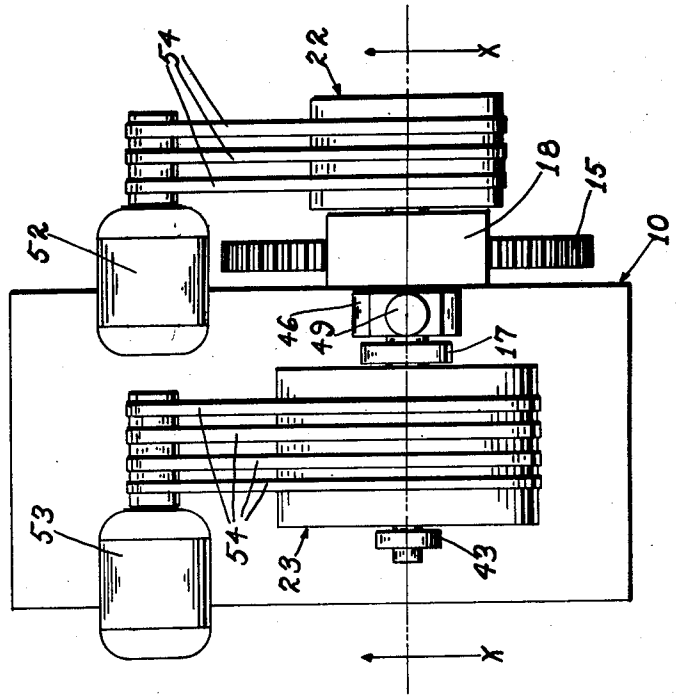


Fig. 2

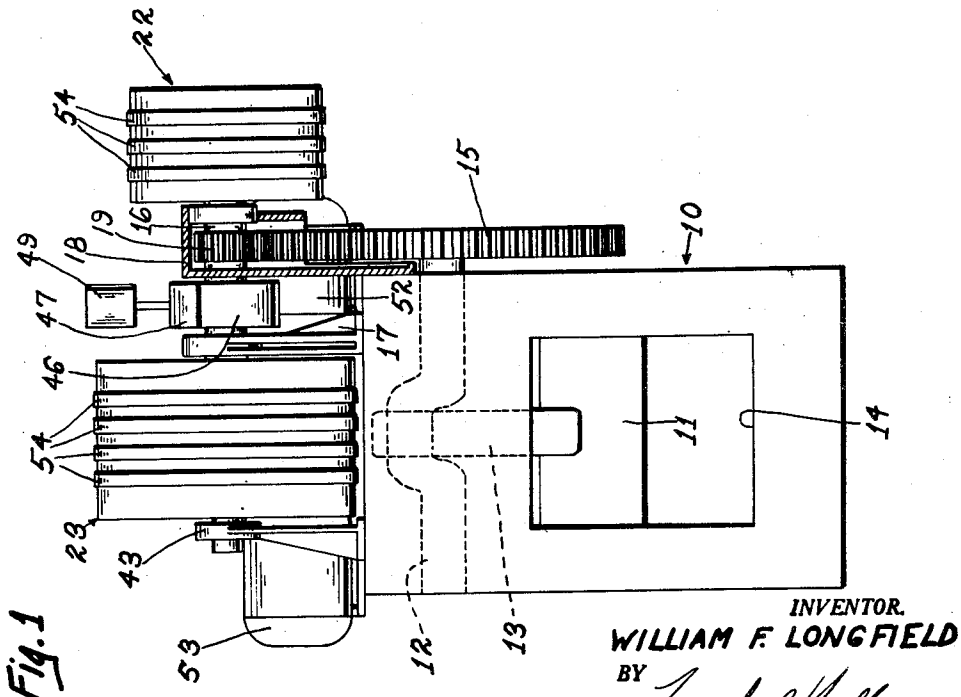


Fig. 1

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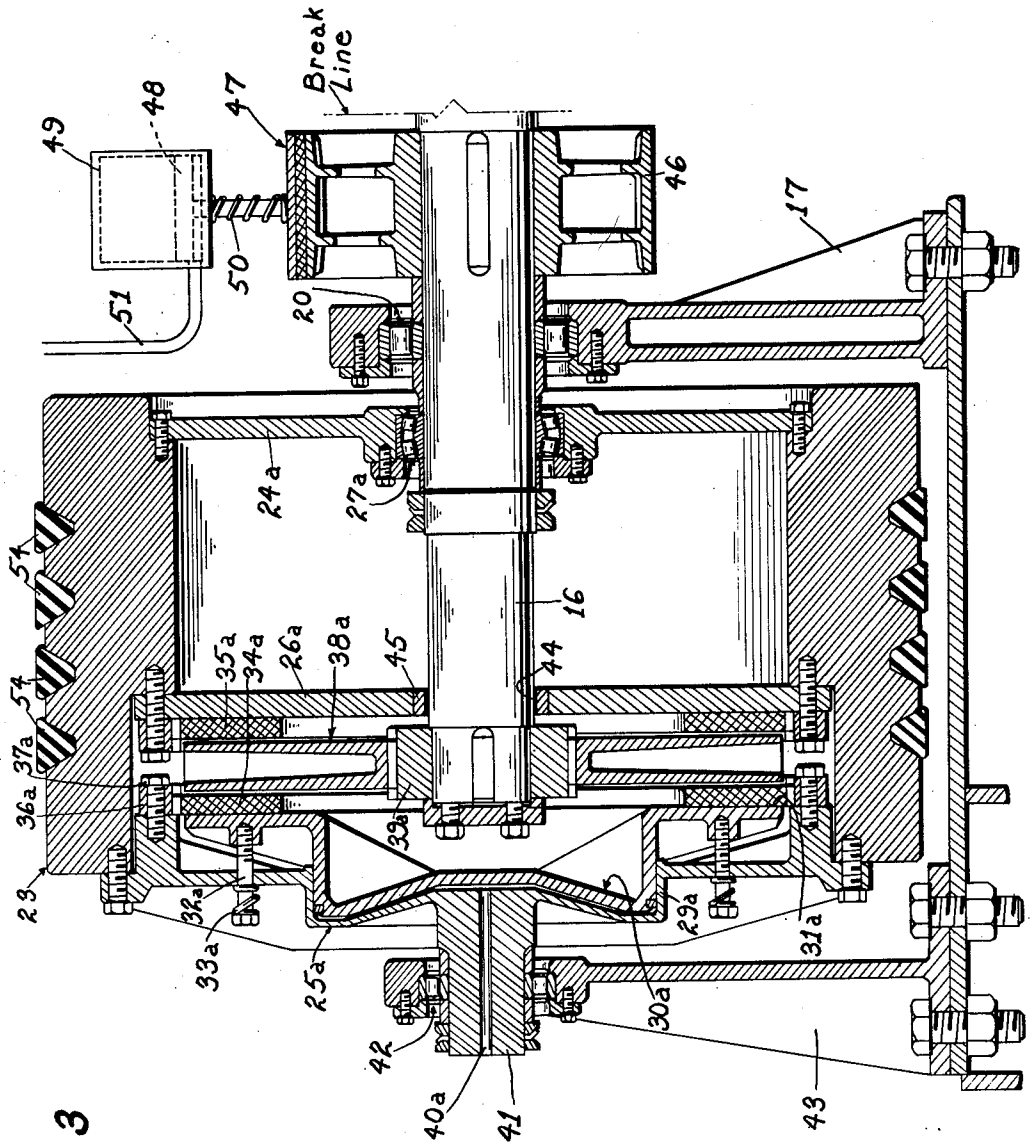


Fig. 3

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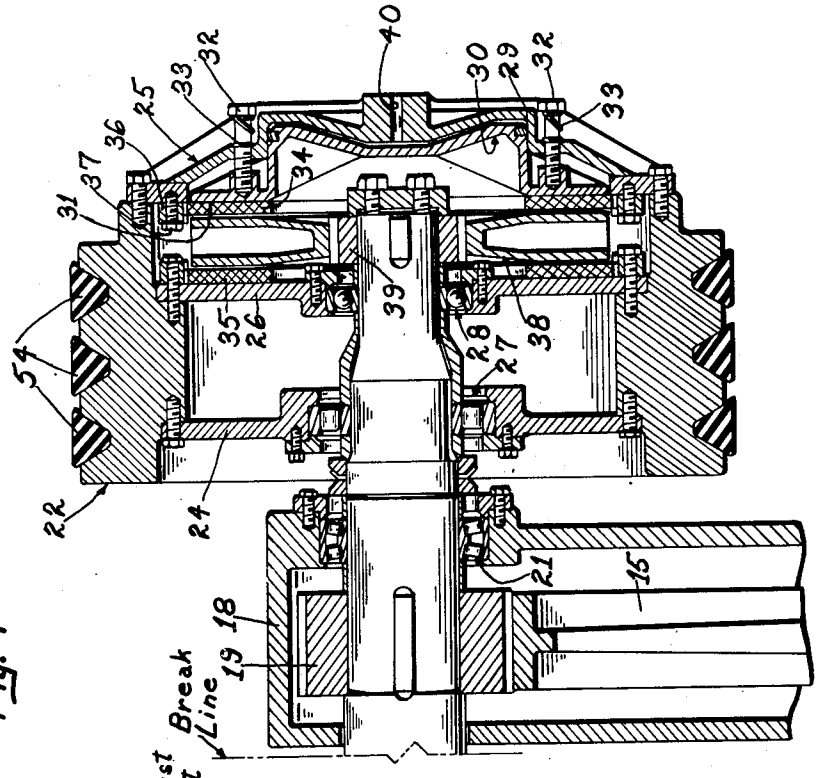


Fig. 4

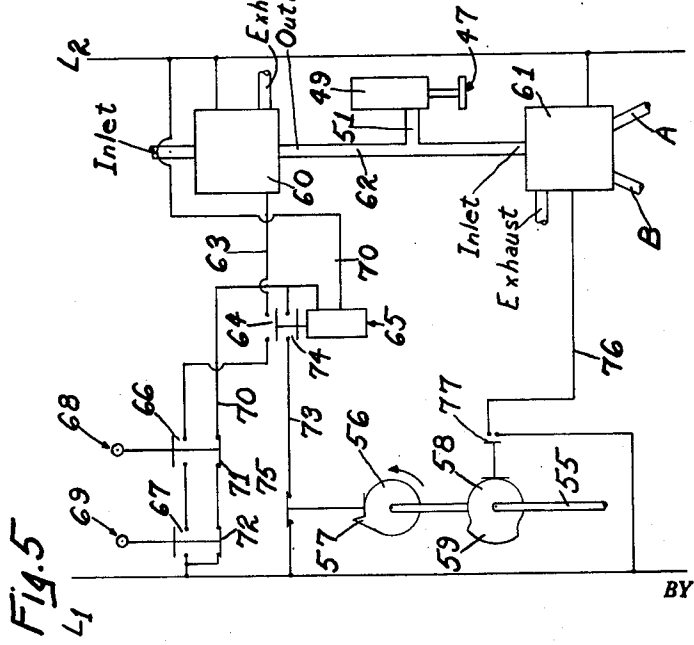


Fig. 5

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2,789,437

DRIVE APPARATUS

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Application May 11, 1955, Serial No. 507,668

7 Claims. (Cl. 74—44)

The present invention relates to drive apparatus, more particularly to apparatus for effecting two speed operation of a press or other device, and the principal object of the invention is to provide new and improved apparatus of the character described.

As is well-known in the art, high speed operation of drawing presses and the like is limited by the fact that the drawing operation cannot be accelerated beyond a certain rate of speed without tearing the material being drawn. In the past, attempts have been made to increase the production of drawing presses by operating them at their optimum speed during the drawing portion of the press cycle and at a higher speed during the other portions of the press cycle preceding and subsequent to the drawing portion. This theory of operation has proven practical; however, it is believed that the prior art mechanisms devised for this purpose have not been entirely satisfactory.

One of the earliest attempts to accomplish multiple speed operation of presses and the like is disclosed in Patent No. 1,060,662 issued to Bauroth. The cam mechanism disclosed in this patent is extremely bulky and is unsuited for high speed operations and/or heavy duty, long stroke presses.

A later approach to the problem is disclosed in Patent No. 2,073,239 issued to Byerlein. The Byerlein construction is more practical than that of Bauroth; however, Byerlein requires cumbersome reduction gearing which is noisy and is troublesome to maintain since the gearing is subjected to considerable shock. Moreover, since the speed ratios of the Byerlein device are established by gearing, changing such ratios requires that the heavy reduction gearing be changed. This, it will be understood, is an expensive, time consuming operation.

The present invention possesses none of the disadvantages of the prior art devices mentioned and since it employs a novel principle of operation which utilizes only that gearing found necessary in ordinary, single speed presses, it is easily adapted to conventional press designs. Other advantages will readily become apparent from a study of the following description and from the drawings appended hereto.

In the drawings accompanying this specification and forming a part of this application there is shown, for purpose of illustration, an embodiment which the invention may assume, and in these drawings:

Figure 1 is a front elevational view of a press embodying the present invention,

Figure 2 is a top plan view,

Figures 3 and 4 are enlarged, complementary views taken along line x—x of Figure 2 and adapted to be joined together at the break line to form the completed section, and

Figure 5 is a schematic diagram of a combination electrical-fluid circuit found suitable for controlling operation of the invention and for coordinating its operation with the press with which it is employed.

While the invention is hereinafter disclosed as being

employed with a drawing press, it is to be clearly understood that this use is illustrative only and that the invention may be advantageously employed with any other suitable apparatus whose operation at more than one speed is desirous.

Figure 1 illustrates a conventional press **10** having a reciprocable slide **11** connected to a crankshaft **12** by means of a connecting rod **13**. The crankshaft **12** is suitably journalled in the frame of the press and rotation of the former reciprocates the slide **11** toward and away from the bed **14** of the press. Although not shown, the bed **14** may carry one part of a forming die while the slide **11** may carry a complementary part of the die. Secured to one end of crankshaft **12** is a bull gear **15** which is adapted to mesh with a suitable drive pinion which, in conventional single speed press constructions, is usually carried by a suitable countershaft. The countershaft usually carries a flywheel for storing energy and the countershaft is adapted to be rotated by any suitable means.

In the embodiment of the invention herein disclosed, the conventional countershaft is replaced by a driveshaft **16** mounted on the press by means of suitable brackets **17, 18**. Shaft **16** carries a drive pinion **19** which meshes with bull gear **15** and, in the present construction, bracket **18** provides at least a partial guard for the gears.

As best shown in Figures 3 and 4, housing **17** rotatably support the shaft **16** by means of an anti-friction bearing **20** while housing **18** rotatably supports the shaft by means of an anti-friction bearing **21**. In the present embodiment, shaft **16** supports a pair of spaced flywheels **22, 23** each of which is independently rotatable with respect to the shaft. The flywheels are adapted to be rotated at different speeds, by means later to be disclosed, and each is preferably of a different size.

Secured to flywheel **22** (see Figure 4) by suitable bolts, are axially spaced-apart end walls **24, 25** and an intermediate wall **26**. End wall **24** is rotatably mounted on shaft **16** by means of a bearing **27** while intermediate wall **26** is mounted on the shaft by means of a bearing **28**. Shaft **16** terminates intermediate walls **25, 26** for a purpose to become clear. End wall **25** is formed to provide an inwardly facing cylinder portion **29** in which a piston member **30** having a transverse face **31** is reciprocable axially of the shaft. Means are provided for locking piston member **30** and end wall **25** against relative rotation and, at present, such means comprises a plurality of bolts **32** which pass through apertures in the end wall and are threaded into the piston member. Springs **33** are interposed between the heads of bolts **32** and end wall **25** to yieldably urge the piston member inwardly of the cylinder portion **29**.

Adapted to seat against face **31** of piston member **30** and against the adjoining face of intermediate wall **26** are respective disks **34, 35** formed of suitable friction material. For a purpose to be seen, the outer periphery of disk **34** is formed to provide teeth, or splines, which mesh with teeth formed in the inner periphery of a ring member **36** secured to end wall **25** by means of bolts **37**. This construction locks disk **34** against rotation relative to the flywheel but permits the disk a limited amount of axial movement. In order to reduce the number of different parts, disk **35** is similar to disk **34** and is mounted in a similar manner (but against intermediate wall **26**) even though it is unnecessary to provide for axial movement of this disk.

Interposed between the disks **34, 35** is a friction member **38** having axially spaced, oppositely facing surfaces each engageable with a respective one of the disks. Note that the width of member **38** is somewhat less than the normal spacing between the disks **34, 35**. Friction mem-

ber 38 has an inner periphery formed to provide teeth, or splines, which mesh with teeth formed in the outer periphery of a collar 39 securely keyed to the adjoining end of shaft 16. Accordingly, friction member 38 is locked to shaft 16 for rotation therewith but is movable axially of the shaft for reasons to appear.

End wall 25 provides a passage 40 which communicates with the interior of the cylinder formed by portion 29 of this wall. A suitable conduit (not shown) connects passage 40 with a fluid control valve later to be described, any suitable swivel connection being interposed between the conduit and end wall 25 to permit the flywheel to rotate relative to the conduit.

Operation of flywheel 22 and the above-described clutch mechanism carried thereby is as follows: Assuming that flywheel 22 is being rotated by means later to be disclosed and that the parts carried by the flywheel are in the position shown, shaft 16 will remain stationary since disks 34, 35 are out of engagement with friction member 38. If fluid under pressure is now admitted to the cylinder formed in end wall 25, piston member 30 will be shifted to the left against the resiliency of springs 33. Disk 34 and friction member 38 will also be moved axially to the left until the friction member is tightly clamped between the two disks 35, 34. This will lock flywheel 22 and shaft 16 together and thus cause the shaft to rotate with the flywheel.

Shaft 16 will be disengaged from flywheel 22 by exhausting the fluid from the cylinder provided by end wall 25. This will permit springs 33 to move piston 30 to the right to thereby effect disengagement between friction member 38 and disks 34, 35 and thereupon permit the flywheel to rotate relative to the shaft.

Referring now to Figure 3, flywheel 23 is similar to flywheel 22 (with the exception of size). Therefore, corresponding parts are identified by the same reference characters but with the suffix "*a*" added. Because of its size, flywheel 23 requires more support than does flywheel 22; accordingly, end wall 25*a* is provided with an outwardly directed axial extension which provides a stub shaft 41 coaxial with shaft 16 and rotatable in a bearing 42 carried by a bracket 43 secured to the press frame. Since the left side of flywheel 23 is rotatably carried by bracket 43, intermediate wall 26*a* is not secured directly to shaft 16 as is intermediate wall 26. Instead, wall 26*a* is apertured at 44 to pass shaft 16.

To facilitate assembly and disassembly by maintaining flywheel 23 generally in alignment with shaft 16 while bracket 43 is being installed or removed, aperture 44 is only slightly larger than shaft 16 so that the intermediate wall 26*a* can support the left end of the flywheel at such times. Since the clearance between wall 26*a* and shaft 16 is slight, a ring 45 of suitable bearing metal may be interposed between the wall and the shaft to protect the shaft against possible damage.

Securely keyed to shaft 16 intermediate flywheels 22, 23 is a drum 46 against the periphery of which a brake shoe 47 is adapted to bear. As generally diagrammatically shown in Figure 3, brake shoe 47 is carried for movement toward and away from the drum by the piston 48 of a fluid cylinder 49. The brake shoe is preferably resiliently biased to engagement with the drum by any suitable means such as by means of a spring 50 interposed between the shoe and the cylinder. A conduit 51 connects the rod end of fluid cylinder 49 with a source of fluid pressure as will later be disclosed.

As previously mentioned, each flywheel 22, 23 is adapted to be independently driven and, in the presently disclosed embodiment and as best shown in Figure 2, separate motors are employed to drive the flywheels. Flywheel 22 is adapted to be driven by an electric motor 52 while flywheel 23 is adapted to be driven by an electric motor 53. It is preferably to connect motors 52, 53 with their respective flywheels by means of drive belts 54 running in grooves in the respective flywheels and over suitable sheaves carried by the motor shafts. This type of drive eliminates noisy gears and tends to reduce shock because of the resiliency of the belts. Moreover, in the event it is desired to vary the speed ratio between the flywheels, it is only necessary to change the size of the sheave on one and/or both of the motor shafts. While the present embodiment employs two drive motors, it is to be clearly understood that a single motor could be employed to drive the flywheels. For example, a motor having a shaft extending from each end could be employed, each shaft extension being adapted to drive a respective one of the flywheels.

In the embodiment herein disclosed, drive motors 52, 53 operate at generally the same speed; accordingly, since the motor sheaves are the same size, while flywheel 22 is materially smaller than flywheel 23, the latter flywheel will be driven at a slower speed than will flywheel 22.

Referring to schematic diagram, Figure 5, there is shown a camshaft 55 which is movable in accordance with movement of the slide 11 of the press. Camshaft 55 may be driven by any suitable member which moves in a fixed ratio with the press slide. For example, the camshaft could be connected to crankshaft 12, drive shaft 16, or even driven by motion of the slide itself, the only requirement being that the camshaft rotate (at least in the present embodiment) one revolution for each stroke of the press. For a purpose to be pointed out, camshaft 55 carries an interrupter cam 56 having a lobe 57 and a speed control cam 58 having a lobe 59.

A spring biased, sloenoid operated, fluid valve 60 having an inlet, an outlet and an exhaust is connected to a spring biased, solenoid operated, fluid valve 61 having an inlet, an exhaust and outlets A and B. The outlet of valve 60 is connected to the inlet of valve 61 by means of a conduit 62 while conduit 51 connects conduit 62 with brake cylinder 49. The inlet of valve 60 is adapted to be connected to a source of fluid pressure while outlet A of valve 61 is adapted to be connected to the interior of the clutch cylinder carried by flywheel 22 and outlet B is adapted to be connected to the interior of the clutch cylinder carried by flywheel 23.

The solenoid actuator of valve 60 is connected across power lines L1 and L2 by means of a circuit 63 which includes normally open contacts 64 of a relay 65 and normally open contacts 66, 67 of respective actuating switches 68, 69. The actuating coil of relay 65 is connected across the power lines by means of a circuit 70 which includes normally closed contacts 71, 72 of respective actuating switches 68, 69. A shunt circuit 73 is provided around contacts 71, 72 through normally open contacts 74 of relay 65 and through the contacts of a normally closed switch 75 which is adapted to be opened by lobe 57 of cam 56. The solenoid actuator of valve 61 is connected across the power lines by means of a circuit 76 which includes the normally open contacts of a switch 77 which is adapted to be closed by lobe 59 of cam 58.

With the arrangement of parts shown in Figure 5, outlet B of valve 61 will be in communication with the exhaust of this valve while outlet A will be in communication with the inlet since the valve is de-energized. No fluid will flow to the clutch of flywheel 22, however, because valve 60 is de-energized, and in this position, the inlet is blocked from the outlet and the latter is connected to exhaust. When the valve 60 is de-energized, the cylinder 49 is also connected to exhaust by reason of its connection to the outlet 62 of valve 60, so that spring 50 holds the brake applied to shaft 16 and thus holds slide 11 of the press in its uppermost position, as herein disclosed, or in any pre-selected position depending upon the angular adjustment of cam 56.

Assuming that drive motors 52, 53 are running, the operator may close a switch (not shown) to establish flow of current through lines L1 and L2, which in turn will cause current to flow through relay 65 via circuit

70 and normally closed contacts 71, 72 of actuating switches 68, 69. Flow of current through the relay will close contacts 64 in circuit 63 and contacts 74 in circuit 73. Since contacts 66, 67 of switches 68, 69 are normally open, no current will flow through circuit 63 at this time so that valve 60 will remain de-energized. Note that closing of contacts 74 will cause current to flow through shunt circuit 73 to thereupon hold relay 65 energized.

For safety purposes, it is necessary that the operator depress both switches 68, 69 in order to effect operation of the press and, normally, the operator will be required to operate one of these switches with one hand and the other switch with the other hand. When the operator closes both switches 68, 69, contacts 71, 72 will be opened; however, since shunt circuit 73 is completed, relay 65 will remain energized. Closing switches 68, 69 will close contacts 66, 67 and current will therefore flow through circuit 63 to energize solenoid valve 60. When this valve is energized, its outlet will be placed in communication with its inlet and fluid under pressure will thereupon flow to the inlet of valve 61 via conduit 62. Since valve 61 is not energized at this time, fluid will flow through the valve from its inlet to outlet A and thence to the clutch carried by flywheel 22.

Fluid will also flow to cylinder 49 thus withdrawing brake shoe 47 from engagement with drum 46. Flow of fluid to the clutch carried by flywheel 22 will engage this flywheel with shaft 16 and thus effect rotation of this shaft and downward movement of slide 11 as before described. Since flywheel 22 is rotating at a relatively high speed, slide 11 will move downwardly at a relatively high speed and, as before described, camshaft 55 will be rotated in the direction of the arrow (Figure 5) in synchronization with the slide.

As slide 11 approaches the working portion of its stroke, lobe 59 of speed control cam 58 will close the contacts of switch 77 and thereupon energize solenoid valve 61. Energization of valve 61 will connect outlet A with the exhaust to release the clutch carried by flywheel 22 and simultaneously connect outlet B with the inlet to engage the clutch carried by flywheel 23. With flywheel 23 engaged with shaft 16, the slide will progress at a slower speed so that the proper drawing action can take place.

At the completion of the drawing operation, camshaft 55 will have rotated sufficiently that lobe 59 of cam 58 will no longer hold the contacts of switch 77 closed. This will deenergize solenoid valve 61 and once again engage the clutch carried by flywheel 22 and disengage the clutch carried by flywheel 23. Accordingly, slide 11 will once again move at high speed.

As the slide approaches its uppermost or other preselected stopping position, lobe 57 of interrupter cam 56 will momentarily open the contacts of switch 75. This will break shunt circuit 73 and de-energize relay 65. De-energization of relay 65 will open contacts 64 in circuit 63 and contacts 74 in circuit 73. With circuit 63 open, solenoid 60 will be de-energized to close this valve's inlet from its outlet and to connect its outlet to exhaust. This will disengage the clutch carried by flywheel 22 and also permit spring 50 to apply the brake to shaft 16 to thereupon stop the slide at the top of its stroke.

It will be noted that although the contacts of switch 75 are only momentarily broken, relay 65 will remain de-energized until such time as the operator releases both actuating switches 68, 69 to permit the latter to return to the position shown in the drawing. Only when the latter occurs, will relay 65 be re-energized to prepare the circuits for the next cycle which will commence when switches 68, 69 are once again depressed by the operator. Accordingly, it will be understood that the hereindisclosed apparatus provides for one-stroke, non-repeat operation of a press or the like at relatively low speed during part of the press cycle and at relatively high speed during the remainder of the cycle.

It will be appreciated that the motors 52, 53 may be of the variable speed type whereby speeds of the flywheels 22, 23 may be quickly changed without necessitating a change of the drive pulleys, or a variable speed drive mechanism may be interposed between the motors and their respective flywheels for the purpose of quickly changing drive speeds. In any event, the drive of the invention possesses considerable flexibility and it is to be noted that one or the other of the flywheel drives may be employed alone to operate the press in a conventional manner and to permit repair of one of the drives without stoppage of production.

In vew of the foregoing it will be apparent to those skilled in the art that I have accomplished at least the principal object of my invention and it will also be apparent to those skilled in the art that the embodiment herein described may be variously changed and modified, without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described, hence it will be appreciated that the herein disclosed embodiment is illustrative only, and that my invention is not limited thereto.

I claim:

1. A power press having a reciprocable slide, a crankshaft having drive connection with said slide to effect reciprocation thereof, a shaft rotatably supported by said press and having driving connection with said crankshaft, a pair of flywheels, each of considerable mass and each mounted on said shaft for rotation relative thereto, means for rotating said flywheels on said shaft, one flywheel rotating at a greater speed than the other, and clutch means for said flywheels and selectively operable to engage one or the other of said flywheels with said shaft and thereby provide rotation of said shaft and consequent rotation of said crankshaft and reciprocation of said slide at a speed governed by the engaged flywheel.

2. A power press having a reciprocable slide, a crankshaft having drive connection with said slide to effect reciprocation thereof, a shaft rotatably supported by said press and having driving connection with said crankshaft, a pair of flywheels of different diameter, each mounted on said shaft for rotation relative thereto, means for rotating said flywheels on said shaft and constructed and arranged whereby the larger flywheel is driven at a lower rotational speed, and a clutch for each of said flywheels and selectively operable to engage a respective flywheel with said shaft, whereby said crankshaft is rotated and said slide is reciprocated selectively at speeds governed by the speed of the engaged flywheel.

3. A power press having a reciprocable slide, a crankshaft having drive connection with said slide to effect reciprocation thereof, a shaft rotatably supported by said press and having driving connection with said crankshaft, a pair of flywheels mounted on said shaft for rotation relative thereto, drive motor means for said flywheels, belt and pulley connections between said drive motor means and said flywheels whereby said flywheels may be rotated at different speeds, and clutch means for said flywheels and selectively operable to engage one or the other of said flywheels with said shaft and thereby provide rotation of said shaft and consequent rotation of said crankshaft and reciprocation of said slide at a speed governed by the engaged flywheel.

4. A power press having a reciprocable slide, and means for reciprocating said slide, including a pair of rotatably mounted flywheels of different diameters, a separate drive motor for each of said flywheels, each drive motor having a pulley on its driving shaft and a belt engaged over such pulley and over the periphery of a respective flywheel whereby said pulleys may be related in size to drive the larger flywheel at a slower rotational speed, and a clutch for each of said flywheels and selectively operable to engage a respective flywheel and thereby provide for reciprocation of said slide at a speed governed by the engaged flywheel.

5. A drawing press having a stationary die supporting portion and a reciprocable die supporting portion movable through a cycle at one speed during drawing operation and at a higher speed preceding and subsequent to said drawing operation, comprising a pair of rotatably mounted flywheels, one rotating at a higher speed than the other, clutch means for said flywheels and selectively operable to engage one or the other of said flywheels and establish a drive connection with said reciprocable die supporting portion, and control means operable during selected portions of the cycle of said reciprocable die supporting portion to engage said clutch means with the slower rotating flywheel during the drawing operation of said press and to disengage said clutch means from said slower flywheel and engage said clutch means with the faster rotating flywheel during the time preceding and subsequent to said drawing operation.

6. A drawing press having a stationary die supporting portion and a reciprocable die supporting portion movable through a cycle at one speed during drawing operation and at a higher speed preceding and subsequent to said drawing operation, comprising a pair of rotatably mounted flywheels and means for driving said flywheels, one flywheel being of greater diameter than the other and rotating at a slower speed, a clutch for each of said flywheels and selectively operable to engage a respective flywheel and establish a drive connection with said reciprocable die supporting portion, and control means operable during selected portions of the cycle of said reciprocable die supporting portion to engage one clutch with the larger and slower rotating flywheel during the drawing operation of said press and to disengage said one clutch and engage the other clutch with the smaller and faster rotating flywheel during the time preceding and subsequent to said drawing operation.

7. A drawing press having a stationary die supporting portion and a reciprocable die supporting portion movable through a cycle at one speed during drawing operation and at a higher speed preceding and subsequent to said drawing operation, comprising a shaft rotatably mounted on said press and having driving connection with said reciprocable die supporting portion, a pair of flywheels of different diameters, each mounted on said shaft for rotation relative thereto, a separate drive motor for each of said flywheels, each drive motor having a pulley on its driving shaft and a belt engaged over such pulley and over the periphery of a respective flywheel whereby said pulleys may be related in size to drive the larger flywheel at a slower rotational speed, a clutch for each of said flywheels and selectively operable to engage a respective flywheel and establish driving connection with said shaft, and control means operable during selected portions of the cycle of said reciprocable die supporting portion to operate the clutch associated with the larger and slower rotating flywheel to engage such flywheel with said shaft during the drawing operation of said press, and being operable to operate the other clutch associated with the smaller and faster rotating flywheel to engage such flywheel with said shaft during the time preceding and subsequent to said drawing operation while rendering said first clutch ineffective.

References Cited in the file of this patent

UNITED STATES PATENTS

2,488,892	Arzt	Nov. 22, 1949
2,557,896	Soule et al.	June 19, 1951
2,577,641	Wissman	Dec. 4, 1951

FOREIGN PATENTS

581,508	Great Britain	Oct. 15, 1946