United States Patent

[11] 3,583,268

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[23] **Continuation of Ser. No. 648,345, June 23, 1967, abandoned**
[45] Patented **June 8, 1971**

[54] **HIGH SPEED STOCK FEEDER**
50 Claims, 19 Drawing Figs.

[52] **U.S. Cl.** **83/225,** 83/247, 83/257, 83/277, 226/112, 226/162
[51] **Int. Cl.** **B26d 5/20**
[50] **Field of Search** 83/225, 247, 257, 277; 226/112, 162

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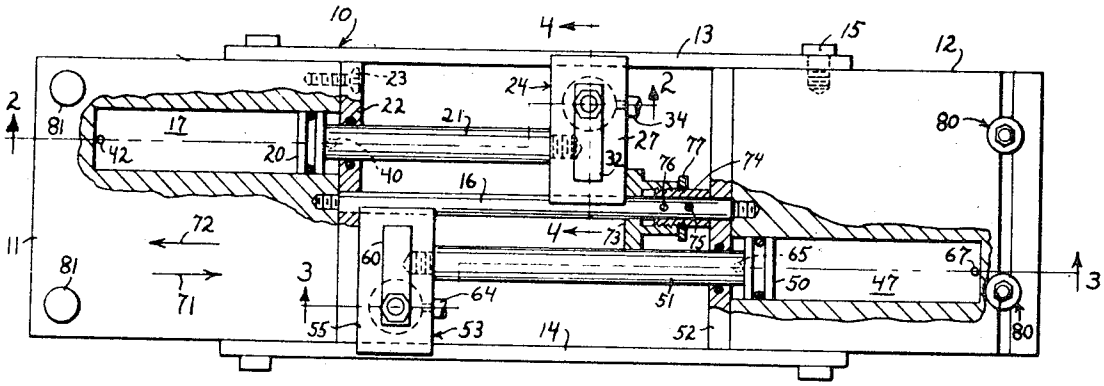
Primary Examiner—Frank T. Yost

ABSTRACT: High-speed strip-feeding apparatus having two feedheads that are reciprocated by two air motor means respectively. A work-clamping device is operatively mounted on each feedhead and is actuated by an additional air motor means. All of said air motor means are adapted to be sequentially controlled by a fluid valve means that is operative in one condition so that at least some of said air motor means may receive fluid pressure, and operative in another condition so that at least some of said air motor means are connected to exhaust means whereby said feedheads are alternately actuated so as to respectively advance successive lengths of the strip to be fed into a work station.



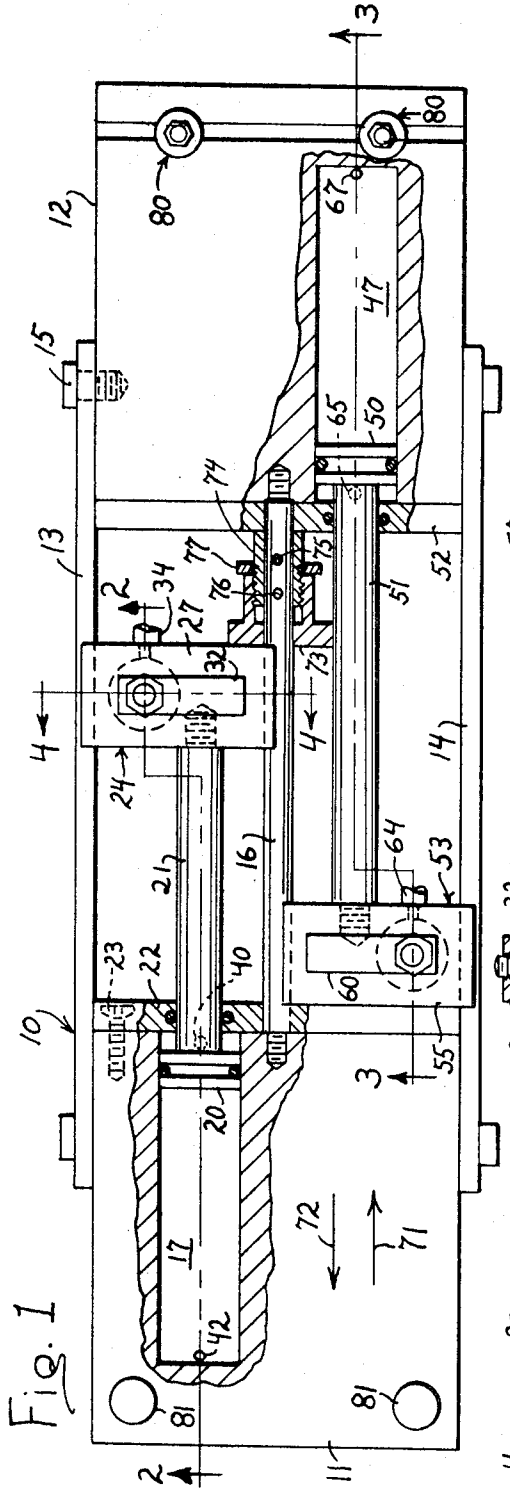


Fig. 1

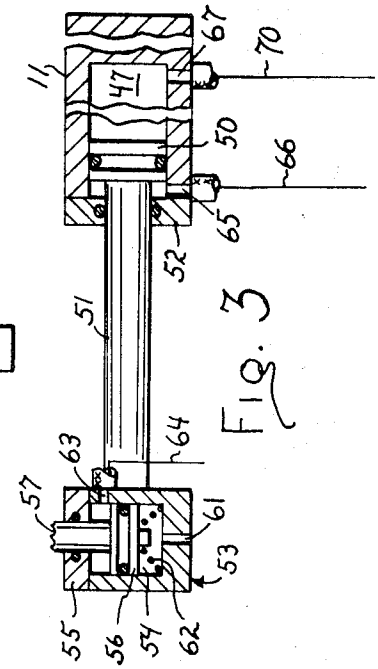


Fig. 3

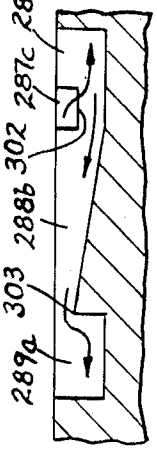


Fig. 17

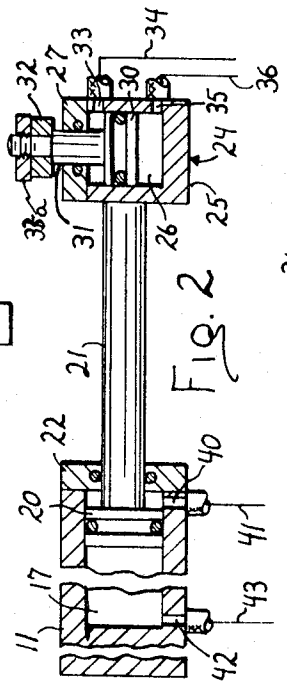


Fig. 2

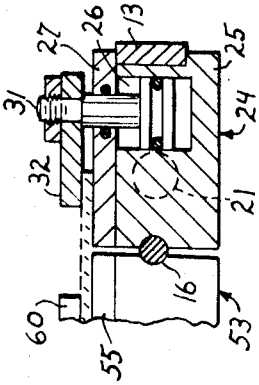


Fig. 4

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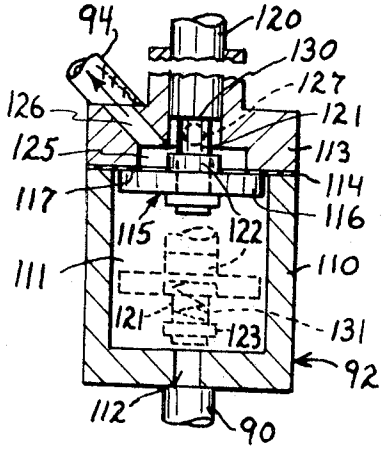


Fig. 6

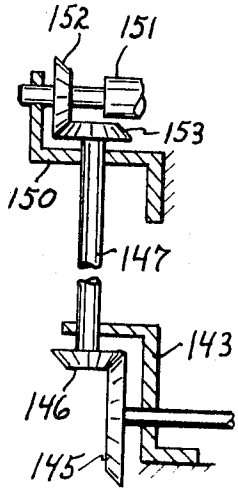
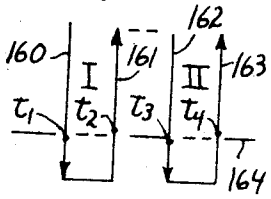


Fig. 9



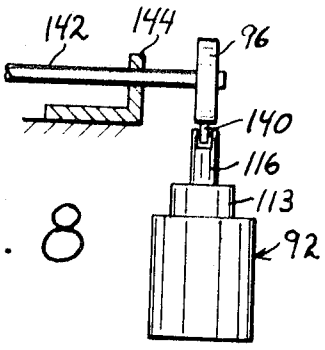


Fig. 8

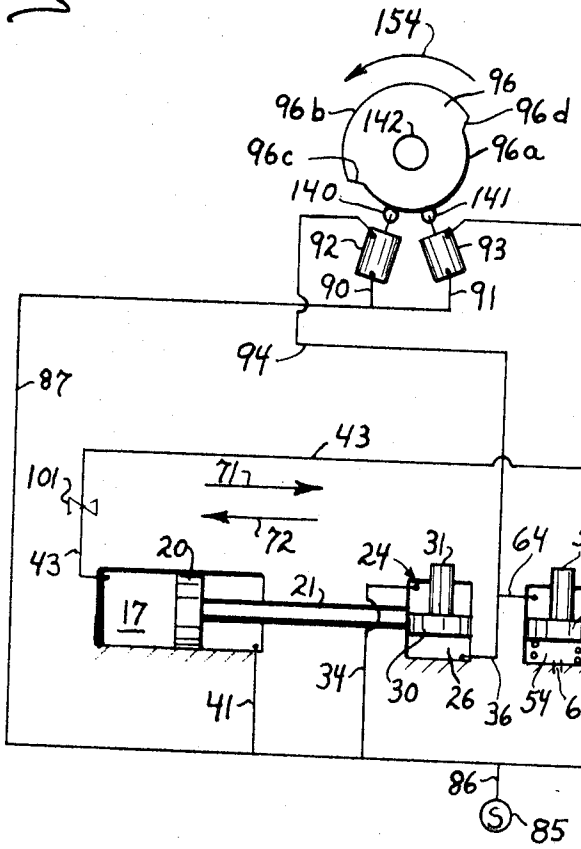


Fig. 5

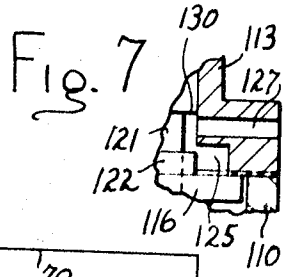


Fig. 7

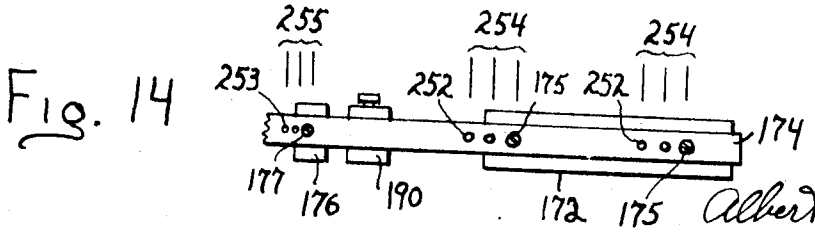


Fig. 14

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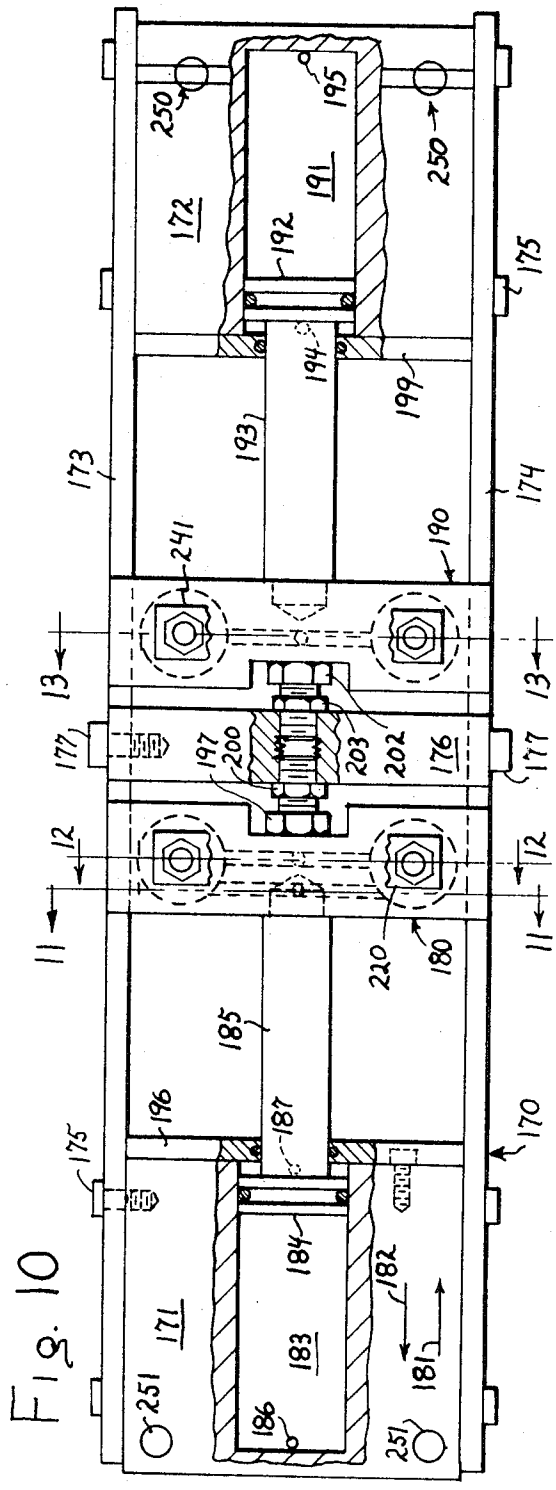

Fig. 10

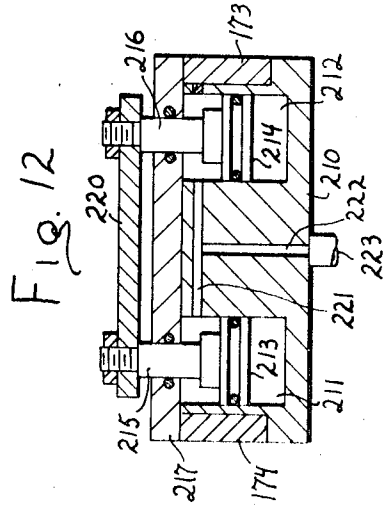

Fig. 12

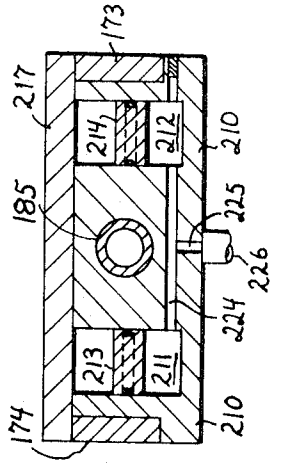

Fig. 11

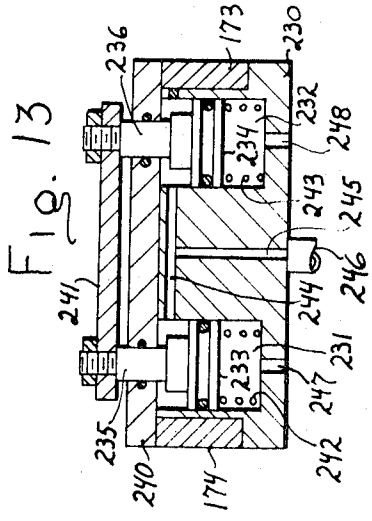

Fig. 13

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Fig. 16

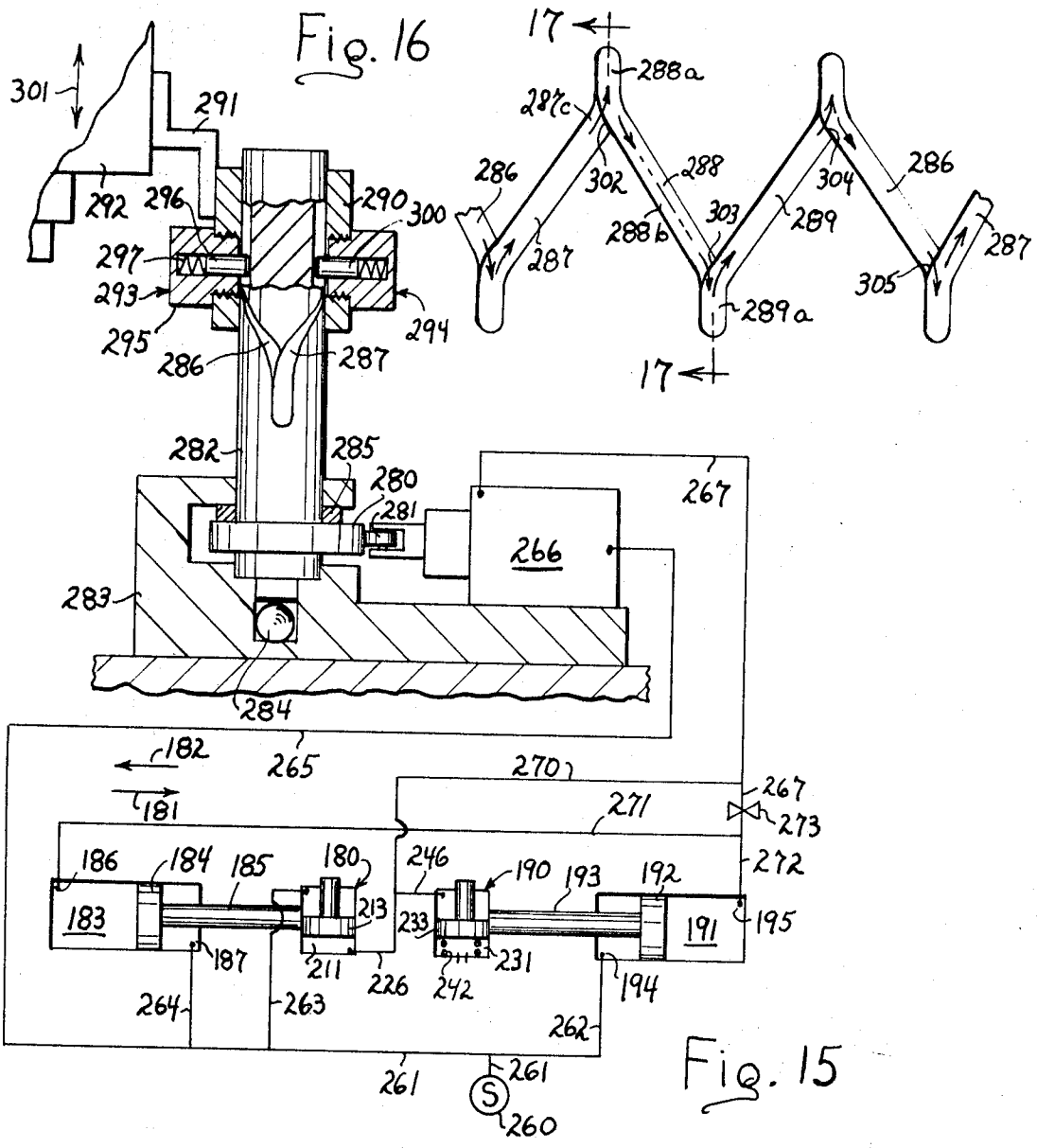

Fig. 15

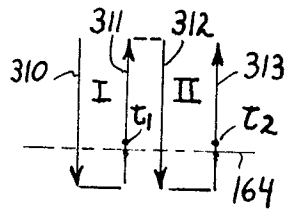

Fig. 18

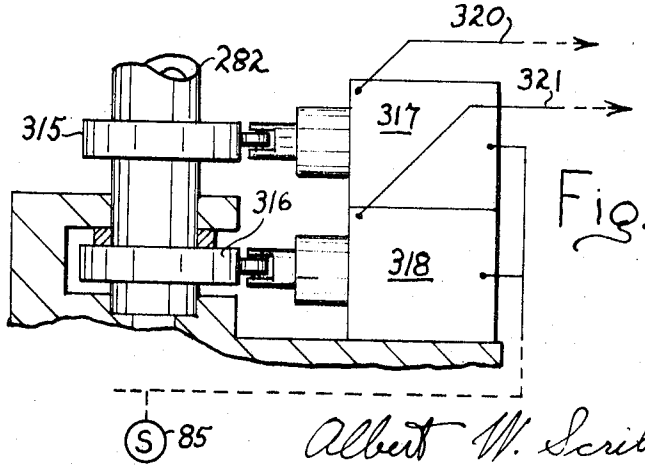

Fig. 19

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HIGH SPEED STOCK FEEDER

This is a continuation of application Ser. No. 648,345 filed June 23, 1967, now abandoned.

This invention relates to an improved high-speed stock-feeding apparatus for punch presses and the like. More particularly the invention relates to improved duplex stock-feeding device that utilizes a novel fluid-actuating and control means.

Newer types of punch presses and similar equipment are being designed to afford higher and higher cyclic operating speeds. Press speeds of over 600 cycles per minute are now common however such operating rates make more difficult the task of accurately and efficiently advancing the strip stock into the press work station. Prior attempts to provide a high-speed stock feeder have for the most part resulted in relatively heavy, cumbersome and/or expensive apparatus. The instant invention contemplates overcoming these difficulties by utilizing a particular combination of fluid-operated components and controls therefore in a stock feeder so as to render the device capable of more efficiently producing a high-speed intermittent advancing movement of the strip stock to be fed into a machine work station.

The primary object of the instant invention is to provide a novel high-speed stock feeder that is constructed so as to be relatively simple, light, inexpensive and easy to install.

Another object of the invention is to provide an improved high-speed stock feeder wherein a novel combination of fluid-operated motors for operating the stock-gripping, stock-clamping and stock-advancing means associated with the feeder.

Another object of the invention is to provide a novel fluid control circuit and related means for more efficiently controlling the operation of a double-acting stock-feeding device.

Another object of the invention is to provide an improved control-valving arrangement for high-speed stock-feeding devices whereby only a minimum of moving elements are required.

A further object of the invention is to provide a novel high-speed stock feeder wherein a novel motion-translating means is arranged so as to be actuated by the reciprocating movement of an associated press ram so as to intermittently operate the fluid-valving means that controls the various fluid motors in said feeder.

Other objects will become apparent as the disclosure progresses.

FIG. 1 is a plan view in partial section of the principal structure of one embodiment of the instant stock feeder.

FIG. 2 is a sectional view taken along section line 2–2 of FIG. 1.

FIG. 3 is a sectional view taken along section line 3–3 of FIG. 1.

FIG. 4 is a sectional view taken along section line 4–4 of FIG. 1.

FIG. 5 is a circuit diagram illustrating the fluid control means for the apparatus of FIGS. 1—4.

FIG. 6 is an axial sectional view of one of the three-way valving units used in the circuitry of FIG. 5.

FIG. 7 is a fragmentary axial sectional view of the exhaust portion of the valve illustrated in FIG. 6.

FIG. 8 is a diagrammatic-type view of the valve-actuating means that is driven by the press crankshaft.

FIG. 9 is a timing diagram for the apparatus of FIGS. 1—8.

FIG. 10 is a plan view in partial section of the principal structure of a second embodiment of the instant feeder.

FIG. 11 is a sectional view taken along section line 11–11 of FIG. 10.

FIG. 12 is a sectional view taken along section line 12–12 of FIG. 10.

FIG. 13 is a sectional view taken along section line 13–13 of FIG. 10.

FIG. 14 is a front elevational view of a portion of the FIG. 10 apparatus.

FIG. 15 is a circuit diagram illustrating the fluid control means for the apparatus of FIGS. 10—14.

FIG. 16 is a diagrammatic view illustrating the nature of the valve-actuating cam grooves.

FIG. 17 is a sectional view taken along the diagrammatic section line 17–17 of FIG. 16.

FIG. 18 is a timing diagram for the apparatus of FIGS. 10—17.

FIG. 19 is a fragmentary elevational view illustrating a modified valve actuating means for the circuit diagram of FIG. 15.

Referring to FIGS. 1—4 there is shown a pneumatically actuated duplex or double-acting stock-feeding arrangement comprising a frame 10 that includes a forward cylinder block 11 and a rearward cylinder block 12 which are rigidly interconnected by a pair of side rails 13 and 14 that are fastened to the sides of said blocks by any suitable means such as screws 15. A center rod 16 is threadedly connected at each of said blocks. A cylinder 17 is formed in block 11 and a piston 20 slidably mounted therein, piston 20 being fastened to a connecting rod 21. Rod 21 extends through a suitable aperture formed in the cylinder-closing end plate 22 that is sealingly secured to the end of the block 11 by any suitable fastening means such as screws 23. The outer end of piston rod 21 is secured to a first feed head 24 that is slidably mounted on the side rail 13 and the center rod 16 as is best shown in FIGS. 1 and 4. The feed head 24 comprises a lower body portion 25 in which is formed a cylinder 26, the top of said cylinder 26 being closed by an upper plate 27 that is sealingly secured to said body portion 25 by an suitable fastening means. A double-acting piston 30, FIG. 2, is slidably mounted in cylinder 26 and is fastened to a piston rod 31 that extends upwardly through a suitable aperture in cover plate 27 and has secured to its upper end, as by any suitable means 33*a*, FIG. 2 a laterally inwardly extending stock-gripping bar 32, constituting an open throated stock-gripping means. The portion of cylinder 26 above the piston 30 is pneumatically coupled through a port 33 to a flexible control tube or line 34 while the portion of the cylinder 26 below said piston 30 is pneumatically coupled through a port 35 to a flexible control tube or line 36. The rearward or right end of cylinder 17 as seen in FIGS. 1 and 2 is pneumatically coupled through a port 40 to a flexible control tube or line 41 while the forward end of cylinder 17 is pneumatically coupled through a port 42 to a flexible control tube or line 43.

The rearward cylinder block 12 is provided with a cylinder 47, a piston 50, a piston rod 51, an end plate 52 a fastening means similar to 23 and a feedhead 53 that are constructed and arranged the same as the above-described corresponding parts associated with the forward block 11. The outer end of piston rod 51 is secured to a second feedhead 53 that is slidably mounted on the side rail 14 and center rod 16. The feedhead 53, the cylinder 54, end cover plate 55, piston 56, piston rod 57 and clamp bar 60 are also all constructed and arranged in a manner similar to the corresponding elements associated with the above-described feedhead 24. The piston 56 however is a single acting piston, the portion of said cylinder 54 below said piston 56 being vented through the port 61 and containing a compression spring 62 that biases the piston 56 upwardly. The portion of cylinder 54 above piston 56 is pneumatically coupled through a port 63 to a flexible control tube or line 64. The forward or left end of cylinder 47 as seen in FIGS. 1 and 3 is pneumatically coupled through a port 65 to a flexible control tube or line 66 while the rearward end of cylinder 47 is pneumatically coupled through a port 67 to a flexible control tube or line 70.

The first fluid motor that is effectively defined by elements 17, 20 and 21, the second fluid motor that is effectively defined by elements 26, 30 and 31, the third fluid motor that is effectively defined by elements 47, 50 and 51, and the fourth fluid motor that is effectively defined by elements 54, 56 and 57 are all provided with the necessary O-ring or other similar means for the sliding actions involved.

The feedheads 24 and 53, which are mounted for movement in side-by-side relation, are reciprocally actuated by said first and third fluid motors, respectively, in indexing and stock-feeding direction 71 and 72, FIG. 1, and said stock-gripping bars 32 and 60 are moved between stock-gripping and stock-releasing positions by said second and fourth fluid motors. The forward limits of movement of feedheads 24 and 53 are each determined by engagement thereof with the said end plate 22 on block 11 while the rearward limits of movement of said feedheads are each determined by engagement thereof with a common stop member 73 that threadedly engages a sleeve 74 that is pinned as at 75 to said center rod 16. The provision of additional holes 76 formed in rod 16 affords a coarse adjustment for the stroke length of feedheads 24 and 53 while the threaded coupling between stop member 73 and sleeve 74 affords a fine feedhead stroke adjustment, the locknut 77 providing means to lock the stop member 73 and sleeve 74 in adjusted position. The feedheads 24 and 53 are thus reciprocally actuated in side-by-side relation and between common stop means 22 and 73. Any suitable adjustable stock-guiding means 80 may be provided at the rearward end of the feeder frame 10 while a pair of bores 81 or other suitable means are provided at the forward end of frame 10 for facilitating the mounting of the instant stock feeder in fixed relation to the associated punch press or other machine.

In FIGS. 5—8 there is shown a fluid control circuit, a control valve means, and a valve-operating means. Referring first to the circuit diagram of FIG. 5 there is diagrammatically illustrated the above noted first, second, third and fourth fluid motors and the control circuitry thereof. A source 85 of fluid pressure is connected directly by line 86 and said line 66 to the forward end of cylinder 47, and is connected directly by line 86 and said line 34 to the upper end of the clamp cylinder 26. Further said source 85 is connected directly by line 86 and said line 41 to the rearward end of cylinder 17 and also directly by lines 86 and 87 to the supply or inlet lines 90 and 91 of two three-way control valves 92 and 93 respectively. The three-way valves 92 and 93 are provided with output lines 94 and 95 and are each adapted to be actuated in timed relation by means of a rotary cam 96. Each valve is operative in its normal condition illustrated in FIG. 5 to connect its output line to exhaust and is operative in its actuated condition to connect its output line to the fluid pressure from said lines 90 and 91 as will be more fully discussed in connection with FIGS. 6 and 7. The output line 94 is connected by said line 36 to the lower end of said clamp cylinder 26 and by said line 64 to the upper end of said clamp cylinder 54. The output line 95 of valve 93 is connected by said line 70 to the rearward end of the cylinder 47 and by said line 43 to the forward end of cylinder 17. Suitable air restriction means 100 and 101 are provided in lines 70 and 43 respectively so as to control the rate of fluid flow to and from said cylinders 47 and 17.

Referring now to FIGS. 6 and 7 the construction and arrangement for one of the two similar three-way valves 92, 93 used here will be described. The valve 92 comprises a body 110 having a cylinder 111 formed therein which is pneumatically connected through a suitable port 112 to said pressure inlet line 90. The upper end of cylinder 111 is closed by means of a cap 113 and a gasket 114 that are suitably secured to said body 110. A valve member 115 is slidably mounted in cylinder 111, and comprises a head 116 which has an effective cross-sectional area that is slightly less than the corresponding effective cross-sectional area of said cylinder 111, and which has a radially outer upper face valving portion 117 that is adapted to normally seat against the adjacent lower surface of said cap 113. A valve stem 120 is connected at its lower end for limited axial sliding movement on and relative to the valve head 116, and extends upwardly through a suitable aperture formed in said cap 113. The lower reduced end 121 of the valve item 120 extends through a suitable aperture formed through the valve head 116 and its upper boss 122 and is provided with a suitable fastening nut 123 or the like at its lowermost end. The cap 113 is formed with a lower cylindrical recess 125 that is pneumatically connected by a port 126 to the said flexible control tube or line 94. Cap 113 is also formed with an exhaust port 127 FIG. 7, that normally communicates with said recess 125 in cap 113.

As will be apparent the fluid pressure that is always present in the lower end of valve cylinder 111 will continuously bias the movable valve 115 to the said normal upper position illustrated in FIG. 6. In this normal condition of the valve 92 the said valve outlet or control line 94 is connected to said exhaust port 127 and hence fluid pressure in line 94 will be normally vented or exhausted to the atmosphere. When the valve stem 120 is axially displaced downwardly the shoulder 130, FIG. 7, on said stem first closes the adjacent end of the exhaust port and then engages the said boss 122 on the valve head 116, the reduced lower end 121 of the valve stem during this much of its downward movement simple moving axially through and relative to the still stationary valve head 116. Continued downward movement of valve stem 120 will now cause the valve head 116 to unseat and move downwardly with the valve stem, as is illustrated by the dotted lines in FIG. 6, so as to thereby pneumatically connect the fluid pressure in the lower portion of said cylinder 111 to said valve outlet line 94 through said recess 125 and port 126. Under these conditions fluid pressure will be applied to line 94 while the valve exhaust port 127 is closed. When the valve stem is allowed to move upwardly the fluid pressure in cylinder 111 will displace the valve member 115 to its normal upper position illustrated in FIG. 6. During this upward movement the valve head 116 will first be arrested in its said normal seated position, thereby sealing off the lower portion of cylinder 111 from the outlet line 94. Continued upward movement of the valve stem will cause the stem shoulder 130 to uncover the exhaust port 127 so that fluid pressure in line 94 may be exhausted. If desired a suitable light spring 131, FIG. 6 may be provided for lightly biasing the valve head 116 upwardly relative to the reduced portion of the valve stem 120. It will be understood that the construction and operation of valve 93 corresponds to that just described for valve 90. As will be apparent the valve 92 controls the operation of the fluid motors that actuate the two instant stock-gripping means while the valve 93 controls the operation of the two fluid motors that actuates the feedheads 24 and 53.

The outer ends of the respective valve stems of valves 92 and 93 are provided with well-known conventional-type rollers that are diagrammatically illustrated at 140 and 141 respectively in FIG. 6. These rollers cooperate with the peripheral surface of said rotary cam 96 so that the valves 92 and 93 may be actuated in timed relation with the operation of the associated press. The cam 96 has two arcuate peripheral camming surfaces 96*a* and 96*b*, surface 96*a* being substantially circular in contour and extending substantially halfway around the cam periphery while surface 96*b* is also substantially circular in contour and extends the remaining way around the cam periphery. The surface 96*a* has a shorter radial dimension than that for surface 96*b*. Interconnecting said surfaces 96*a* and 96*b* are inclined surfaces 96*c* and 96*d*. The means for driving the cam 96 functions to cause the latter to rotate once for each two rotations of the main crankshaft of the press and comprises a shaft 142, FIG. 8, on which cam 96 is secured and which is rotatably supported on the press frame by any suitable means such as brackets 143 and 144. The shaft 142 is coupled through bevel gears 145, 146 to a shaft 147 that is rotatably supported by any suitable means such as brackets 143 and 150 on the press frame. The gear 145 is effectively twice as large as gear 146 and hence the gear ratio between shafts 147 and 142 is two to one. The shaft 147 is adapted to be driven by the main crankshaft 151 of the press through bevel gears 152, 153. As the cam 96 is thus rotated as indicated by arrow 154 of FIG. 5 the inclined cam surface 96*c* will first depress the stem of the stock-gripping control valve 92 so that the fluid motors for the stock clamp bars 32 and 60 first set said stock-gripping means to their operative positions and thereafter said inclined surface 96*c* will depress the valve

stem of the feedhead-actuating control valve **93** so that the fluid motors for actuating said feedheads **24, 53** will then be operated. Subsequently the inclined surface **96***d* will permit said valve stems for valves **92** and **93** to be sequentially restored to their normal positions so that the said stock-gripping means and the said feedheads **24** and **53** are corresponding and sequentially actuated.

A description of the overall operation of the instant stock-feeding device will now be made. Referring initially to the timing diagram of FIG. **9** the arrows **160** and **161** indicate the downwardly and upwardly moving halves respectively, of the motion of the press ram during a first cycle I of operation. Arrows **162** and **163** correspondingly denote the downward and upward motions of the ram during its next following cycle II of operation. During these two ram cycles the cam **96** will be rotated only once. The dotted line **164** of FIG. **9** indicates the periods when the press punch is in engagement with the stock material (these periods being represented by those portions of arrows **160, 161, 162** and **163** that are below said line **164**). In the normal upper rest position of the press ram the rotary cam **96** will be in a position similar to that shown in FIG. **5** wherein both valve stem rollers **140, 141** are in contact with the radially shorter cam surface **96***a* so that both valves **92** and **93** are in their normal positions wherein their outlet lines **94** and **95** are connected to exhaust. Under these valve conditions the condition of the FIG. **5** fluid circuit and associated fluid motors will be as follows. The piston **20** and feedhead **24** will be moved by the said continuous fluid-biasing pressure in the rearward end of cylinder **17** in a feed direction **72** so that feedhead **24** engages the main block plate **22**. During this movement the stock-gripping bar **32** on feedhead **24** will be held in a stock-gripping position by reason of the action of the continuous fluid-biasing pressure in the upper end of said feedhead cylinder **26**. In similar fashion the piston **50** and feedhead **53** will be moved by the said continuous fluid-biasing pressure in the forward end of cylinder **47** in an indexing direction **71** so that said feedhead **53** engages the adjustable stop **73**. During this movement the stock-gripping bar **60** on feedhead **53** will be held in a stock-releasing position by the spring **62**. Thus the feedhead **24** is normally held in a forward stock-gripping position while the feedhead **53** is normally held in a rearward stock-releasing position. When the punch press is set in operation the press crankshaft will rotatably drive the came **96** in the direction indicated by arrow **154**, FIG. **5**, at a two-to-one gear ratio through the gearing described in connection with FIG. **8**. As the cam **96** thus rotates its inclined surface **96***c* will, at a time *t*, in the timing diagram of FIG. **9**, first depress the stem of stock-gripping control valve **92** so that fluid pressure is admitted to valve outlet line **94** which thereby causes piston **30** to be moved upwardly and piston **56** to be moved downwardly thus respectively moving the stock-gripping means on feedhead **24** to a stock-releasing position and the stock-gripping means on feedhead **53** to a stock-gripping position. Shortly thereafter at a time t_2 in the timing diagram of FIG. **9**, said inclined cam surface **96***c* will depress the stem of the feedhead actuating valve **93** so that fluid pressure is admitted to valve outlet line **95** which thereby causes piston **20** and feedhead **24** to be moved in direction **71** and piston **50** and feedhead **53** to be moved in a feed direction **72**. During this described cycle I of operation of the punch press the stock-gripping means on the feedheads are set at a time t_1 just after said press punch has engaged the stock and the feedhead-actuating motors are actuated at a time t_2 just after said press punch has withdrawn from engagement with said stock. Thus during cycle I feedhead **24** is actuated through an indexing stroke while feedhead **53** is simultaneously actuated through a stock-feeding stroke so as to advance the stock by a predetermined length into the work station of the press.

During the next cycle II of the press the continued rotation of cam **96** will cause, at a time t_3 in the timing diagram of FIG. **9**, the inclined surface **96***d* thereof to first allow the stem of stock-gripping control valve **92** to be restored to its said normal position so that the outlet line **94** thereof is connected to exhaust which thereby allows the said downwardly biased piston **30** and the associated stock-gripping means on the feedhead **24** to be moved to a stock-gripping position while the upwardly spring-biased piston **56** and associated stock-gripping means on the feedhead **53** are moved to a stock-releasing position. Shortly thereafter, at a time t_4 in the timing diagram of FIG. **9**, the inclined surface **96***d* of the rotating cam will allow the valve stem of the feedhead-actuating control valve **93** to be restored to its said normal position so that the outlet line **95** thereof is connected to exhaust which thereby allows said forwardly biased piston **20** and feedhead **24** to be moved in a feed direction **72** and said rearwardly biased piston **50** and feedhead **53** to be moved in an index direction **71**. During this cycle II of operation of the press the stock-gripping means on the feedheads are again set at a time t_3 just after the press punch has engaged the stock and the feedheads are again actuated at a time t_4 just after the said punch has been withdrawn from engagement with said stock. Thus during cycle II feedhead **53** is actuated through an indexing stroke while feedhead **24** is simultaneously actuated through a stock-feeding stroke so as to advance a second equal length of stock into the work station of the press. It will be apparent that by utilizing two feedheads substantially all of the time during each press cycle that the punch is out of engagement with the stock may be used for the stock-advancing movement of one of said feedheads. Further the stock-gripping means are already set and ready for the next stock-feeding stroke when the punch is withdrawn from said stock. Under these conditions the successive stock-advancing movements alternately produced by the feedheads **24** and **53** may occur at a very rapid rate so as to efficiently and accurately feed stock into the work station.

Referring to FIGS. **10—19** an alternate embodiment of a duplex-type feeder and control arrangement therefor is illustrated. In FIGS. **10—13** there is shown a feeder construction that includes a frame **170** comprising a forward body block **171**, a rearward body block **172**, and a pair of side rails **173** and **174** that are fixedly secured to the sides of said blocks by any suitable means such as screws **175**. A stop block **176** is fixedly mounted to rails **173, 174** as by means of screws **177**, at a location approximately midway between said blocks **171** and **172**. Slidably mounted on rails **173, 174** between body block **171** and stop block **176** is a first feedhead **180** that is connected to and adapted to be actuated in indexing and stock-feeding directions **181** and **182** respectively by a first fluid motor that is effectively defined by a cylinder **183**, a piston **184**, a piston rod **185** and fluid flow ports **186, 187** at opposite ends of said cylinder **181** that are constructed and arranged in the same manner as that effectively defined by **17, 20, 21** and **42, 40** etc., FIGS. **1—4**, for similarly actuating said feedhead **24**. Slidably mounted on rails **173, 174** between the body block **172** and the stop block **176** is a second feedhead **190** that is connected to and adapted to be actuated in said directions **181, 182** by a second fluid motor that is effectively defined by a cylinder **191**, a piston **192**, a piston rod **193**, and fluid flow ports **194, 195** at opposite ends of said cylinder **191** that are constructed and arranged in the same manner as that effectively defined by **47, 50 51** and **65 67**, FIGS. **1—4** for similarly actuating said feedhead **53**. The forward limit of movement of feedhead **180** is determined by engagement of the latter with the end plate **196** secured to the block **171** while the rearward limit of movement thereof is determined by engagement with an adjustable stop bolt **197** which is threadedly fastened to stopblock **176** and which is locked in adjusted position by a locknut **200**. In similar fashion the rearward limit of movement of feedhead **190** is determined by engagement of the latter with the end plate **199** secured to said block **172** while the forward limit of movement thereof is determined by engagement with an adjustable stop bolt **202** which is also threadedly engaged with said stopblock **176** and which may be locked in adjusted position by locknut **203**. For any given stock-feeding operation the stop bolts **197** and **202** are adjusted so that feedheads **180** and **190**, which are arranged in tandem, have feed strokes of equal length.

Each of the feedheads **180** and **190** carries a stock-gripping means that is adapted to be actuated by two similar fluid motors. Considering first the feedhead **180** illustrated in FIGS. **10**, **11** and **12**, a body **210** is provided with cylinders **211** and **212** in which are slidably mounted two pistons **213** and **214** that are connected to two piston rods **215** and **216** respectively. Rods **215** **216** extend upwardly through suitable apertures in a cover plate **217** that is secured by any suitable means to said body **210**. The upper ends of piston rods **215**, **216** are respectively connected by any suitable means to the end portions of a stock-gripping bar **220** that is adapted to be moved between stock-gripping and stock-releasing positions. The upper ends of cylinders **211** and **212** are each connected through bores **221** and **222** with a flexible control tube or line **223** as is best seen in FIG. **12**. The lower ends of cylinders **211** and **212** are each connected by bores **224** and **225** with a flexible control tube or line **226**.

The feedhead **190** comprises a body **230**, FIG. **13**, in which is formed two cylinders **231** and **232** in which are slidably mounted two pistons **233** and **234** that are connected to piston rods **235** and **236** respectively. The rods **235** and **236** extend upwardly through appropriate apertures in a cover plate **240** which effectively closes the upper ends of said cylinder **231**, **232** and which is secured by any suitable means to the upper face of body **230**. The upper ends of piston rods **235** and **236** are respectively connected to the end portions of a stock-gripping bar **241** that is adapted to be moved between stock-gripping and stock-releasing positions. Springs **242** and **243** respectively bias pistons **233**, **234** and the bar **241** to stock-releasing positions. The upper portions of cylinders **231** and **232** are each connected by bores **244** and **245** to a flexible control tube or line **246**, while the lower portions of cylinders **231**, **232** are vented to atmosphere by ports **247** and **248** respectively.

As before mentioned any suitable sealing means, such as O-rings or the like may be used for the various sliding piston-cylinder arrangements. Any suitable stock-guiding means **250** may be provided in the rearward block **172** while suitable feeder mounting holes **251** may be provided in the forward block **171**. As illustrated in FIG. **14** the side rails **173** and **174** are provided with extra sets of holes **252** to accommodate the mounting screws **175** for the block **172**, and also with extra sets of holes **253** to accommodate the mounting screws **177** for the stop block **176**. The spacing **254** between the sets of holes **252** is twice as long as the corresponding spacing **255** between the sets of holes **253**. By this arrangement the blocks **172** and **176** may be adjusted relative to the fixed block **171** so as to thereby define a coarse adjustment for the stroke lengths of feedheads **180**, **190**, while said stop nuts **197** and **202** provide a fine adjustment means for varying the stroke lengths of said feedheads.

Referring now to FIGS. **15**, **16** and **17** a pneumatic circuit for the instant feeder is shown together with a control valve and a valve-actuating means. Referring first to the circuit diagram of FIG. **15** the various fluid motors described in connection with FIGS. **10**—**13** are interconnected as follows. A source **260** of fluid pressure is connected directly by line **261** and said line **262** to the said port **194** at the forward end of cylinder **191**, and directly by lines **261** and **263** to the upper end of cylinders **211** and **212** of feedhead **180**. (only feedhead cylinders **211** and **231** and their related elements have been illustrated in FIG. **15** however it will be understood that the corresponding circuit connections exist, through the above-described FIGS. **10**—**13** apparatus, for the cylinders **212** and **232** and their related elements.) The fluid pressure source **260** is also directly connected by lines **261** and **264** to the said port **187** at the rearward end of the cylinder **183**, and directly by line **265** to the supply inlet to the three-way valve **266**, the latter being constructed and arranged in the same manner as that previously described in connection with FIGS. **6** and **7** for valve **92**. The output or control line **267** of valve **266** is connected to the lower ends of said cylinders **211** and **212** through line **270** and said line **226**, and to the upper ends of cylinders **231** and **232** through said lines **270** and **246**. The output line **267** of valve **266** is also connected to said port **186** at the forward end of cylinder **183** through a line **271**, and to the said port **195** at the rearward end of said cylinder **191** through a line **272**. A fluid flow restriction means **273** is provided in the lines to said ports **186** and **195** so as to control the rates at which fluid may flow to and from said cylinders **183** and **191**.

Not only is the circuit in FIG. **15** different from that in FIG. **5**, the means for actuating the single three-way valve **266** is also different. The valve-actuating means here comprises a camming means that is operated directly by the press ram so that the FIG. **8** gearing connections etc. to the press frame are all but eliminated. In this way the FIGS. **10**—**13** stock feeder may be readily set up by a relatively simple direct connection between the press ram and the instant valve-actuating means. Referring again to FIG. **15** there is shown a cam **280** having a periphery contoured in a manner similar to that described above for cam **96** of FIG. **5** and cooperating with the roller **281** of the valve stem for said valve **266**. Cam **280** is fixed to a shaft **282** that is rotatably mounted in a bracket **283** which may be secured on either the press or on the said stock feeder frame. Suitable thrust bearing means **284** and **285** are provided for shaft **282**. The upper end of said shaft **282** is formed with a set of four serially interconnected similar spiral-type grooves **286**, **287**, **288**, **289** as are illustrated in developed plane form in FIG. **16**. Cooperating with the grooved upper portion of shaft **282** is a collar **290** that is connected by any suitable fastening means to a bracket **291** that is secured by any suitable means to the adjacent side of the press ram **292**. The collar **290** is provided with two similar diametrally opposed cam follower units **293** and **294**. In that each of said units is constructed and operates in a similar manner only a detailed description of one of said units need be made here. The unit **293** comprises a tubular type cap **295** which is threadedly fastened to said collar **290** and which contains a cam follower pin **296** that is biased radially inwardly towards the axis of shaft **282** by means of a suitable spring **297**. The inwardly biased cam follower pin **300** for the said unit **294** is coaxially disposed relative to said cam follower pin **296**. The inner ends of these diametrally opposed pins are adapted to cooperate with the four equally peripherally spaced and symmetrically located grooves **286**, **287**, **288** and **289**. As will be apparent from FIG. **16** each of said grooves extends 90° around the periphery of shaft **282**.

As the collar **290** is axially reciprocated by the reciprocating motion **301** of of the press ram the cam follower pins **296** and **300** will, in cooperating with said grooves, cause shaft **282** to be intermittently rotated through successive 90° increments of movement. Means are provided to insure that the said intermittent rotary movement of the shaft **282** is always in one rotative direction. Such means are provided by contouring the bottom of said grooves in a manner that will now be described. In that each of said spiral-type grooves is correspondingly contoured a description of just groove **288** will suffice here. Referring to FIGS. **16** and **17**, (the latter being a sectional view diagrammatically taken along a section line **17**–**17** of FIG. **16**), there is shown a stepdown shoulder **302** at the junction of the end **287***c* of the groove **287** and the beginning **288***a* of groove **288**. The bottom of the central portion **288***b* of groove **288** is slightly inclined until it reaches at the end **288***c* of said groove **288** another stepdown shoulder **303** at the deep-ended beginning **289***a* of the next groove **289**. As will be apparent from the arrows in FIGS. **16** and **17**, which denote the movement of the cam follower pins **296**, **300** through said grooves, that as each of these radially inwardly biased pins moves from one groove to the next it will drop successively down off the shoulders **302**, **303**, **304** and **305** to the deeper portion of the next following groove and the cam follower pins **296** **300** are thus compelled to successively move from one groove to the next the shaft **282** will be intermittently actuated through successive 90° increments of rotary movement in the same rotary direction. It will be noted that each half of every press cycle produces one 90° increment of rotation of shaft

282 and thus cam 280 completes one revolution for every two consecutive cycles of the press.

A general description of the operation of the apparatus of FIGS. 10—17 will now be made. REferring initially to FIG. 18 there is shown a timing diagram that is similar to that shown in FIG. 9. Here the time t_1 indicates the time when the stem of valve 266 is depressed while time t_2 indicates the time that said valve stem is allowed to be restored to its normal position. Cam 280 which is peripherally contoured like cam 96 is fixed in the proper rotative position on shaft 282 to produce this FIG. 18 timing. The cam 280 is arranged so that in the normal upper rest position of the press ram the valve 266 is in its said normal condition wherein the outlet line 267 thereof is connected to exhaust. Under these conditions the condition of the fluid circuit and associated fluid motors will be as follows. In FIG. 15 the piston 184 and feedhead 180 will be moved by said continuous fluid-biasing pressure in the rearward end of cylinder 183 in said feed direction 182 so that feedhead 180 engages said end plate 196, FIG. 10. During this movement of feedhead 180 the stock-gripping bar 220 will be held in a stock-gripping position by the continuous fluid-biasing pressure in the upper portions of the feedhead cylinders 211, 212. In similar fashion the piston 192 and the feedhead 190 will be moved in an indexing direction 181 by the continuous fluid-biasing pressure in the left or forward end of the cylinder 191 so that said feedhead 190 engages the end plate 199, FIG. 10. During this movement of the feedhead 190 the stock-gripping bar 241 is held in a stock-releasing position by the springs 242, 243. Thus the feedhead 180 is normally held in a forward stock-gripping position while the feedhead 190 is normally held in a rearward stock-releasing position. When the punch press is set in motion the downward movement 310, FIG. 18 of the press ram will cause the cam 280 to be rotated through a 90° increment of movement, there being no actuation of the valve 266 during this first half of cycle I as may be seen from FIG. 18. After the punching operation the press ram will move upwardly as indicated at 311 and at a time t_1 immediately after the punch has been withdrawn from the stock the cam 280 will depress the stem of valve 266 so that fluid pressure will be supplied to the said valve outlet line 267. Under these conditions pistons 213, 214 will be moved upwardly and pistons 233, 234 will be moved downwardly, thus respectively moving the stock-gripping means on feedhead 180 to a stock-releasing position and the stock-gripping means on feedhead 190 to stock-gripping position. Supplying of fluid pressure to the said outlet line 267 will also cause the main pistons 184 and 192 to be moved to the right and left respectively as seen in FIG. 15. Thus during cycle I of operation of the press said feedhead 180 will partake of an indexing stroke in direction 181 while feedhead 190 partakes of a stock-feeding stroke in direction 182 to thereby advance the stock by a predetermined length into the press work station.

In the next cycle II of operation of the press the press punch will effect a working operation on the newly positioned stock during the downward movement 312, FIG. 18, thereof, there being no valve actuation during this half cycle. After the punching operation the press punch will move upwardly as indicated at 313 and at a time t_2 shortly after the punch has been withdrawn from the stock the cam 280 will allow the stem of valve 266 to be restored to its said normal position wherein the valve outlet line 267 is connected to exhaust. Under these conditions the said downwardly biased pistons 213, 214 and the stock-gripping bar 220 will be moved to stock-gripping position while the said springs 243 and 244 will move pistons 233 and 234 and the stock-gripping bar 241 to stock-releasing position. Connecting said line 267 to exhaust will also cause the forwardly biased piston 184 to move the feedhead 180 in a feed direction 182 and the rearwardly biased piston 192 to move said feedhead 190 in an index direction 181. Thus during cycle II the stock-gripping means are set and the feedhead 180 partakes of a stock-feeding stroke while the feedhead 190 partakes of an indexing stroke.

As will be apparent as the press ram reciprocates through successive cycles the valve 266 will be successively placed in one of its operative conditions during each such cycle so that the feedheads 180, 190 alternately partake of feed strokes so as to intermittently advance the stock into the press work station. As was previously mentioned FIG. 15 shows only one fluid motor on each feedhead however it is to be understood that both of the fluid motors on any given feedhead are constructed and actuated in a similar manner. In the actual wiring for the circuitry of both FIGS. 5 and 15 the lengths of the fluid conduit lines from the valve means to the two respectively associated feedheads are preferrably made as closely equal as possible and the lengths of the fluid conduit lines from the valve means to the respectively associated feedhead actuating cylinders are also preferrably made as close to equal as possible; the same applies for the fluid conduit lines between the fluid source and the feedheads respectively associated therewith and between the said source and the respectively associated feedhead-actuating cylinders. In this way the stock-gripping means will tend to be operated together and the feedheads will also tend to be actuated together.

In FIG. 19 there is shown a modified embodiment of the control arrangement of FIG. 15. Here the said shaft 282 is provided will two cams 315, 316 each of which is peripherally contoured similar to said cam 96, and which are respectively adapted and arranged to control the operation of two three-way valves 317 and 318 that each have the same construction and operation described for valve 92, FIGS. 6 and 7. The two valves 317 and 318 are supplied with fluid pressure in the same manner as are valves 92, 93 respectively, of FIG. 5 and the two output lines 320, 321 of said valves 317, 318, respectively, are connected to a fluid circuit that is identical to that illustrated in FIG. 5 for controlling the various fluid motors of the stock feeder of FIGS. 10—13.

The control arrangements illustrated in FIGS. 5, 15, and 19 may each be used in connection with the apparatus of either FIGS. 1—4 or FIGS. 10—13.

Since many changes could be made in the embodiment of the invention particularly described and shown herein without departing from the scope of the invention, it is intended that these embodiments be considered as exemplary and that the invention not be limited except as warranted by the following claims.

What I claim is:

1. A high-speed stock-feeding device adapted to intermittently feed stock into a punch press having a reciprocating ram: comprising

a frame;

a pair of feedheads reciprocally mounted on said frame;

a stock-gripping means carried by each of said feedheads, each of said stock-gripping means being adapted to be moved between stock-gripping and stock-releasing positions;

fluid motor means for reciprocating said feedheads;

additional fluid motor means for actuating said stock-gripping means;

fluid valve means for controlling the supply of fluid pressure to said fluid motor means;

a first cam means for operating said fluid valve means;

actuator means for intermittently actuating said first cam means; said actuator means including

a second cam means connected to said first cam means; and

drive means adapted to be operated by the reciprocating movement of said press ram for driving said second cam means so as to thereby impart an intermittent indexing motion to said first cam means that operates said fluid valve means.

2. Apparatus as defined by claim 1 wherein said second cam means includes a rotatable member having camming surfaces formed thereon, and a cam follower member cooperating with said camming surfaces, one of said members being connected to drive said first cam means while the other of said members is connected so as to be operated by said press ram so that the resulting relative movement of said members will intermittently drive said first cam means.

3. Apparatus as defined by claim 2 wherein said rotatable member is formed with a series of interconnected spiral-type grooves, each groove being stepped in depth along its length so that said cam follower once traversing a given spiral groove is forced to then traverse the next spiral groove whereby said first cam is intermittently driven in one rotative direction.

4. A stock-feeding device for intermittently advancing stock into the tool station of a punch press or the like: comprising

a frame;

a pair of feedheads reciprocally mounted on said frame for movement in indexing and stock feed directions;

a first stock-gripping means mounted on one of said feedheads and conditionable to grip and release the stock to be fed;

a second stock-gripping means mounted on the other one of said feedheads and conditionable to grip and release said stock;

a first fluid motor means for actuating said feedheads so that the latter effectively reciprocate in 180° phase relation;

a second fluid motor means for actuating said stock-gripping means to their respective stock-gripping conditions; and

control means for said first and second fluid motor means for causing said feedheads to alternately partake of stock-feeding strokes, said control means being operated in timed relation to the operation of said punch press whereby said first and second stock-gripping means are actuated to opposite operative conditions while the tool of said punch press is still in said stock and said first and second feedheads are actuated in opposite reciprocating directions just after withdrawal of said tool from said stock.

5. Apparatus as defined by claim 4 wherein said feedheads are mounted in tandem relation on said frame.

6. Apparatus as defined by claim 4 wherein said feedheads are mounted on said frame for movement in side-by-side relation so that said gripping means are adapted to alternately grip opposite side portions of said stock.

7. Apparatus as defined by claim 4 wherein said second fluid motor means includes separate fluid motor means for each of said first and second stock gripping means, and wherein said control means includes valve means for alternately supplying fluid pressure to said separate stock-gripping fluid motor means, whereby said first stock-gripping means is moved to a stock-gripping condition and said second stock-gripping means is moved to stock-releasing condition during one cycle of operation of said press and whereby said first stock-gripping means is moved to a stock-releasing condition and said second stock-gripping means is moved to a stock-gripping condition during the next cycle of operation of said press.

8. Apparatus as defined by claim 7 wherein said first fluid motor means includes separate fluid motors for respectively actuating said feedheads, and wherein said control means includes a second valve means for alternately supplying fluid pressure to said fluid motors.

9. Apparatus as defined by claim 8 wherein said control means includes cam means for sequentially operating said valve means in timed relation to the operation of said press.

10. Apparatus as defined by claim 9 wherein said control means further includes linkage means coupled at one operative end thereof so as to be actuated by the punch press ram mechanism and at the other end thereof so as to operate said cam means.

11. A stock-feeding device for intermittently advancing stock into the tool station of a punch press or the like: comprising

a frame;

a pair of feedheads reciprocally mounted on said frame for movement in indexing and stock feed directions;

a first stock-gripping means mounted on one of said feedheads and conditionable to grip and release the stock to be fed;

a second stock-gripping means mounted on the other one of said feedheads and conditionable to grip and release said stock;

a first fluid motor means for actuating said feedheads so that the latter effectively reciprocate in 180° phase relation;

a second fluid motor means for actuating said stock-gripping means to their respective stock-gripping conditions; and

control means for said first and second fluid motor means for causing said feedheads to alternately partake of stock-feeding strokes, said control means being operated in timed relation to the operation of said punch press and including valve means for controlling the operation of said first and second fluid motor means whereby both of said first and second fluid motor means are actuated just after withdrawal of the punch press tool from the said stock.

12. Apparatus as defined by claim 11 wherein said feedheads are mounted in tandem relation on said frame.

13. Apparatus as defined by claim 11 wherein said feedheads are mounted on said frame for movement in side-by-side relation so that said gripping means are adapted to alternately grip opposite side portions of said stock.

14. Apparatus as defined by claim 11 wherein said first fluid motor means includes separate fluid motors for respectively actuating said feedheads, and wherein said second fluid motor means includes separate fluid motors for respectively actuating said stock-gripping means.

15. Apparatus as defined by claim 11 wherein said control means includes valve means actuated in response to the operation of the tool drive means of said punch press for controlling the flow of pressure fluid to said first and second fluid motor means.

16. A duplex stock-feeding arrangement for intermittently advancing stock into the work station of a punch press or the like: comprising

a frame;

a pair of feed slides each mounted for longitudinal reciprocation on said frame;

a first fluid motor means for operating a first one of said feed slides and including a first piston and cylinder unit that operatively extends in one longitudinal direction;

a second fluid motor means for operating the second one of said feed slides and including a second piston and cylinder unit that operatively extends in the opposite longitudinal direction;

stock-gripping means mounted on each of said feed slides;

a third fluid motor means for actuating said stock-gripping means;

valve means for controlling said fluid motor means; and

actuating means operable in timed relation to the operation of the press for actuating said valve means whereby said feed slides alternately partake of feed strokes.

17. Apparatus as defined by claim 16 wherein said feed slides are both disposed between said piston-cylinder units.

18. Apparatus as defined by claim 17 wherein said feed slides are disposed in tandem relation.

19. Apparatus as defined by claim 17 wherein said feed slides are disposed for movement along substantially parallel paths.

20. Apparatus as defined by claim 16 wherein means are provided for continuously biasing said feed slides in one of the respective directions of movement of each slide.

21. Apparatus as defined by claim 16 wherein said valve means comprises a first valving means for said first and second fluid motor means and a second valving means for said third motor means, and wherein said actuating means includes means for sequentially operating said first and second valving means.

22. Apparatus as defined by claim 16 wherein said actuating means includes cam means, and means for intermittently actuating said cam means in timed relation to the operation of said punch press.

23. Apparatus as defined by claim 16: additionally comprising a common stroke-limiting abutment means that may be adjustably moved from one condition to a second condition so that the respective operative feed strokes of said feed slides are thereby changed by equal amounts.

24. A duplex stock-feeding device for intermittently advancing stock into the work station of a punch press or the like; comprising

a frame;

a pair of feed slides each mounted on said frame for reciprocation in indexing and stock-feeding directions;

said feed slides being mounted on said frame in side-by-side relation for movement along laterally offset and substantially parallel feed paths;

open-throated stock-gripping means mounted on each of said feed slides, said stock-gripping means being adapted to grip and release opposite side portions of said stock;

a first motor means for actuating said feed slides;

a second motor means for actuating said stock-gripping means;

valve means for controlling said second motor means; and

actuating means operable in timed relation to the operation of the press for actuating said valve means so that said stock-gripping means are alternately operated to stock-gripping positions while the press tool is still in the stock whereby said feed slides alternately partake of feed strokes.

25. Apparatus as defined by claim 24: additionally comprising a common stroke limiting abutment means that may be adjustably moved from one condition to a second condition so that the respective operative feed strokes of said feed slides are thereby changed by equal amounts.

26. Apparatus as defined by claim 24 wherein said valve means includes two four-way valves, and wherein said actuating means includes means to sequentially operate said four-way valves during each cycle of the press; the actuation of the stock-gripping means occurring before the press tool is withdrawn from the stock.

27. A duplex stock feeder for intermittently advancing stock into a work station: comprising

a frame;

a pair of feed slides reciprocably mounted on said frame for movement in indexing and stock feed directions;

a normally fixed abutment means carried by said frame for determining the effective limits of reciprocating movement of said feed slides respectively, said feed slides being respectively adapted to move into and out of contact with said abutment means during reciprocation thereof;

said abutment means including two abutment surfaces which respectively determine the limit of movement of said slides in one of the respective directions of reciprocation of each slide, and further including adjusting means for effectively displacing said surfaces by equal amounts whereby the effective lengths of the feed strokes of said slides may be thereby varied by equal amounts;

stock-gripping means carried by each of said slides;

a first actuating means for reciprocating said slides;

a second actuating means for operating said stock-gripping means; and

control means operable in timed relation with the operation at said work station for controlling the operation of said first and second actuating means whereby said feedheads alternately partake of stock feed strokes.

28. Apparatus as defined by claim 27 wherein said two abutment surfaces are disposed on a common member that is threadedly adjustably mounted on said frame.

29. Apparatus as defined by claim 4 wherein said control means includes a means for controlling said first and second fluid motor means so that said feedheads alternately partake of a plurality of feed strokes for each cycle of operation of said press.

30. Apparatus as defined by claim 11 wherein said control means includes a means for controlling said first and second fluid motor means so that said feedheads alternately partake of a plurality of feed strokes for each cycle of operation of said press.

31. A duplex stock-feeding device for intermittently advancing stock into the work station of a punch press or the like: comprising

a frame;

a pair of feed slides each mounted on said frame for reciprocation in indexing and feed directions;

stock-gripping means mounted on each of said feed slides;

a first pair of fluid motors for respectively actuating said feed slides;

a second pair of fluid motors for respectively actuating said stock-gripping means;

valve means for controlling the operation of said first pair of fluid motors;

additional valve means controlling operation of said second pair of fluid motors;

actuators for respectively actuating said valve means; and

control means operatively responsive to the motion of the ram of said press for controlling the operation of said actuators whereby said valve means and fluid motors cause said feed slides to alternately partake of stock feed strokes, said control means also being operative to cause said stock-gripping to be alternately displaced to their stock-gripping positions while the tool of said press is still in said stock.

32. Apparatus as defined by claim 31 wherein each fluid motor of said first pair of motors comprises a double-acting cylinder.

33. Apparatus as defined by claim 31 wherein said control means is adapted to cause said actuators to actuate at least a portion of said valve means at different times during each cycle of operation of said press.

34. Apparatus as defined by claim 33 wherein said control means is adapted to cause said gripping means to shift their operative conditions while the tool of said press is in said stock.

35. Apparatus as defined by claim 31 wherein said control means is adapted to cause both of said valve means to be actuated so that operation of both of said first and second pairs of fluid motors is initiated while the tool of said punch press is out of said stock.

36. Apparatus as defined by claim 31 wherein said control means is operatively coupled to said press ram.

37. Apparatus as defined by claim 31 wherein said control means includes a mechanical connection to said press.

38. Apparatus as defined by claim 37 wherein said connection is made to the press ram and intermittently drives said actuators in response to the movement of said ram.

39. Apparatus as defined by claim 32: additionally comprising means for continuously supplying air to one end of each of said first pair of fluid motors.

40. Apparatus as defined by claim 31 wherein each of said valve means comprises three-way valve means.

41. Apparatus as defined by claim 31 wherein said actuators include cam means.

42. Apparatus as defined by claim 31 wherein said control means is adapted to actuate said valve actuators at different times in response to the press ram's passing through predetermined different positions along its reciprocating path.

43. Apparatus as defined by claim 31 wherein said control means is adapted to actuate said valve actuators in response to the press ram's passing through one point along its reciprocating path.

44. Apparatus as defined by claim 31: additionally comprising means for continually biasing said feed slides in one direction.

45. Apparatus as defined by claim 31 wherein said control means is adapted to cause all four of said fluid motors to be actuated at times when the tool of said press is considerably below the midpoint of its vertical travel.

46. A high-speed duplex feeder for intermittently advancing stock into the work station of a punch press or the like: comprising

a frame;

a pair of feed slides reciprocally mounted on said frame for movement in feed and index directions;

stock-gripping means carried by each of said feed slides, said stock-gripping means being shiftable between stock-gripping and release conditions;

a first drive means for actuating said feed slides so that the latter alternately partake of movement in a stock feed direction;

a second drive means for operating said stock-gripping means so that the latter alternately grip the stock to be fed; and

control means operated in response to the operation of said press for controlling the operation of said first and second drive means so that at least one of said feed slides makes at least one stock-feeding stroke for each cycle of operation of said punch press;

said control means including timing means that cause initiation of said feed strokes of said slides at a time when the ram of said press is nearer to the bottom of its operative stroke than to the top of its said stroke.

47. Apparatus as defined by claim 46 wherein said second drive means comprises a fluid motor means, and wherein said

control means includes a fluid valve means that is operable to cause initiation of operation of said fluid motor means at a time when the ram of said press is nearer to the bottom of its operative stroke than to the top of its said stroke.

48. Apparatus as defined by claim 47 wherein said first drive means includes a fluid motor means.

49. Apparatus as defined by claim 46 wherein said first drive means includes fluid motor means for displacing said slides in one direction and means for yieldably biasing said slides in the opposite direction.

50. A high-speed feeder for intermittently advancing stock into the work station of a punch press or the like: comprising

a pair of opposed cooperating grippers for gripping and feeding the stock to be worked;

actuating means for intermittently displacing said grippers to cause said stock to be intermittently advanced in a stock feed direction;

control means operated in timed relation to the operation of said punch press for controlling said actuating means; said control means including timing means for causing said grippers to initiate their stock-advancing movement at a time when the ram of said press is nearer to the bottom of its operative stroke than to the top of its said stroke.