

[54] **TABLET PRESS**

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[22] Filed: **Jan. 21, 1974**

[21] Appl. No.: **435,302**

[52] U.S. Cl. .... **425/344; 425/136; 425/354;**  
**425/348; 425/389; 425/261**

[51] Int. Cl.<sup>2</sup> ..... **B29C 3/00**

[58] Field of Search ..... **425/354, 344, 347, 348,**  
**425/151, 389, 804, 261, 136**

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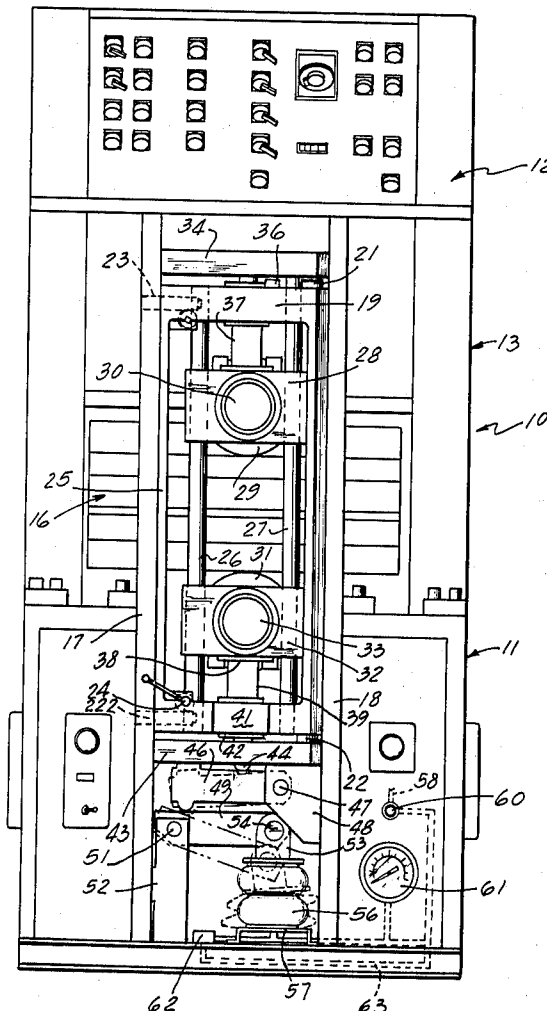
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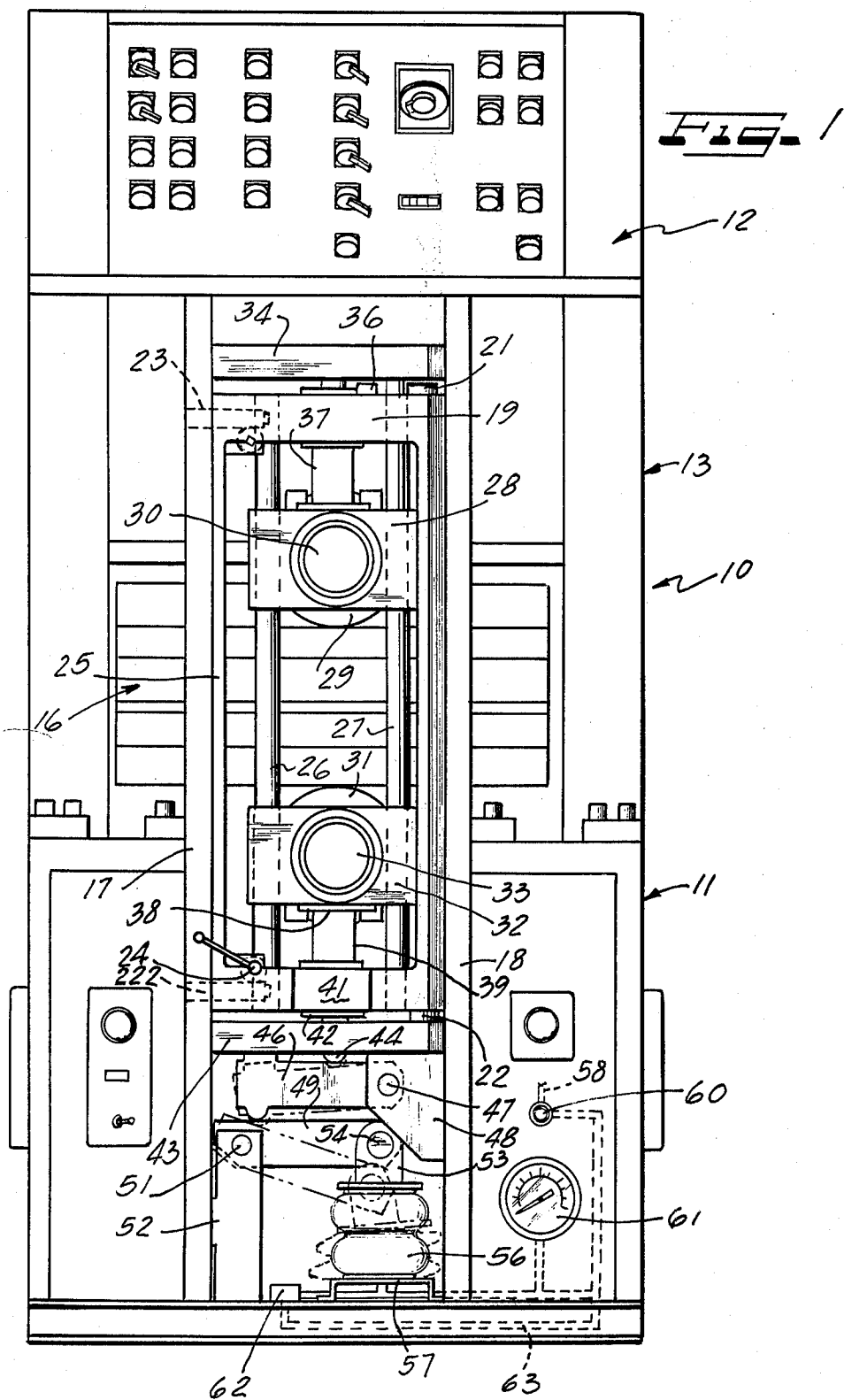
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**ABSTRACT**

A very rapid four station rotary tablet press which has pressure rollers cantileverly mounted in pivoted doors so that the dies and upper and lower punches can be easily installed, removed and serviced. The upper pressure rolls are adjustable vertically and the lower pressure rolls are air supported providing a safety interlock so as to prevent jamming and breaking in the machine. Induced die feeders are provided for each of the pressure roller stations so as to feed material into the dies and means for detecting sticking of the punches in their guide holes are provided so as to stop the machine.

**9 Claims, 6 Drawing Figures**





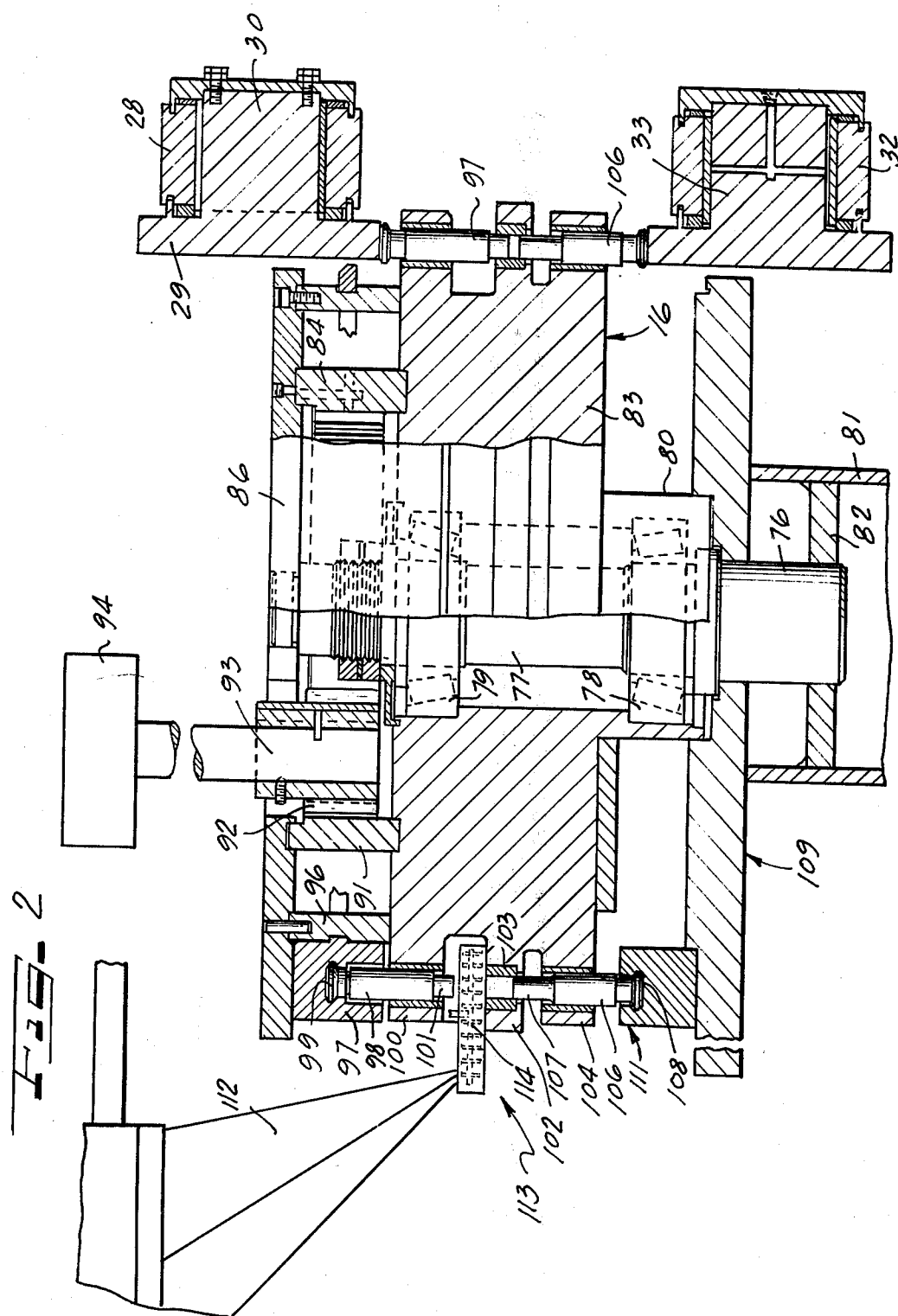
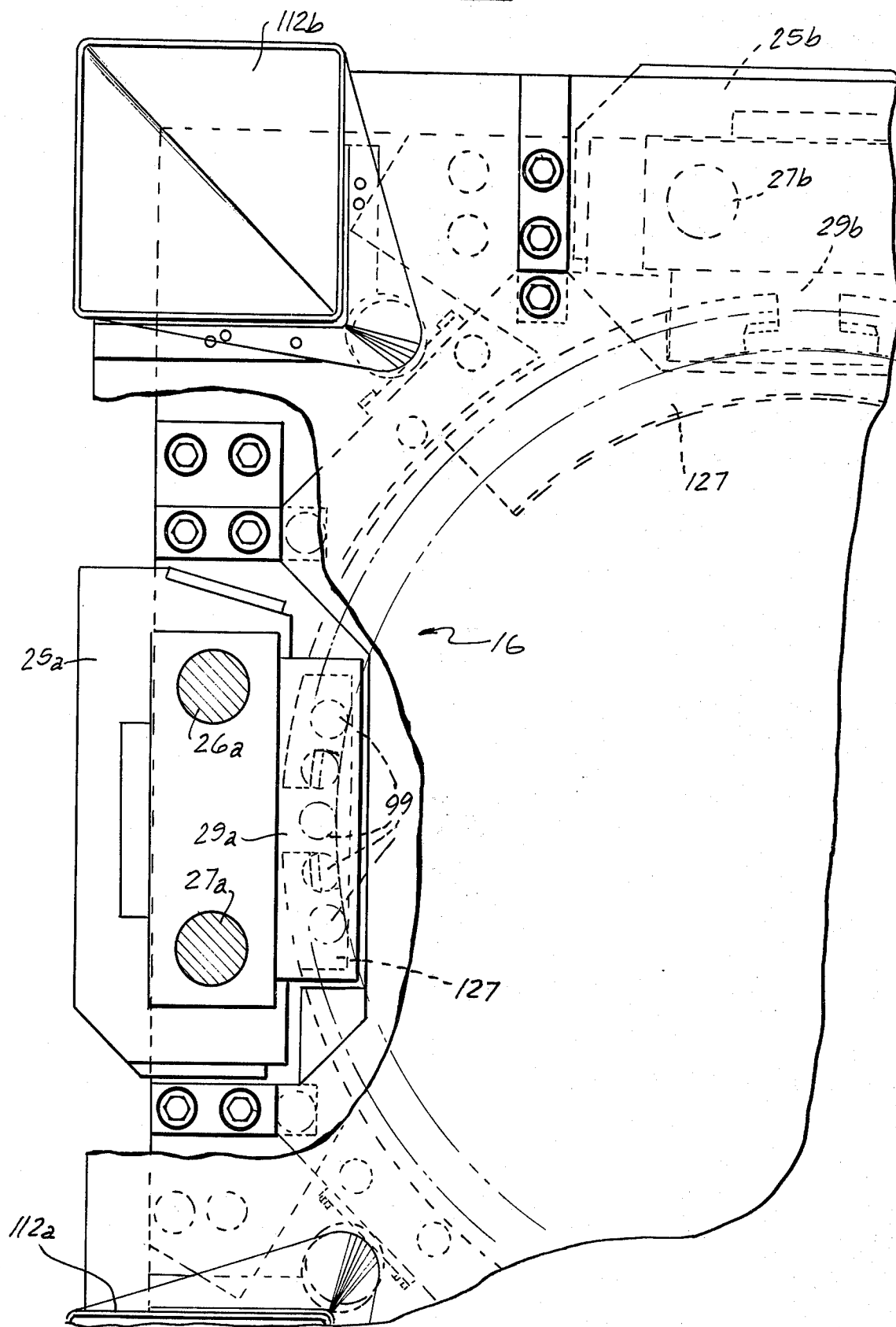
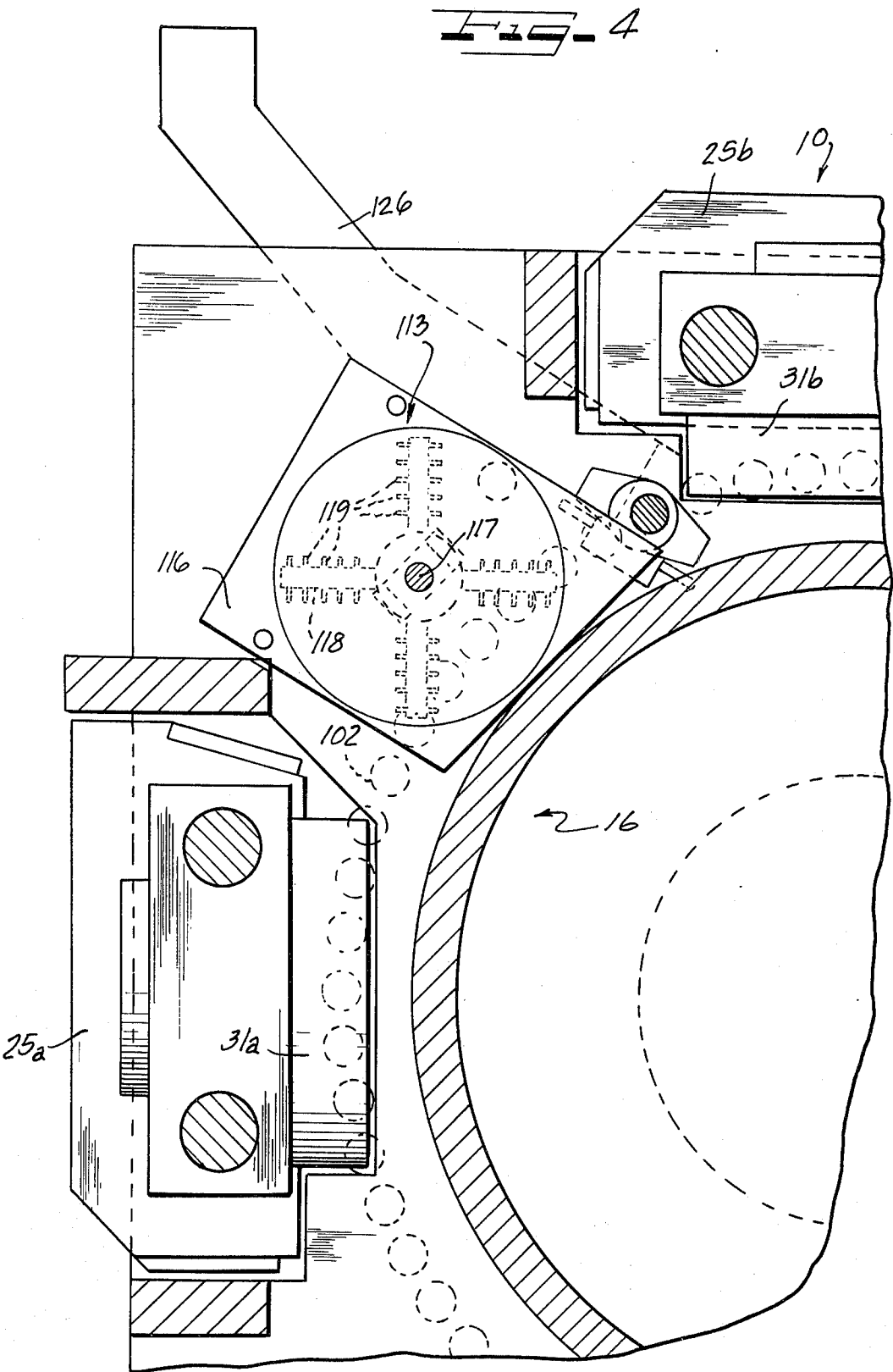
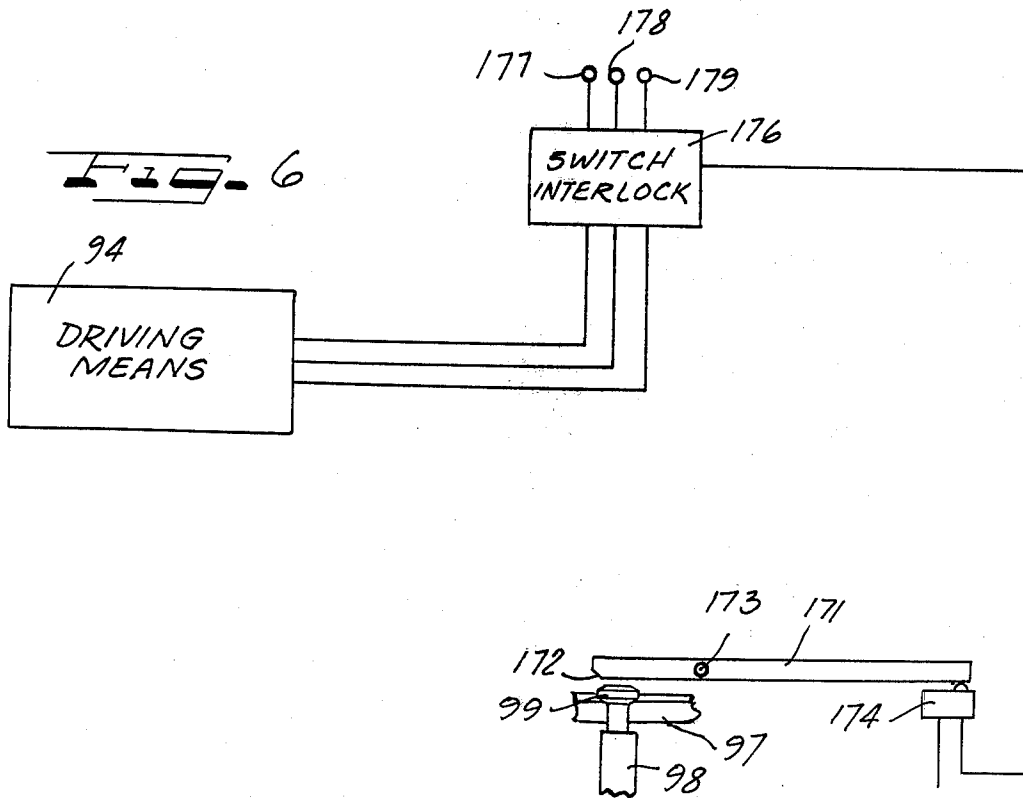
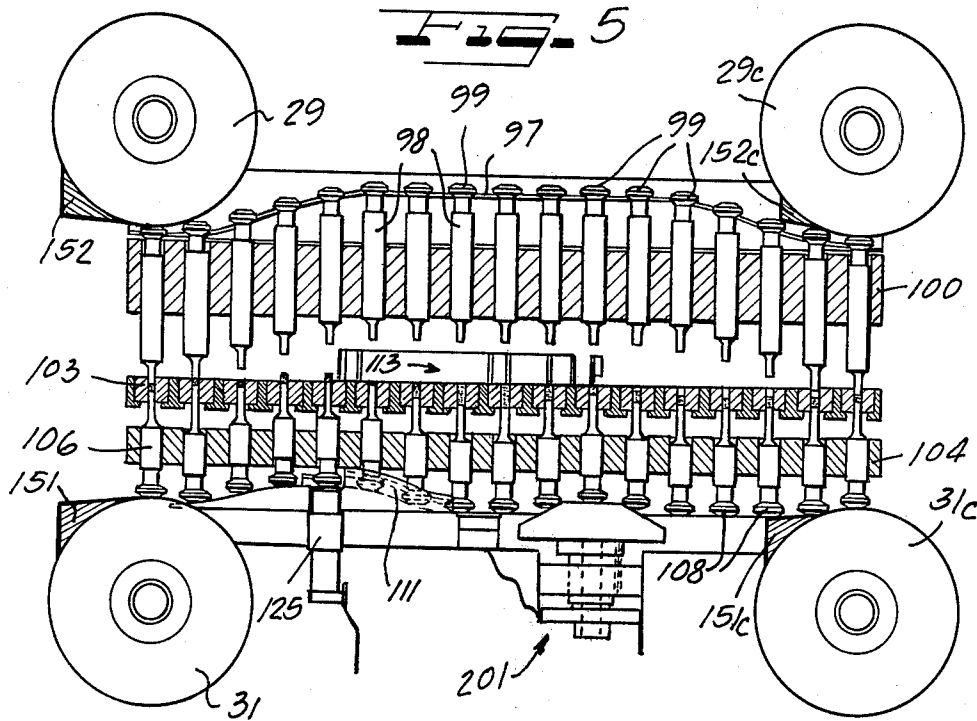


FIG. 3







## TABLET PRESS

## BACKGROUND OF THE INVENTION

## 1. Field of the Invention

This invention relates in general to a very fast rotary press.

## 2. Description of the Prior Art

Rotary presses of the prior art have had pressure rolls which are supported on either side by supporting shafts and such produces a machine which is hard to service and requires the disassembling of a substantial portion of the machine so as to replace the dies and the punches.

## SUMMARY OF THE INVENTION

The present invention provides a four-station rotary press which has pressure rolls mounted on doors in a cantilever fashion, and wherein, the doors are pivotally mounted on the machine so that pressure rolls may be swung away from the machine to allow easy access and servicing of the dies and upper and lower punches. The upper pressure rolls are adjustable and the lower pressure rolls are adjustable and are air supported with a safety interlock so as to detect and stop the machine in the event overloading or jamming occurs. Means are provided for sensing sticking of the punches in their guide holes. The machine has induced die feeders for each of the four pressure roll stations. The machine is capable of forming 16,600 items per minute.

Other objects, features and advantages of the invention will be readily apparent from the following description of certain preferred embodiments thereof, taken in conjunction with the accompanying drawings, although variations and modifications may be effected without departing from the spirit and scope of the novel concepts of the disclosure, and in which:

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front plan view of the invention;

FIG. 2 is a sectional showing the rotor, pressure rolls and induced die feeder;

FIG. 3 is a partial top sectional view;

FIG. 4 is a top view;

FIG. 5 illustrates the punches, cams, and pressure rolls; and

FIG. 6 illustrates the safety interlock system.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a plan view of the high speed rotary press of the invention designated generally as 10 which comprises a main frame having a base 11 and side support members 13 and 14 and a top member 12. A rotor 16 is centrally mounted in the machine and carries dies and upper and lower press punches which are controlled by upper and lower cams. The high speed press of this invention has four separate tablet making stations which are symmetrically located on the four sides of the machine. One of the stations is illustrated in FIG. 1 and comprises a pair of pressure rollers 29 and 31 mounted in a door 25 which applies pressure to the upper and lower punches which move into the dies and form the tablets. Each pair of upper and lower pressure rollers 29 and 31 are respectively mounted in doors 25 pivotally supported by the frame 10 and the base 11 such that in their operating positions the door is locked in the position shown in FIG. 1 with the upper and

lower pressure rolls 29 and 31 positioned so as to drive the upper and lower punches respectively into the dies. The doors 25 may be unlocked when the machine is not operating and moved to their open positions which disengages the upper and lower pressure rolls 29 and 31 from the upper and lower punches respectively so as to allow the press to be serviced without removing the pressure rollers and substantially disassembling the machine as is required in prior art devices. The rollers 29 and 31 are respectively cantileverly supported on shafts 30 and 33 respectively as shown in FIGS. 1 and 2 supported in supporting blocks 28 and 32 which are carried on the door 25. Upper and lower cross members 19 and 41 of the door 25 have a pair of columns 26 and 27 which extend therefrom and the upper roller support 28 is formed with openings through which the columns 26 and 27 extend and an adjustable spacer 37 extends between the upper support 28 and the cross member 19. A bearing plate 36 is mounted between a fixed frame member 34 and bears against the upper edge of the cross member 19 when the door 25 is in the closed position.

The lower cross member of the door 41 is formed with an opening through which a support shaft 39 extends and which has an upper end that bears against the lower roller support 32. A plate 42 is attached to the end of shaft 39 and in the closed position of the door 25 is engaged by a support pin 44 which is slidably mounted in the cross frame member 43. The lower end of pin 44 rests on a link 46 which is supported by pivot pin 47 from frame member 48. The free end of the link 46 rests on a second link 49 which is pivotally supported by pivot pin 51 to a frame member 52. The other end of the link 49 is connected by pivot pin 54 to an actuator 53 which is connected to a hydraulic flexible bellows 56 which rests on the support 57 of the frame member. A fluid supply line 58 connects to an air regulator 60 which is connected to a pressure gauge 61. The pressure gauge is connected to the bellows 56 and to a quick exhaust valve 62. A conduit 63 is connected between the valve 62 and the air regulator 60. In FIG. 1, the flexible bellows 56 is shown in the extended position with the links 46 and 49 in the upper position thus pressing the pin 44 against the shaft 39 so as to hold the pressure roller 31 in its full operating position. The dotted position of the links 46 and 49 illustrate the bellows 56 in the collapsed position which removes pressure from the link 46 and the pin 44.

A crank 24 is connected by rack and pinion or other mechanical linkages to latch bolts 222 and 23 which are movable to the locked position from the door into the side support members 13 and 14 which have aligned openings for locking the door 25 in the closed operating position. The shafts 21 and 22 are connected to the other side of the door and extend into the members 34 and 43 and provide support and pivot points for the door.

FIG. 2 is a sectional view illustrating the die turntable and related structure. Main frame members 81 and 82 support a vertical shaft 76 which has an upper portion 77 upon which are mounted bearings 78 and 79. The rotating turntable 16 has a hub 80 which is attached to the bearings 78 and 79. An internal ring gear 91 is attached to the drive rotor 16 and is formed with teeth on its inner surface which mate with a drive gear 92. The drive gear 92 is mounted on a drive shaft 93 which is coupled to a driving means 94 so as to turn the rotor

16. An upper plate 86 is formed with an opening through which the drive shaft 93 extends. The plate 86 is fixed to the frame of the machine and has a downwardly extending cylindrical portion 96 upon which upper punch cam 97 is mounted. The upper punches 98 are provided with heads 99 which are in engagement with the upper cam 97 and as the punches move with the rotor 16 the cam 97 controls their vertical position.

The tool bed 109 has four cam guides 111 which engage the heads 108 of lower punches 106. The rotor 16 is formed with punch guides 100 and 104 in which a plurality of openings are formed for guiding the upper and lower punches 98 and 106, respectively. A third projection 102 of the rotor 16 is provided with a plurality of aligned openings in which dies 103 are mounted in alignment with the upper and lower punches 98 and 106, respectively. The lower end 101 of punch 98 is receivable in the die 103 and the upper end 107 of the punch 106 is receivable in the die 103.

As shown in FIG. 2, an induced die feeder 113 is supplied suitable material from a hopper 112 which passes into the induced die feeder 113. The induced die feeder is shown in greater detail in FIG. 4 and includes a drive shaft 117 to which the radial arms 118 of the induced die feeder are connected. A plurality of fingers 119 are attached to each of the induced die feeder arms 118. The shaft 117 is driven by the main driver 94, and a transmission may be provided so as to obtain the desired speed. As shown in FIG. 4, the hopper 112 supplies material into housing 116 in which the induced die feeder drive wheel is mounted which then moves the material over the portion 102 where the dies 103 are mounted so that the material will drop into the die 103 as shown in FIG. 2. It is to be realized that at this time, as shown in FIG. 2, the upper punches 98 have been moved by the cam 97 out of the way of the induced die feeder so that it does not engage the induced die feeder. The lower punch 106, as shown in FIG. 2, still closes the bottom end of the die 103 so that the material from the induced die feeder does not fall out of the die.

FIG. 5 is a laid out side view of two pressure stations of the machine. The adjacent pressure rolls 29 and 29c are mounted 90° about the rotor 16 in the doors 25 and the punches form the compressed article as the punches pass between the rollers 29 and 31. After the punches have entered the die under roller 29 and 31, the upper cam 97 moves the upper punches up and out of the die as shown in FIG. 5 and the lower cam 111 and ejector mechanism 125 ejects the articles which might, for example, be tablets from the dies. They then pass through the discharge chute 126 illustrated in FIG. 4 from the machine. The induced die feeder 113 is mounted between adjacent rollers 29 and 29c as shown in FIG. 5 and at this time the punches 98 are moved substantially clear of the dies 103 as shown in FIG. 5 so that the dies can again be filled with material before the next compression. It is to be noted that the lower punches 106 move down into the die but continue to close the end of the dies after ejection has been made so as to allow measured quantities of the material to pass into the die.

It is to be realized, of course, that the upper and lower cams 97 and 111 do not terminate. They are, however, designed so that clearance exists between the pressure roll and the cam track. We have discovered that tapered pre-compression plates which are con-

nected to the roller supports 28 and 32, respectively, and which are indicated by numerals 151 and 152, respectively in FIG. 5, guide the heads 99 and 108 of the upper and lower punches, respectively, so that there is a smooth and desirable engagement of the rollers 29 and 31 with the heads 29 and 108 of the punches.

It is possible for the punches to jam or stick in the punch guides 100 and 104. The apparatus and structure illustrated in FIG. 6 provides a sticking punch detector for monitoring the position of the punches. A sensing pivoted member 171 is mounted adjacent the heads 99 of the punches 98 to sense the position of the punches 98 as they move downwardly toward the pressure rollers 29. The heads of the punches should ride by force of gravity against the upper cam 97; but if they are sticking, the heads 99 will stay above the cam 97 which will cause them to engage the end 172 of detector 171 which is mounted on the pivot pin 173. When the head engages the sensor 171, the other end actuates a switch 174 which is connected into a suitable interlock 176 for disconnecting power from power lines 177, 178, and 179 from the driving means 94. The pressure transducer 63 which monitors the pressure in the pneumatic bellows 56 also is connected to the switch, which in the event the pressure in the pneumatic bellows 56 exceeds pre-determined limits, an indicator light will display the fact.

In operation, the hoppers 112 are filled with material which is to be compacted into tablets, and the doors 25 are closed so as to move the pressure rollers 29 and 31 into operative position and in engagement with the heads 99 and 108 of the punches 98 and 106. The valve 60 is open to apply pneumatic pressure to the flexible bellows 56 thus moving the linkage 46 and 49 upwardly so that the lower roller 31 is moved into operative position. The driving means 94 is energized and starts to rotate the rotor 16 of the machine. The induced die feeders are each driven by their own SCR controlled DC motor. Each has its own electrical switch.

Material supplied from the hoppers 112 pass into the induced die feeders 113 and are moved by the rotating feeder wheels so as to drop material into the dies as shown in FIGS. 2 and 5. The upper and lower punches are guided by the upper and lower cams 97 and 111 such that the dies are filled and then the upper and lower punches engage the pre-compression plates 151 and 152 before passing under the rollers 29 and 31 which compress the material in the dies to make the tablets or other items. After the punches pass from beneath the rollers 29 and 31, the upper punch is moved upwardly as shown in FIG. 5 by the cam 97, and the lower punch is moved upwardly to eject the tablet into the discharge chute 126 before moving down into the die and under the induced die feeder 113 for a charge for the next operation.

If the punches stick, they will engage the sticking punch detector 171 illustrated in FIG. 6 which is interlocked so as to turn off the driving means and stop the machine. Also, in the event of excessive pressure on the lower pressure roll 31 such pressure will produce a signal warning of the overload. The provision of doors 25 which can be pivoted outwardly from the machine thus allowing easy access to the internal operating mechanism such as the punches and dies allows easy and rapid replacement of the dies and punches and other maintenance required by the machine without removing numerous parts.

The safety features provided by the pressure control system for the lower rollers, as well as the sticking punch detectors, prevent breakage and jamming of the machine. The movable pressure rollers are made possible due to the cantilever support of the pressure rollers and provides for a very fast machine and four stations may be provided about the machine.

In a particular machine constructed according to this invention, 16,600 tablets per minute can be produced which is by far the fastest rotary press in the world.

A material weighing system 201 is illustrated in FIG. 5 for allowing precise control of the weight of the tablets.

It is seen that this invention provides an improved rotary press, and although it has been described with respect to the preferred embodiments, it is not to be so limited as changes and modifications may be made therein within the full intended scope as defined by the appended claims.

We claim as our invention:

1. A high speed press comprising a frame structure, a rotor rotatably supported by said frame structure on a vertical axis and carrying a plurality of dies and coacting first and second plurality of punches receivable in said dies, driving means connected to drive said rotor, cam means for moving said punches relative to said dies, material feed means furnishing material to be formed to said dies, and a movable door support means pivotally attached on said frame structure by a vertical shaft and a pair of vertically adjustable pressure rolls rotatably supported on a pair of support columns and engageable respectively with said first and second plurality of punches and both of said pressure rolls cantileverly supported on horizontal axes by said movable door support means wherein said door support means is movable about said vertical shaft to a first position where said pair of pressure rolls respectively engage said first and second plurality of punches and movable about said pair of support columns to a second position where said pair of pressure rolls do not engage said first and second plurality of punches.

2. A high speed press according to claim 1 including locking means for locking said door in said first position.

tion.

3. A high speed press according to claim 2 comprising a movable bellows mounted on said frame structure, pressure supply means connected to said movable bellows, a movable pressure roll member mounted on said door and cantileverly supporting one of said pair of pressure rolls, and said movable bellows coupled to said movable pressure roll member when said door is in said first position.

4. A high speed press according to claim 3 including mechanical linkage means coupling said movable bellows to said movable pressure roll member.

5. A high speed press according to claim 4, wherein said mechanical linkage means includes a first portion movable with said door and a second portion not movable with said door.

6. A high speed press according to claim 5 including a pressure transducer connected to said movable bellows and to an indicator light which warns the operator when the pressure in said bellows is outside operating limits.

7. A high speed press according to claim 3, further including at least a second pair of pressure rolls rotatably and cantileverly supported by said frame structure and respectively engageable with said first and second plurality of punches at a second location, and second material feed means furnishing material to said dies between said first and second pairs of pressure rolls.

8. A high speed press according to claim 7, wherein a second door is pivotally connected to said frame and said second pair of pressure rolls are cantileverly mounted thereon and said second door movable to a first locked position wherein said second pair of pressure rolls engage said first and second plurality of punches and movable to a second unlocked position wherein said second pair of pressure rolls do not engage said first and second plurality of pressure rolls.

9. A high speed press according to claim 1 further including tapered pre-compression means mounted adjacent said pair of pressure rolls for engaging said punches to drive them into said dies before said pair of pressure rolls engage said punches.

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