Oct. 25, 1949. H. E. BALSIGER ET AL 2,486,244

GRINDING WHEEL FEED MECHANISM

Filed Feb. 21, 1946

3 Sheets-Sheet 1

Fig 1

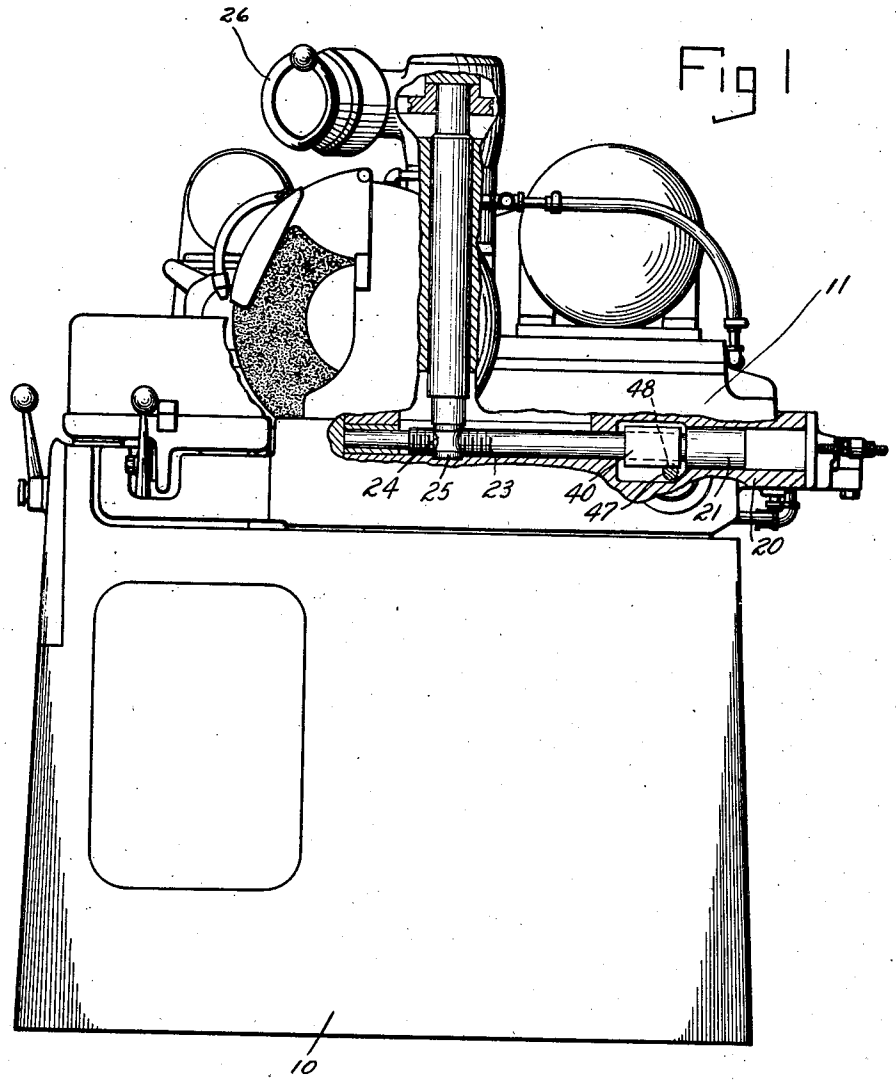

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Fig 2

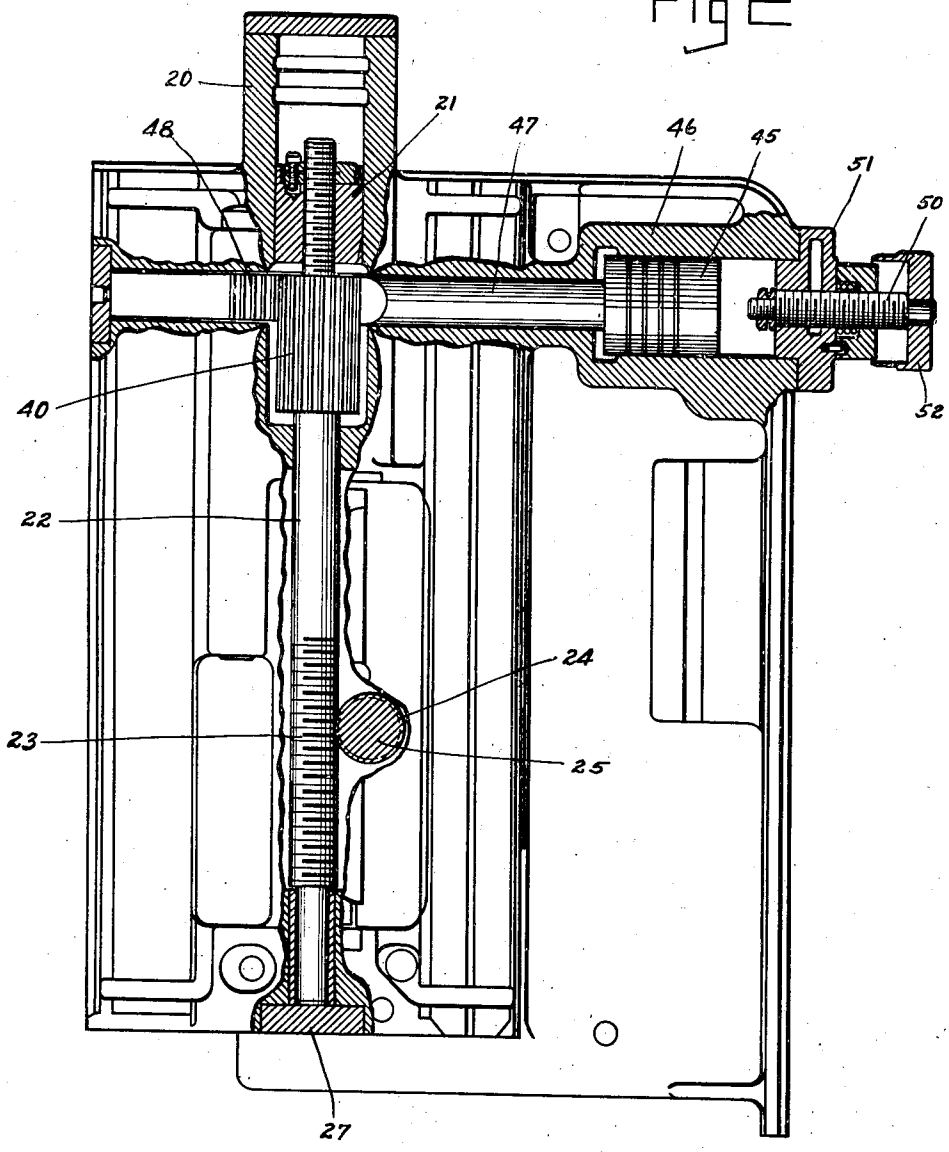

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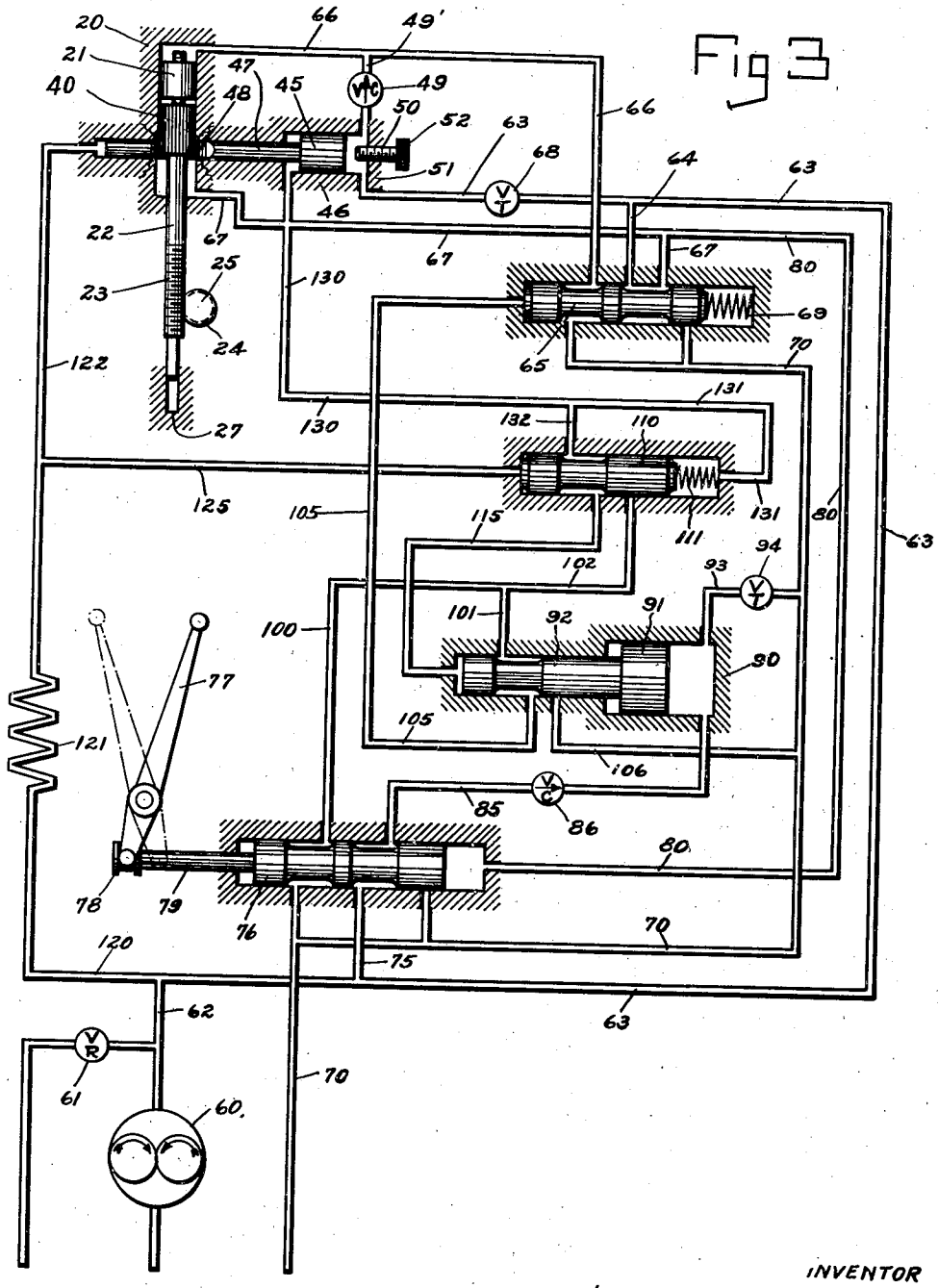
Fig 3



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UNITED STATES PATENT OFFICE

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GRINDING WHEEL FEED MECHANISM

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9 Claims. (Cl. 51—2)

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This invention relates to hydraulic mechanisms for machine tools particularly to a timer for controlling a feed mechanism.

Timers have been used in various ways to control feed mechanisms. They may be used to time a cycle beginning with the rapid feed movement or at a predetermined time or position thereafter. They may be actuated after the start of the feed movement by the movement of the feed slide or by a sizing device. A timer may be used to determine a part of the slide movement or an interval after the slide has reached the end of its movement.

This invention is concerned with the latter condition. Previous timer controls used in this manner were intiated by a sizing device which stopped the feed and started the timer. In this case the sizing device is not available and other means must be utilized to start the timer at the end of the feed movement.

It is therefore an object of this invention to provide a timing mechanism and means for initiating operation thereof after the feed movement has stopped.

A further object is to provide means for returning the slide to inoperative position after a predetermined interval of rest in working position.

A further object is to provide a timer control valve operable in response to restriction of a fluid jet.

A further object is to provide control of a machine, by utilizing the reaction resulting from interference with a jet of fluid.

A further object is to provide means for holding the timer in slide retracting position until the start and stop valve has been shifted to inoperative position.

In the drawings:

Figure 1 is an end elevation of a grinding machine.

Figure 2 is a plan view of the feed mechanism partly in section.

Figure 3 is a diagram of the hydraulic system of which this invention is a part.

The bed of the machine is indicated by numeral 10, the grinding wheel support by numeral 11. This machine has been described in detail in the Price et al. Patents No. 2,335,356 granted November 30, 1943, and 2,313,479 granted March 9, 1943.

Said feed mechanism consists of a cylinder 20 in bed 10 and having a piston 21 slidably mounted therein. Piston rod 22 is in the form of a lead screw having screw threads 23. Said threads mesh with a worm wheel 24 on vertical shaft 25 which is rotatably mounted in wheel base 11 and

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actuated by means of a handwheel 26. Movement of piston 21 is transmitted through threads 23 and worm wheel 24 to effect a lateral movement of shaft 25 to move wheel base 11 at a rapid rate to operative position. Forward movement of said piston is limited by engagement of piston rod 22 with a positive stop 27.

A slow feed movement of said base is effected by rotating piston rod 22. Screw threads 23 rotating in engagement with worm wheel 24 cause said worm wheel to function as a nut. Since the screw is stationary in the bed, the worm wheel and the base must move axially thereof. This rotation of rod 22 is accomplished by mounting thereon an elongated pinion 40. A piston 45, slidably mounted in cylinder 46 in bed 10 and movable transversely of rod 22 has a piston rod 47 on which are cut rack teeth 48 for engaging pinion 40. Said pinion 40 is long enough that it can move through the complete stroke of piston 21 and still remain in operative engagement with rack teeth 48.

The stroke of piston 45 and hence the amount of grinding feed may be varied by means of an adjusting screw 50 in cylinder head 51. Said screw has a graduated head 52 to enable the operator to adjust the mechanism for the total amount of feed or stock removal.

The hydraulic system for actuating the above described feed mechanism consists of a pump 60 and a relief valve 61 for relieving excess pressure in the system. Fluid under pressure from said pump is conducted through line 62 and a distributing line 63 direct to the head end of slow feed cylinder 46. A throttle valve 68 in said line near said cylinder determines the rate of the grinding feed.

A branch 64 from line 63 supplies fluid to a pressure operated reversing valve 65. Said valve is held normally in left hand position by a spring 69. Said reversing valve distributes said fluid alternately through line 66 to the head end of cylinder 20 and line 67 to the rod ends of both cylinders 20 and 46. A check valve 49 in passage 49' permits fluid to pass from cylinder 46 to line 66. Exhaust fluid from said reversing valve is carried off through line 70.

Another branch line 75 from line 63 supplies fluid to a start and stop valve 76. A pivoted lever 77 acts through a spool 78 on valve stem 79 to shift said valve 76. A pressure line 80 connects the right hand end of said valve with line 67 from reversing valve 65. Thus when fluid is directed through line 67 to withdraw wheel base 11 it also

passes through line 80 to shift valve 76 and lever 77 to the position shown in Figure 3.

In this position fluid is directed through a passage 85 and a check valve 86 in said passage to the head end of a cylinder 90 in which is mounted a piston 91 forming part of a timing valve 92. Another passage 93 having a throttle valve 94 connects said cylinder with the exhaust passage 70. In the dotted line position of lever 77, valve 76 is positioned to direct fluid through line 100 which divides into line 101 to valve 92 and line 102 to timer control valve 110.

In the inoperative position of valve 92 shown in Figure 3 said valve connects line 101 to line 105 which directs fluid to the left end of reversing valve 65.

A spring 111 holds valve 110 normally in the left hand position shown. A line 115 connects valve 110 with the left end of timer valve 92 for the purpose of directing fluid to shift said valve to the right.

Fluid from line 62 is also directed through line 120 and a restriction in the form of a coil 121 which permits a predetermined flow of fluid through line 122 to an outlet through which fluid passes in a jet directed against the end of piston rod 47. There is enough clearance around piston rod 47 to permit the escape of said fluid. A branch 125 from line 122 leads to the left end of timer control valve 110 so that any increase in pressure resulting from interference with said jet is exerted against the valve 110 to shift it to the right against spring 111.

A line 130 connects line 67 with valve 110. Said valve when in normal position connects line 130 with line 115. An extension 131 of line 130 is connected to the right hand end of valve 110.

Operation

In operation lever 77 is moved to the dotted line position and valve 76 is shifted to the right. In this position valve 76 connects line 75 with line 100 and directs fluid through line 101, valve 92 and line 105 to shift reversing valve 65 to the right against spring 69. In this position of the reversing valve fluid from line 63 passes through line 64 which is connected through valve 65 to line 66 and the head end of cylinder 20 to shift piston 21 and slide of wheel base 11 forward to operative position. This movement continues until piston rod 22 engages the positive stop 27. At the same time fluid from line 63 which has been passing through valve 68, cylinder 46 and check valve 49 and exhausted through line 66, valve 65 and exhaust line 70 is caused to act on piston 45 due to the fact that line 66 has been changed to a pressure line by valve 65 and the fluid entering cylinder 46 can no longer escape. Piston 45 thus moves to the left to rotate piston rod 22 and screw 23 by means of rack teeth 48 and pinion 40. Thus, even after rod 22 has engaged stop 27 movement of the wheel base continues due to the rotation of screw 23 in contact with worm wheel 24 which acts as a nut and moves together with the wheel base 11 relative to said screw 23.

Piston 45 moves to the left until it interfers with the flow of fluid from line 122 which results in the building up of pressure in said line and also in line 125 leading to valve 110. Said valve is thus shifted to the right against spring 111. In this position valve 110 connects line 102 with line 115 and causes timer valve 92 to move to the right at a rate determined by the setting of throttle valve 94 in exhaust passage 93. As valve

92 moves to the right, it cuts off the flow of fluid from line 101 to line 105 and reversing valve 65 and connects line 105 with exhaust passage 106. Valve 65 is then shifted to the left by spring 69 connecting line 66 with exhaust and pressure supply line 64 with line 67 leading to the rod ends of the two cylinders 20 and 46.

Fluid under pressure entering the rod end of cylinder 20 acts through line 122 and line 125 against the end of valve 110 and would ordinarily hold said valve in operative or right hand position. In order to permit said valve to be shifted to the left hand position by spring 111, said fluid in line 67 also acts through line 130 and line 131 to the right hand end of valve 110 to balance the pressure exerted in the other end of said valve. With equal pressure at each end, the spring 111 is free to shift the valve to the left. In this position the supply of pressure from line 102 is blocked and thereafter valve 110 connects line 115 with line 132 which in turn is connected to line 130. Pressure is thus maintained on the timer valve 92 until valve 76 is shifted to the left to connect line 100 with the exhaust passage 70 and thus make sure that when timer valve 92 is reset that there will be no pressure exerted through lines 101 and 105 to shift reversing valve 65 to the right and thus cause accidental operation of the rapid feed mechanism. In the left hand position of valve 76 pressure line 75 is connected to line 85 in which is located a check valve 86 to the head end of cylinder 90 to move piston 91 to the left and thus reset timer valve 92.

When the reversing valve 65 is in the position shown the pressure line 67 also supplies fluid through line 80 to the right hand end of valve 76. Ordinarily, if said valve 76 failed to function properly at this time, fluid in line 93 which is higher than cylinder 90 would flow back into said cylinder and shift valve 92 to starting position in which position, because of the failure of valve 76 to function, line 100 would still be connected to the pressure supply and said pressure would be exerted through lines 101 and 105 to shift reversing valve 65 to operative position.

We claim:

1. In a machine tool a tool support, a work support, hydraulic means for effecting movement of one of said supports toward and from the other including a piston and cylinder, a timing mechanism for initiating one of said movements, a jet of fluid under pressure, means movable with said piston for restricting said jet of fluid, means responsive to the restriction of said jet for initiating operation of said timing mechanism including a timing valve for controlling a supply of fluid under pressure for actuating said piston to separate said support and a pressure operated valve for directing fluid under pressure to actuate said timing valve.

2. A hydraulic feed mechanism including a slide, a piston and cylinder for moving said slide toward and from operative position, a reversing valve normally in position to direct fluid under pressure to move said slide toward inoperative position, a conduit from said reversing valve to a source of fluid under pressure, a start and stop valve, a timing valve, and a timing control valve normally in position to prevent actuation of said timing valve, connections from said start and stop valve to said timing valve and said timing control valve, connections from said timing valve to said reversing valve to direct fluid under pressure to shift said reversing valve to a position to cause movement of said slide toward operative

position, a jet of fluid under pressure directed against a part of said slide moving mechanism, said jet being restricted as said slide approaches final operative position, a conduit from said fluid supply having a restriction therein for maintaining pressure in the system while supplying fluid for said jet, a connection from said conduit between said jet outlet and said restriction to said timing control valve for shifting said valve in response to increase in pressure as said slide approaches said final operative position, said timing control valve being thus positioned to direct fluid to initiate operation of said timing valve, means for controlling the rate of movement of said timing valve, said timing valve being operable after a predetermined interval to permit the reversing valve to return to normal position and cause said slide to be retracted and said start and stop valve to be reset, said start and stop valve being effective in reset position to direct fluid to reset said timing valve.

3. In a grinding machine, a grinding wheel support, a work support, hydraulic means for effecting relative movement of one of said supports toward and from operative position including a piston and cylinder, a jet of fluid in the path of one of said moving parts, a timing mechanism for initiating movement of said support away from said operative position after a predetermined interval, said jet of fluid being restricted at a predetermined point in said movement toward operative position and means responsive to the restriction of said jet for initiating operation of said timing mechanism.

4. In a machine tool, a tool support, a work support, means for effecting movement of one of said supports toward and from the other including a feed screw, a hydraulic motor operable through a rack and pinion for rotating said feed screw, a jet of fluid under pressure directed against the end of said rack, said rack being operable to restrict said jet, a timing mechanism for controlling the withdrawal of said support, and means responsive to restriction of said jet to initiate operation of said timing mechanism.

5. In a grinding machine, a grinding wheel support, a work support, means for effecting movement of one of said supports toward and from the other including a feed screw, power means for rotating said feed screw, a timing mechanism for controlling withdrawal of said support and means operable by said power means to initiate operation of said timing mechanism.

6. In a machine tool, a tool support, a work support, means for effecting movement of one of said supports toward and from the other including a feed screw, a hydraulic motor for rotating said feed screw, a timing mechanism for controlling withdrawals of said support and means operable in response to movement of said motor to initiate operation of said timing mechanism.

7. In a machine tool, a tool support, a work support, hydraulic means for effecting relative transverse movement between said supports, including a piston and cylinder, a start and stop valve for controlling operation of said piston and cylinder and a reversing valve, plus, a hydraulic timing mechanism for initiating a movement of one of said supports away from the other including a timing valve and a timer control valve, means operable when said piston reaches the end of its stroke in moving one of said supports toward the other for shifting said timer control valve to direct fluid under pressure to move said timing valve through its timing cycle and thus determine the duration of the interval during which said supports are held in operative relation, said timer being operable after said predetermined interval to cause said reversing valve to direct fluid under pressure to said piston and cylinder to separate said supports, reversing of said piston being effective to permit resetting of said timing control valve, said reversing valve also directing fluid to reset said start and stop valve, and said start and stop valve when reset, directing fluid to reset said timing valve.

8. In a grinding machine, a grinding wheel support, a work support, hydraulic means for effecting relative movement of one of said supports toward and from operative position, including a piston and cylinder, a jet of fluid in the path of one of said moving parts, a common supply of fluid under pressure for said hydraulic means and said jet, a mechanism for initiating movement of said support away from said operative position, said jet of fluid being restricted at a predetermined point in said movement toward operative position, and means responsive to the change in pressure due to said restriction of said jet for initiating operation of said mechanism.

9. In a grinding machine, a grinding wheel support, a grinding wheel rotatably mounted thereon, a work support, hydraulic means for effecting relative movement of one of said supports toward and from operative position to perform a grinding operation including a piston and cylinder, a jet of fluid in the path of one of said moving parts, a supply of fluid under pressure for said hydraulic means and said jet, means for restricting the supply of fluid under pressure to said jet, and a mechanism operable in response to relative movement between said moving part and said jet of fluid for determining the progress of said grinding operation.

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