May 23, 1944. F. TURRETTINI 2,349,477

THREAD GRINDING MACHINE

Filed Dec. 8, 1942 6 Sheets-Sheet 1

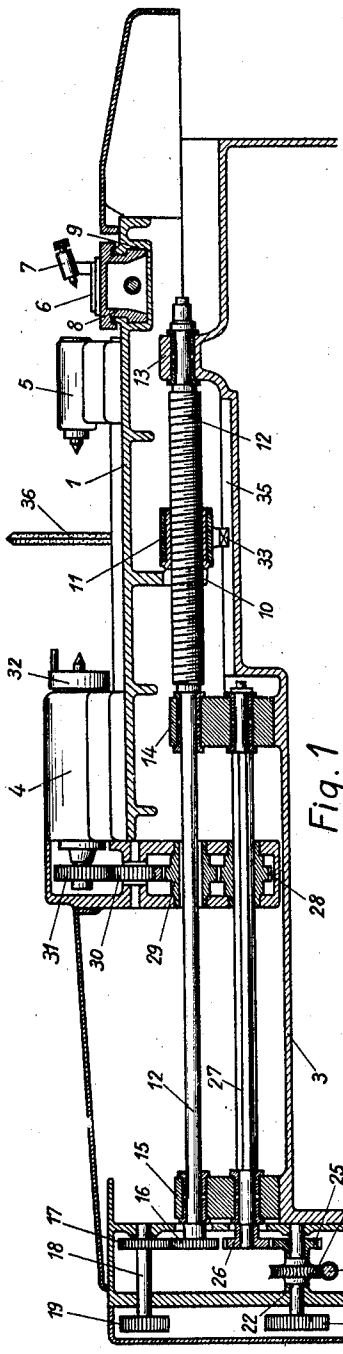


Fig. 1

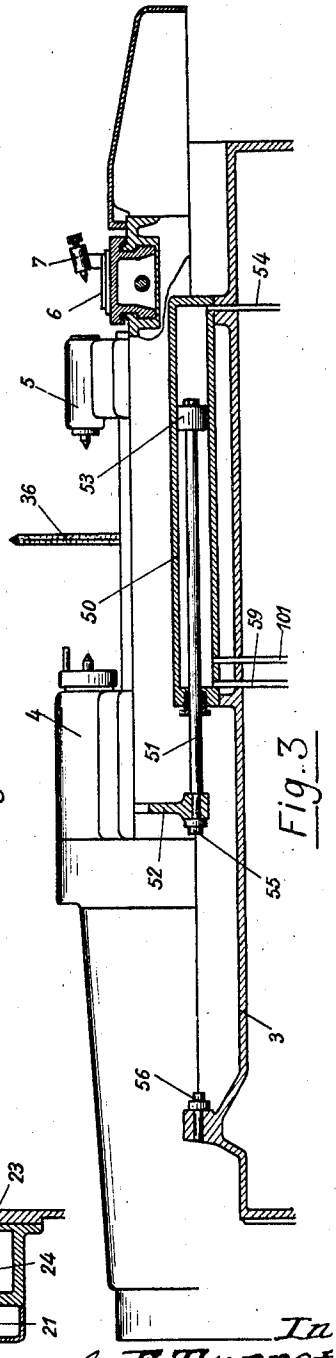


Fig. 3

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THREAD GRINDING MACHINE

Filed Dec. 8, 1942 6 Sheets-Sheet 2

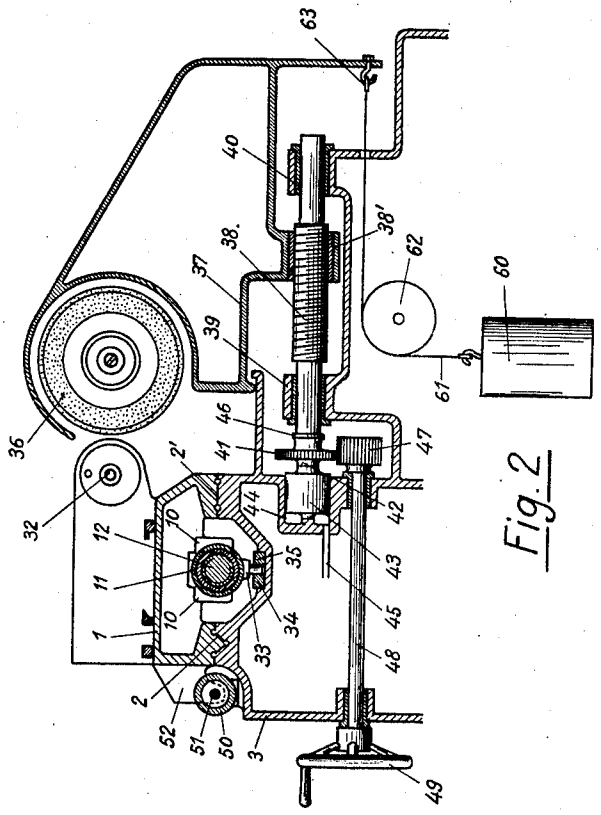


Fig. 2

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THREAD GRINDING MACHINE

Filed Dec. 8, 1942 6 Sheets-Sheet 3

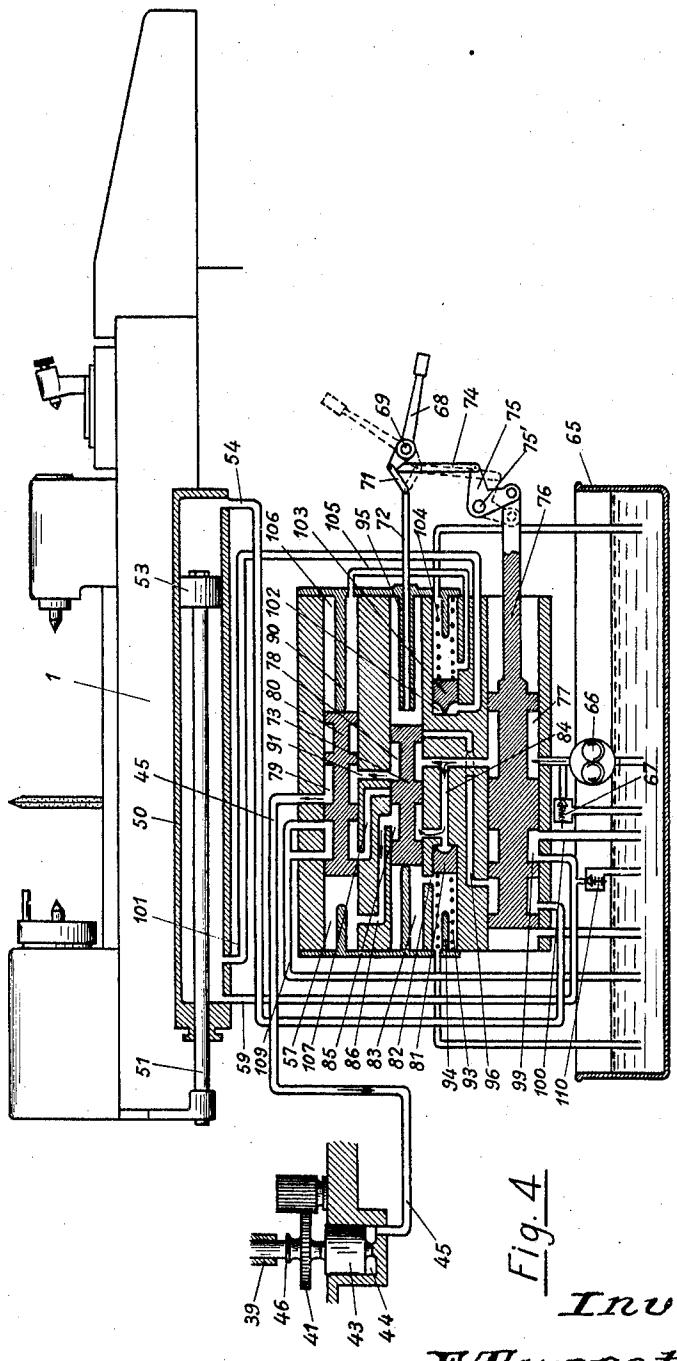


Fig. 4

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May 23, 1944. F. TURRETTINI 2,349,477

THREAD GRINDING MACHINE

Filed Dec. 8, 1942 6 Sheets-Sheet 4

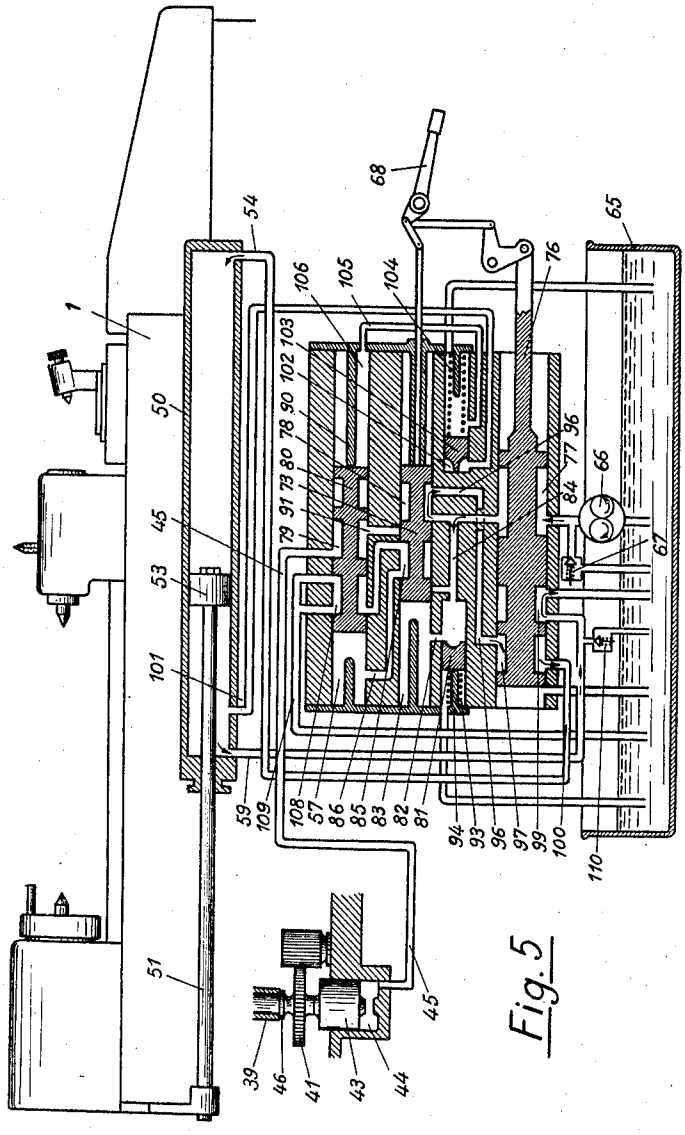


Fig. 5

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May 23, 1944. F. TURRETTINI 2,349,477

THREAD GRINDING MACHINE

Filed Dec. 8, 1942 6 Sheets-Sheet 5

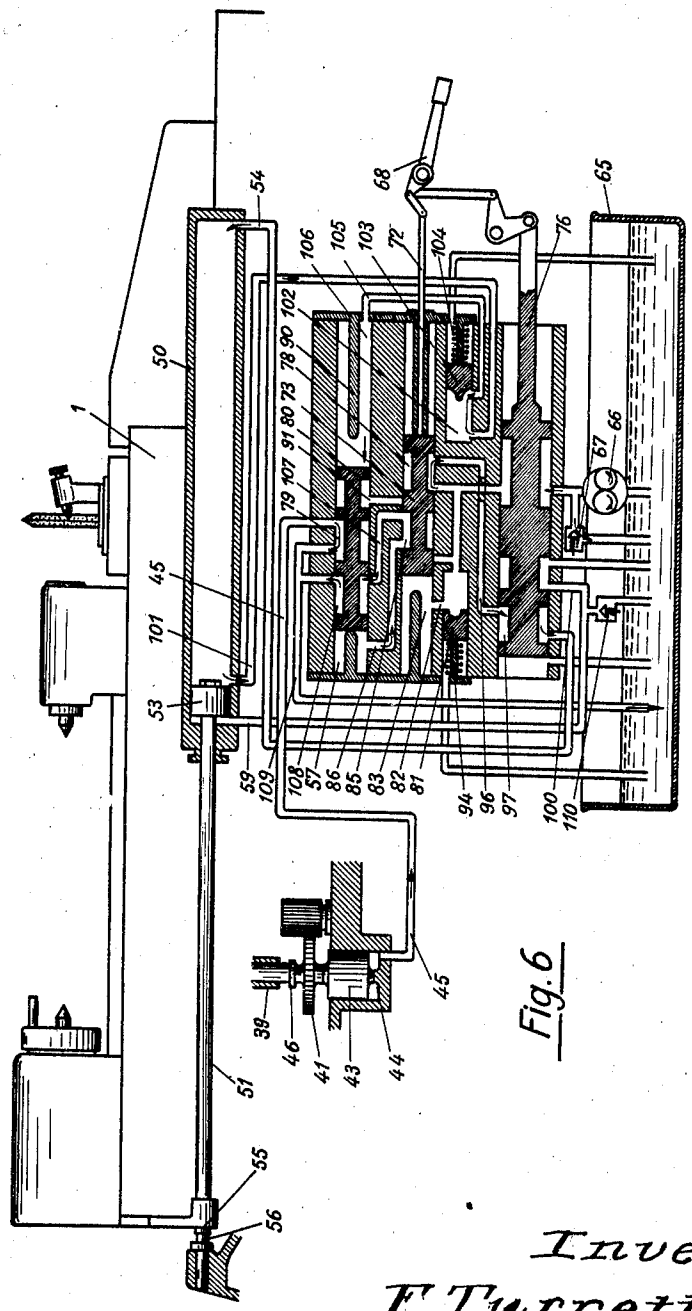


Fig. 6

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THREAD GRINDING MACHINE

Filed Dec. 8, 1942 6 Sheets-Sheet 6

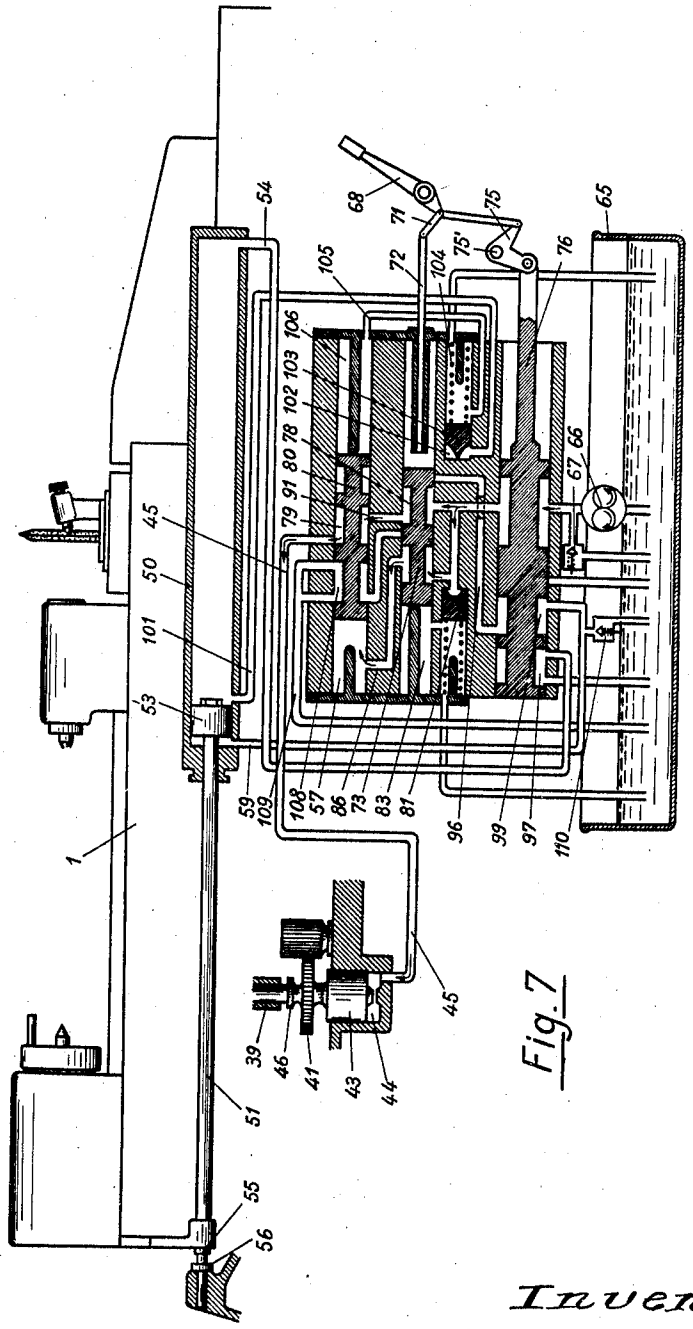


Fig. 7

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2,349,477

UNITED STATES PATENT OFFICE

2,349,477

THREAD GRINDING MACHINE

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Application December 8, 1942, Serial No. 468,269
In Switzerland July 2, 1942

6 Claims. (Cl. 51—95)

The object of the present invention is a thread grinding machine in which the piece-carrying table, movable in front of the grinding wheel, carries a dressing device for the latter. This machine is characterized by a lead-screw, by a nut independent of the table and able to move on the lead-screw but unable to rotate with the latter, by a hydraulic motor operating on this table and by a stop provided on the frame, the whole in such a way that the hydraulic motor, according to the direction of its operation, may either bring the table against the nut and maintain it there, whereby the table can be displaced by means of the nut, for the grinding work, or take this table away from this nut and bring it against the stop of the frame, position in which the dressing device is in regard of the grinding wheel, for dressing the latter.

The annexed drawings represent, by way of example, an embodiment of the present invention.

Fig. 1 is an axial section thereof and Fig. 2 a cross-section in the plane of the grinding wheel; Fig. 3 is an axial section of a detail. Figs. 4, 5, 6 and 7 represent schematically the same part of the machine in different operating positions.

The table 1 is movable on slides 2 and 2' provided in the frame 3. It carries at 4 the headstock and at 5 the riding stock, between which the workpiece is mounted rotatively, in order that its thread may be ground by the grinding wheel 36. A dressing device provided at 6, for dressing the grinding wheel 36 from time to time, is represented schematically by a diamond-holder 7. It is obvious that the dressing device will be that suitable for the type of profile to be cut on the grinding wheel and that different dressing devices suitable for various purposes may be interchangeable on the same machine. This device or these devices are placed on a slider 8 movable in a slide 9 provided in the table 1.

The table 1 carries on its lower face a boss 10 extending to the right and to the left of the lead-screw 12 (Fig. 2), by means of which boss the table abuts against the nut 11 of the lead-screw 12. The latter is carried by the bearings 13, 14 and 15 of the frame 3 and linked with an axis 18 by a set of gears 16, 17. The pinion 19, fitting on the axis 18, constitutes the first element of a reduction set of gears which determines the pitch of the thread to be ground and whose last element is the pinion 21 mounted on the axis 22. The latter is linked at 23 and 24 with a driving mechanism not shown. The axis 22 is linked through the gears 25, 26 with the shaft 27 which, by means of the pinion 28, sliding on a key, drives the pinions 29, 30 and 31. The bearings of the three latter pinions, as well as those of the pinion 28, are fixed on the table, the pinion 31 rotating the workpiece carrying the broach 32.

The nut 11 is provided with an extension 33 sliding between the guides 34—35 of the frame in order to prevent this nut from rotating.

In Fig. 2, one sees more particularly the grinding wheel 36, its sliding support 37 and the mechanism that regulates the distance between the grinding wheel and the axis of the workpiece, in order to determine the diameter of the latter. It comprises a weight 60 hanging to a cable 61 led over a pulley 62 and attached at 63 to the sliding support 37. This weight tends constantly to bring the grinding wheel towards the workpiece. A regulating screw 38 carried by the bearings 39 and 40 of the frame is provided with a pinion 41 and can rotate in the nut 38' carried by the support 37. With that screw cooperates a hydraulic motor comprising a ram 43 forming piston in a recess 44 provided in the frame 3; the screw 38 leans by its end 42 on the ram 43. A duct 45 leads the fluid under pressure into the recess 44, when it is required to push the ram 43 bringing the screw 38 and the grinding wheel support 37 backwards, until this movement is stopped by the shoulder 46 abutting against the bearing 39. The pinion 47 and the hand-wheel 49 mounted on the axis 48 permit to regulate by hand the distance of the grinding wheel from the broach 32. One can also design for this adjustment an automatic feed device operating by successive advances after each grinding run.

The cylinder of the hydraulic motor that must bring the dressing device into working position in regard to the grinding wheel 36 is located in 50 and fixed on the frame; 53 is the piston and 51 the piston rod, which is attached to the table 1 at 52.

Fig. 3 shows more particularly the hydraulic cylinder 50. When the piston 53 receives the fluid under pressure from the duct 54, it pushes the table from right to left until the end 55 of the piston rod 51 comes to bear against the stop 56 fixed on the frame 3. During this time, the fluid that finds itself on the other side of the piston flows out through the duct 59. When the piston rod abuts against the stop 56, the dressing device 6 is in working position in regard of the grinding wheel 36.

For bringing again the table in contact with the nut 11 and resume the grinding work, the fluid under pressure will be brought into the cylinder through the duct 59. It will push the piston from

left to right until the boss 10 comes into contact with the nut 11 on which it will press during the whole grinding work. The fluid displaced by the piston will flow out through the duct 54, until the boss 10 has come into contact with the nut 11, and then through the ducts 54 or 59, according to the direction of motion of the table.

Figs. 4, 5, 6 and 7 represent schematically the hydraulic circuit of the two above mentioned motors and of the distributor regulating automatically the operation of these two motors, i. e. the succession of the movements to be effectuated by the grinding wheel and by the table for changing over from grinding to dressing and vice-versa.

Fig. 4 shows the relative position of the table and of the organs of the distributor at the moment when the control lever of the distributor has been brought from the position "grinding" (in dotted lines) into the position "dressing" (in full lines), but before all these organs have had time to react under the action of this manipulation.

Fig. 5 shows the relative position of the organs of the table and of the organs of the distributor after they have reacted, but before the table has come to abut against the stop 56; the grinding wheel is thus in its backward position.

In Fig. 6, the table has come to abut against the stop 56 and the grinding wheel has come back into working position to be dressed.

In Fig. 7, the dressing has just been finished, the control lever of the distributor has been brought back into "grinding" position, the grinding wheel must yet be pushed backwards, the table must move to the right in order that the boss 10 comes to bear against the nut 11, after what the grinding wheel will come again near the workpiece to resume its grinding work.

The fluid is contained in a tray 65 where it is aspirated by a pump 66 provided with a safety valve 67 that lets the unused excess of liquid return to the tray. The control lever 68, which has just been set into dressing position, is pivoted at 69 and provided with an articulation 70 which operates, through a connecting rod 71, a push rod 72 which can displace a pilot valve 73. The articulation passes, in its movement, through a dead point in relation with the displacement of the push rod 72, so that for each manipulation of the lever 68, the push rod 72 begins by displacing the pilot valve 73 fully to the left and leaves it in this position when retiring itself.

A second connecting rod 74 is articulated on a bent lever 75 pivoted at 75', which operates the distributor valve 76, whose position determines the direction of motion of the piston 53 in the cylinder 50, by bringing the fluid under pressure to one or the other of the ends of the latter.

The fluid discharged from the pump flows into the annular space 77 cut in the distributor valve 76; it reaches the space 78 of the pilot valve 73. The duct 84 leads the fluid to the annular space 85 of the pilot valve 73; and from there, the fluid flows through the duct 86 into the space 57 and exerts a pressure on the control valve 80, which moves to the right until it contacts with the rod 90 (position shown in Fig. 4).

When the valve 80, which controls the motor 43—44, has reached this position, the fluid contained in the annular space 78 can pass through the duct 91, reach the annular space 79 of the control valve 80 and, from there, flow through the duct 45 that leads it into the recess 44. The ram 43 is thus operated and the grinding wheel moves away from the workpiece. The stepping back of the grinding wheel is completed when the shoulder 46 comes to abut against the bearing 39 (see Fig. 5).

As soon as the ram 43 thus arrives to the end of its travel, the pressure of the fluid begins to rise. The piston 81 is subjected to this pressure, but it is first retained by a spring 93. When the pressure of the fluid reaches a sufficient value, the spring 93 yields, and the piston 81 is pushed back until it comes to abut against the rod 94. At this moment, the aperture 82, which was previously obturated by the piston 81, is opened to the fluid; the latter flows into the space 83 and exerts a pressure on the end of the pilot valve 73, which is pushed to the right until it is stopped by the guiding tube 95 of the push rod 72. The various valves have then taken the relative position shown in Fig. 5.

The annular space 78 of the pilot valve 73 remains always in communication with the fluid under pressure arriving from the pump. But now the duct 91, 45 is closed and the duct 96 communicates with the annular space 78; the fluid can flow through this duct and reach the annular space 97 of the distributor valve 76. The annular space 97 is in communication with the duct 54 which ends in the cylinder 50. The fluid exerts its pressure on the piston 53. The fluid that was on the other side of this piston is expelled through the duct 59 that leads into the annular space 99 of the distributor valve 76. From there, the expelled fluid flows through the pipe 100 and returns to the tray 65.

As soon as the piston 53 begins to move, the pressure of the fluid falls; it is limited by the reaction presented by the friction of the table 1. The piston 81 is partially relieved and its spring 93 brings it back into the position shown in Fig. 4. This displacement occurs without influence on the pilot valve 73 and the control valve 80.

When the table reaches the end of its travel by abutting against the stop 56 (see Fig. 6), a duct 101 leading to the cylinder 50 is opened. The fluid coming in from the duct 54 cannot displace any further the piston 53, which is at the end of its travel, and it flows through the duct 101. This duct leads to the space 102 and the piston 103 is subjected to a pressure acting from left to right. It is maintained by the spring 104 in the position in which it was up to this moment and which is shown in Fig. 5.

Since there is no other possible outflow of the fluid supplied by the pump 66, its pressure begins to rise again until the spring 104 yields. At this moment, the piston 103 takes the position in which it is shown in Fig. 6. The fluid can penetrate through the duct 105 into the space 106 and brings the control valve 80 fully to the left.

The liquid which is imprisoned in the space 57, and which would have hindered the motion of the control valve 80, can flow through the duct 86 into the annular space 85 of the pilot valve 73. In the position of the pilot valve 73 at this moment, the fluid can flow through the duct 107 to reach the annular space 108 of the control valve 80 and from there return to the tray 65 through the duct 109.

When the control valve 80 will have reached the position shown in Fig. 6, the duct 45 will be put in communication with the outlet duct 109.

The weight 60 (Fig. 2) which was compressing the fluid imprisoned in the recess 44 will then act to return the fluid to the tray 16; the grind-

ing wheel will thus return into working position and will be ready to be dressed.

After completion of the dressing operation, one brings again the lever **68** into the position "grinding" (Fig. 7). During this setting of the lever **68**, the push rod **72** is first pushed to the left and then pulled back to the right. In its motion to the left, it displaces the pilot valve **73** to the left also and leaves it in the position visible in Fig. 7. The distributor valve **76** is also brought into a new position.

The various movements described above for the displacement of the table **1** from right to left repeat themselves in the same sequence, but the table will move from left to right. The duct **96** will then be connected to the duct **59** and not to the duct **54**; the latter will be used for the return of the fluid. The table **1** will continue to advance to the right until its boss **10** comes to stop against the nut **11** (Fig. 1). Since that moment, the table will follow exactly the movements of this nut.

The fluid continuing to ebb, its pressure rises, and it flows through the duct **101** to the space **102** and can push the piston **103** as soon as this pressure becomes sufficient. The fluid under pressure then flows through the duct **105** into the space **106** and pushes the control valve **80** to the left, establishing a communication between the ducts **45** and **109**. The grinding wheel will return into working position as explained before.

Since that moment, the piston **53** is solicited towards the right by a force depending only on the adjustment of the safety valve **111**. The table will thus remain in contact with the nut **11**, on which it will exert an effort depending on this adjustment, whereby the table will follow all the movements of the nut resulting from the rotation of the lead-screw **12**.

The fluid under pressure operating the two motors can also be used to carry out other functions, such as reversing the direction of motion of the table at the end of its run, the automatic recoil of the grinding wheel during the return of the table after a grinding run, or a periodical movement of the grinding wheel holder, for grinding buttress threads and the like. The ducts and the additional organs which are necessary for carrying out these complementary functions are not described in the text, neither represented in the accompanying figures, in order to avoid superfluous complications.

The machine represented possesses various advantages:

The displacements of the table for changing over from the grinding position to the dressing position and vice-versa are produced automatically as well as those for taking the grinding wheel away from the workpiece during the table displacements and for bringing it back when the table is again at standstill. All these movements are simply produced by setting the lever **68** on one or the other of its two positions for grinding and for dressing. In addition, while the table moves from its grinding position to its dressing position or vice-versa, it is completely separated from the lead-screw and from its nut **11**, which are thus subjected to no effort and to no wear; and the hydraulic control permits of moving the table very quickly. Finally, when the dressing device is in dressing position, it attacks the grinding wheel at the same point of its periphery by which the wheel itself attacks the workpiece to be ground. One avoids in this way profile deformations in the thread to be ground, deformations which could result either from the inclination of the grinding wheel according to the slope of the thread spiral to be ground, or from the fact that the axis of the grinding wheel and that of the workpiece are not contained in parallel planes, vertical planes if one admits that the centre of the grinding wheel lies at the same level as the axis of the workpiece.

We have now described the object of the invention in such a way as to make it clear for those acquainted with the art.

What is claimed to be new is:

1. A thread grinding machine comprising a grinding wheel, a frame, a lead screw, a nut fitted on said screw, a work piece supporting table mounted on said frame and movable in one direction into grinding position in which the table engages the nut, a wheel dressing device on said table, an abutment for limiting the movement of the table in the opposite direction to a dressing position in which said dressing device is operatively positioned with respect to said wheel, and manually controlled fluid pressure operated means for selectively moving said table into either of said positions.

2. A thread grinding machine comprising a grinding wheel, a frame, a lead screw, a nut fitted on said screw, a work piece supporting table mounted on said frame and movable in one direction into grinding position in which the table engages the nut, a wheel dressing device on said table, an abutment for limiting the movement of the table in the opposite direction to a dressing position in which said dressing device is operatively positioned with respect to said wheel, a support for the grinding wheel displaceable perpendicularly to the axis of the work piece, manually controlled means for selectively moving the table into either of said positions, and means rendered operative by said manually controlled means to displace the wheel support to inoperative position upon initiation of movement of the table in either direction.

3. A thread grinding machine comprising a grinding wheel, a frame, a lead screw, a nut fitted on said screw, a work piece supporting table mounted on said frame and movable in one direction into grinding position in which the table engages the nut, a wheel dressing device on said table, an abutment for limiting the movement of the table in the opposite direction to a dressing position in which said dressing device is operatively positioned with respect to said wheel, a support for the grinding wheel displaceable perpendicularly to the axis of the work piece, manually controlled means for selectively moving the table into either of said positions, means rendered operative by said manually controlled means to displace the wheel support to inoperative position upon initiation of movement of the table in either direction, and means to return the wheel support to operative position at the termination of each movement of the table.

4. A thread grinding machine comprising a grinding wheel, a frame, a lead screw, a nut fitted on said screw, a work piece supporting table mounted on said frame and movable in one direction into grinding position in which the table engages the nut, a wheel dressing device on said table, an abutment for limiting the movement of the table in the opposite direction to a dressing position in which said dressing device is operatively positioned with respect to said wheel, a fluid pressure operated motor for moving the table in opposite directions, a fluid pressure oper-

ated motor for displacing the wheel support to inoperative position, manually operable means for initiating operation of one of said motors, and means rendered effective by the motor in operation to initiate operation of the other motor.

5. A thread grinding machine comprising a grinding wheel, a frame, a lead screw, a nut fitted on said screw, a work piece supporting table mounted on said frame and movable in one direction into grinding position in which the table engages the nut, a wheel dressing device on said table, an abutment for limiting the movement of the table in the opposite direction to a dressing position in which said dressing device is operatively positioned with respect to said wheel, a fluid pressure operated motor for moving said table in either direction, a fluid pressure operated motor for displacing said wheel support to inoperative position, manually controlled means for determining the direction of movement of said table by the related motor, and means rendered operative prior to movement of said table for displacing said wheel support to inoperative position.

6. A thread grinding machine comprising a grinding wheel, a frame, a lead screw, a nut fitted on said screw, a work piece supporting table mounted on said frame and movable in one direction into grinding position in which the table engages the nut, a wheel dressing device on said table, an abutment for limiting the movement of the table in the opposite direction to a dressing position in which said dressing device is operatively positioned with respect to said wheel, a fluid pressure operated motor for moving said table in either direction, a fluid pressure operated motor for displacing said wheel support to inoperative position, manually controlled means for determining the direction of movement of said table by the related motor, means rendered operative prior to movement of said table for displacing said wheel support to inoperative position, and means rendered operative at the termination of each movement of the table to restore the wheel support to operative position.

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