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(54) Machine for the centreless abrasive machining of tubes, bars and the like.

(57) The machine for the centreless abrasive machining of tubes, bars and similar bodies or workpieces, comprises a preferably modular bed supporting at least one workpiece rest unit formed from idle rollers or wheels and able to be variously inclined to the workpiece feed direction, and at least one unit which, besides acting as a rest by way of rollers or wheels, rotates and feeds the workpiece in consequence of the operation of at least one of its rest rollers or wheels. This latter unit also comprises an idle presser roller which acts on the workpiece by way of a control device operated by pressurised fluid and can be inclined in the reverse direction to the inclination of the rest rollers or wheels. A single control member, for example in the form of a handwheel, enables both the rest rollers and the presser roller to assume the required inclinations by virtue of a linkage between the handwheel and units.

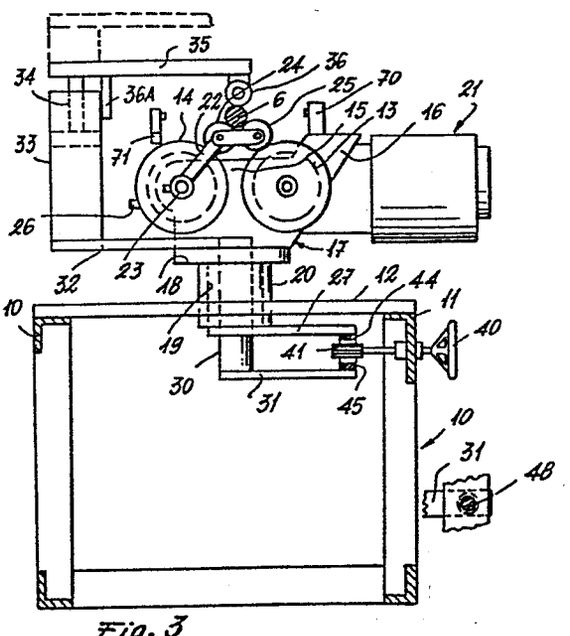

Fig. 3

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MACHINE FOR THE CENTRELESS ABRASIVE MACHINING OF TUBES, BARS AND THE LIKE

This invention relates to a machine for the centreless abrasive machining of tubes, bars and similar workpieces, or of cylindrical or conical bodies, of any material. More particularly, the invention relates to machines known as lapping machines, polishing machines and grinding machines which operate on the workpiece with one or more abrasive tools such as abrasive belts, grinding wheels, cleaning wheels and the like.

In certain known machines of the said category, the workpiece rests at its machining zone on a vertically and horizontally adjustable blade or the like, and is disposed between a motorised roller or wheel and the abrasive tool. The motorised roller can also be adjusted horizontally and vertically, and is also inclinable in order to give the workpiece its necessary feed movement. The adjustments necessary for adaptation to the workpiece dimensions are generally mutually independent, and the operating times required therefore substantially affect the machine productivity. The situation worsens if the workpiece to be machined has a substantial length, for example some metres, and must therefore be supported upstream and downstream of the machining point by discharge and loading devices. In this respect, such devices comprise a series of pairs of idle rest rollers for the workpieces, and each pair can be adjusted independently of the others in terms of inclination and verticality.

The object of the present invention is to provide a machine for the

centreless abrasive machining of workpieces, comprising at least one abrasive tool (grinding wheel, disc, belt or the like) and means on which the workpiece can rest, the machine enabling the adjustments required on the basis of the workpiece dimensions to be made in a substantially shorter time than in the case of known machines.

This and further objects which will be more apparent from the detailed description given hereinafter are attained by a machine characterised essentially by comprising at least one support structure supporting at least one workpiece rest unit formed from idle rollers or wheels and able to be variously inclined to the workpiece feed direction, and at least one unit which, besides acting as a rest by way of rollers or wheels, rotates and feeds the workpiece in consequence of the operation of at least one of its rollers, and said latter unit can be associated with at least one presser roller which acts on the workpiece by way of a control device operated by pressurised fluid and can be inclined in the reverse direction to the inclination of the rest rollers by way of a linkage with a control means (for example a handwheel) to which the rest rollers of the units are also linked.

The operation of a single control means (represented for example by a handwheel) therefore enables the operator to adjust the inclination both of the rest rollers and presser rollers, with considerable increase in machine productivity.

According to a preferred embodiment of the invention, the machine comprises at least one operating unit of the abrasive tool type (grinding wheel, disc, belt or the like) which is mounted on its own autonomous structure by means of an arm which is rotatable in a vertical plane and is controlled by a pressurised fluid cylinder-piston unit, so that the tool can be applied to the workpiece substantially from above, thus automatically adapting to the dimensions of the workpiece being machined.

According to a particular aspect of the invention, in order to enable a wide range of diameters to be machined, with each pair of rollers

(which can be either merely rest rollers or rest and feed rollers for the workpiece) there is associated at least one pair of directionable idle rollers of smaller diameter which, by rotation, can be brought into contact with the preceding rollers, so as to act as a rest for, and provide movement to, workpieces which because of their (small) diameter would not be able to be adequately supported in the gap between the rollers of greater diameter.

The invention will be more apparent from the detailed description of a preferred embodiment thereof given hereinafter by way of non-limiting example and illustrated on the accompanying drawing, in which:

Figure 1 is a diagrammatic plan view of a machine according to the invention;
Figure 2 is a diagrammatic section on the line II-II of Figure 1;
Figure 3 is a more detailed section on the line II-II of Figure 1, but with certain parts omitted for clarity;
Figure 4 is a detailed plan view of a rest and movement unit for the workpiece;
Figure 5 is a perspective view of the unit of Figure 4;
Figure 6 is a detailed section through the control system (with handwheel) for the bars which control the inclination of the units;
Figure 7 is a diagrammatic section on the line VII-VII of Figure 6.

The machine of the given example comprises three identical, substantially cage-like modular base elements constructed of metal sections, and indicated by A, B and C respectively. It also comprises an operating unit G formed from a column 1, a rotatable arm 2 hinged at an intermediate point 3 to the column 1, and a double acting cylinder-piston unit 5 controlled by pressurised fluid and interposed between the arm 2 and a projecting part 4 of the column 1 so as to cause the arm to rotate, ie to approach or withdraw from the workpiece which is here assumed to be a bar of circular cross-section, indicated by 6. In this specific but not limitative example, the abrasive tool is represented by an endless belt 7 passing over two rollers 8 and 9, the latter being driven by a motor (possibly associated with a

reduction gear, not shown) mounted on the arm or on the column. A fraction of the periphery of the roller 9 projects from the arm 2 so that the belt can attack and thus machine the workpiece 6. A grinding wheel, polishing disc or the like can be used instead of the abrasive belt, and these would be mounted in the arm in known manner instead of the roller 9.

The operating unit G is mounted laterally to the intermediate base element B, which is connected at its ends to the base elements A and C by any known screw means. The base elements A and C (together with the workpiece rest and movement means which will be described in detail hereinafter) represent the loading and discharge sections of the machine respectively, whereas the intermediate base element B (also together with the workpiece rest and movement means which will be described in detail hereinafter) represents the operating section.

The aforesaid rest and movement means for the workpiece being machined, are basically of two types and serve for all the sections A, B and C. These means are mounted on cross-members connected by screw means to the longitudinal members 11 and 10 of the base elements at predetermined distances apart, and are basically of two types. The first and more complicated type is formed from a pair of coplanar rubber-coated rollers 13, 14 which are disposed close together to define an upper intermediate gap which receives the workpiece being machined if this has a diameter greater than a given value. The workpiece obviously rests on the periphery of said rollers. The rollers in question are rotatably supported in a projecting manner by the vertical side 16 of a L-shaped member 17, of which the horizontal side 18 is connected lowerly to a vertical hollow shaft 19 rotatably mounted in a hub fixed to the cross-member 12.

The roller 14 is motorised by a chain 100 from the roller 13, which is driven by a geared motor unit 21.

On the pivot 23 of the roller 14 there is directionably mounted an angle arm 22 carrying two coplanar, idle rollers 24, 25 disposed

close together which, when the arm is in the position of Figure 3, rest on the rollers 14, 13 respectively.

The pair of rollers 24, 25 serves for the smaller diameter workpieces 6, which are placed in the upper gap defined by them, and which would not be able to be adequately supported on the rollers 13, 14 if placed in the gap 15 between these latter. On rotating the arm 22 in the direction of the arrow F, the rollers 24, 25 are moved into their inoperative position. In this position, the arm 22 can rest by way of the roller 24 against a stop 26 present on the vertical side 16 of the member 17.

At its lower end, projecting from the hub 20, the hollow shaft 19 comprises a radial arm 27 which serves to adjust the inclination of the rollers 13, 14 and rollers 24, 25 to the longitudinal axis of the workpiece 6, in order to give this latter its necessary feed movement.

Inside the hollow shaft 19 there is rotatably supported a vertical shaft 30 which projects at its ends. At its lower end, said shaft is provided with a radial arm 31 by means of which it is possible to adjust the angular position of said shaft and of the members connected to it, and which will now be described. At its upper end the shaft 30 comprises a radial arm 32 which supports a double acting cylinder-piston unit 33 operated by pressurised fluid. The rod 34 of the cylinder-piston unit 33 also carries a radial arm 35, the free end of which supports on its lower side an idle presser roller 36. In order to prevent the arm 35 rotating about the geometrical axis of the rod 34, said arm is for example made rigid with a prong 36A guided in a longitudinal groove (not shown) provided on the outside of the cylinder of the cylinder-piston unit 33.

The presser roller 36 serves to press the workpiece 6 (see Figure 3) against the rollers 24, 25 or, when these are inactive, against the rollers 13, 14.

The workpiece rest and movement unit heretofore described serves for

supporting the workpiece, and for rotating it about its axis and providing it with an axial feed movement, this latter by virtue of the inclination of the unit to the workpiece axis. The presser roller 36, which assumes a reverse inclination to that of the rollers 13, 14 and 24, 25 (see Figure 4 in particular), serves to ensure adherence of the workpiece 6 to these latter so that they can transmit the necessary rotary-translatory movement against the action which the abrasive tool (belt 6) exerts on the workpiece. These units are indicated by D in the figures.

The second type of workpiece rest means is represented by at least one unit, representing a simplification of the unit D. This unit, indicated by E in the figures, is obtained from the unit D by removing the members 21, 30, 31, 32, 33, 34, 35, 36A, 36 from this latter. In other words, the unit D is reduced to the rest rollers 13, 14, 24, 25, all of which are idle and can be variously inclined by means of their arms 27.

In order to adjust the inclination of the various units D and E heretofore described, a single control member is provided, represented in this case by a handwheel 40 rotatably supported by the base element B, together with a linkage comprising connection bars between the units.

More precisely, the handwheel 40 is rigid with a pinion 41. The pinion is interposed between two racks 42, 43 which are fixed to bars 44, 45 of considerable length. The lower bar 45 interconnects all the arms 31 of the units D, whereas the bar 44 interconnects all the arms 27 both of the units D and of the units E. The arms 27, 31 support the relative bars 44, 45, to which they are connected by pivots 48 which allow a relative angular movement between bars and arms. On rotating the handwheel 40, the two racks 42, 43 and thus the relative bars 44, 45 move horizontally in opposite directions. Furthermore, by the effect of the rotational connection with the relative arms, racks and bars, they move transversely (see arrow F of Figure 6) to the control pinion 41. In this manner, the rest rollers 13, 14 and 24, 25 and

the presser rollers 36 become inclined to the longitudinal axis of the workpiece 6, namely the former (13, 14 and 24, 25) becoming inclined to the latter (36).

The operation is as follows:
the inclination of the units D and E is adjusted with the handwheel 40. The workpiece 6 is placed on the rest rollers of these units, and the presser rollers 36 of the loading section A are lowered. The motors of the units 21 are started, and the workpiece thus advances towards the machining section B. Sensors (photoelectric cells 70, 71) cause the presser rollers 36 of the machining section B to lower when they sense the presence of the workpiece 6 (they were previously raised as shown by the dashed lines in Figure 3). When the workpiece intercepts an analogous sensor in a position corresponding with the operating unit D, this latter rotates under the action of the cylinder-piston unit 5, so that the tool comes into contact with the workpiece 6 and machines it while the workpiece rotates and advances. When the workpiece reaches the discharge section C, its units D lower the relative presser rollers 36 when the relative sensor is intercepted. The machined piece advances along this section and is then removed.

Claims:

1. A machine for the centreless abrasive machining of tubes, bars and similar workpieces, characterised in that on a support structure (A, B, C) there are supported at least one rest unit (E) for the workpiece (6), formed from idle rollers or wheels (13, 14; 24, 25) and able to be variously inclined to the feed direction of the workpiece (6), and at least one unit (D) which, besides acting as a rest for the workpiece (6) by way of rollers or wheels (13, 14; 24, 25), rotates and feeds said workpiece (6) in consequence of the operation of at least one of its rollers (13), and said latter unit (D) can be associated with at least one presser roller (36) which acts on the workpiece (6) by way of a control device (33) operated by pressurised fluid and can be inclined in the reverse direction to the inclination of the rest rollers (13, 14; 24, 25) by way of a linkage (43, 44) with a control means (40) to which the rest rollers (13, 14; 24, 25) of the units (D, E) are also linked (42, 45).

2. A machine as claimed in claim 1, characterised by comprising an operating unit (G) provided with its own support frame (1) and with a tool support arm (2) rotatable in a horizontal plane.

3. A machine as claimed in claim 1, characterised in that the support structure (A, B, C) is formed from modular elements.

4. A machine as claimed in one or more of the preceding claims, characterised in that the rest rollers (13, 14; 24, 25) comprise two pairs of rollers, the rollers of one pair being of a different diameter from those of the other pair, and the pair of lesser diameter being able to be moved by rotation into an inoperative position.

5. A machine as claimed in claim 4, characterised in that the pair of smaller rollers (24, 25) is supported on the pivot of one of the rollers (14) of the other pair (13, 14) by means of a rotatable arm (22).

6. A machine as claimed in one or more of the preceding claims, characterised in that the presser roller (36) is disposed on an arm (35) driven vertically by a cylinder-piston unit (33), and this latter is mounted on a further arm (32) which is rotatably supported.

7. A machine as claimed in one or more of the preceding claims, characterised in that the rest rollers (13, 14; 24, 25) are mounted on a rotatable support (17), of which the geometrical axis of rotation coincides with that of the arm (32) carrying the cylinder-piston unit (33).

8. A machine as claimed in one or more of the preceding claims, characterised in that the rotatable support (17) and if provided the arm (32) carrying the cylinder-piston unit (33) are connected to coaxial shafts (19, 30), each provided with an operating arm (27, 31).

9. A machine as claimed in one or more of the preceding claims, characterised in that the linkages comprise two bars (44, 45) connected to racks (42, 43) disposed on opposite sides of a pinion (41) controlled by a handwheel (40).

10. A machine as claimed in one or more of the preceding claims, characterised in that the arms (31) associated with the rotatable supports (17) are hinged to one of the bars (45), and the arms (27) associated with the cylinder-piston units (33) are hinged to the other bar (44).

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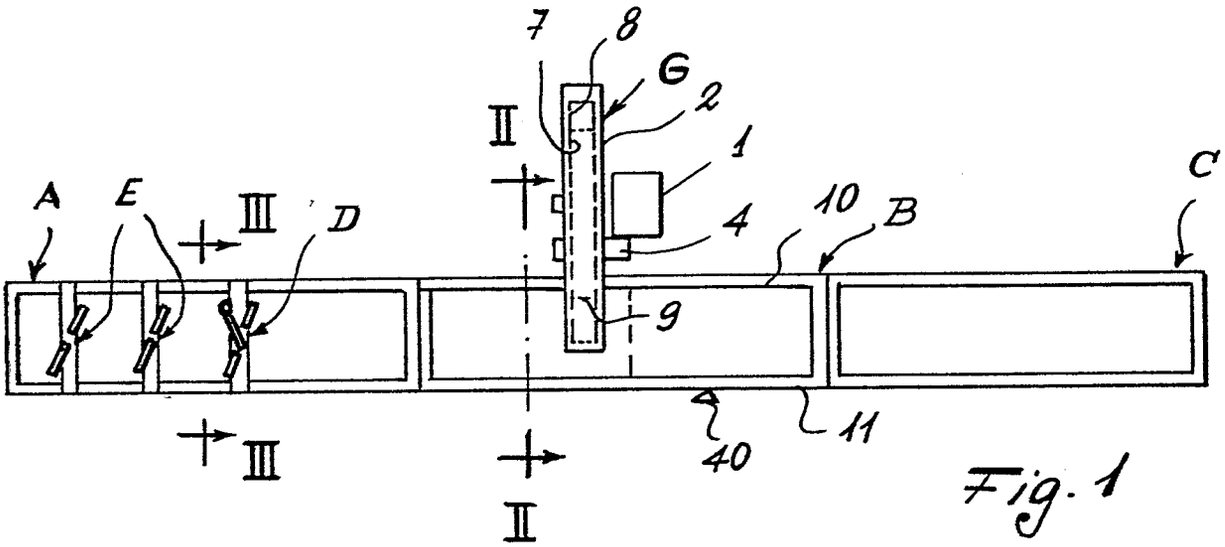

Fig. 1

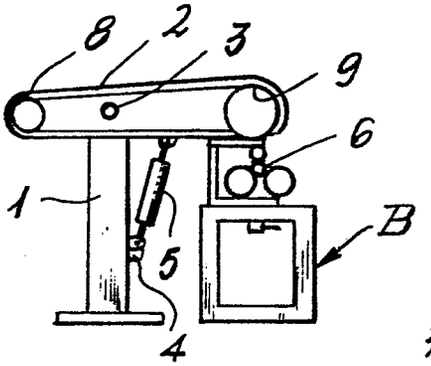

Fig. 2

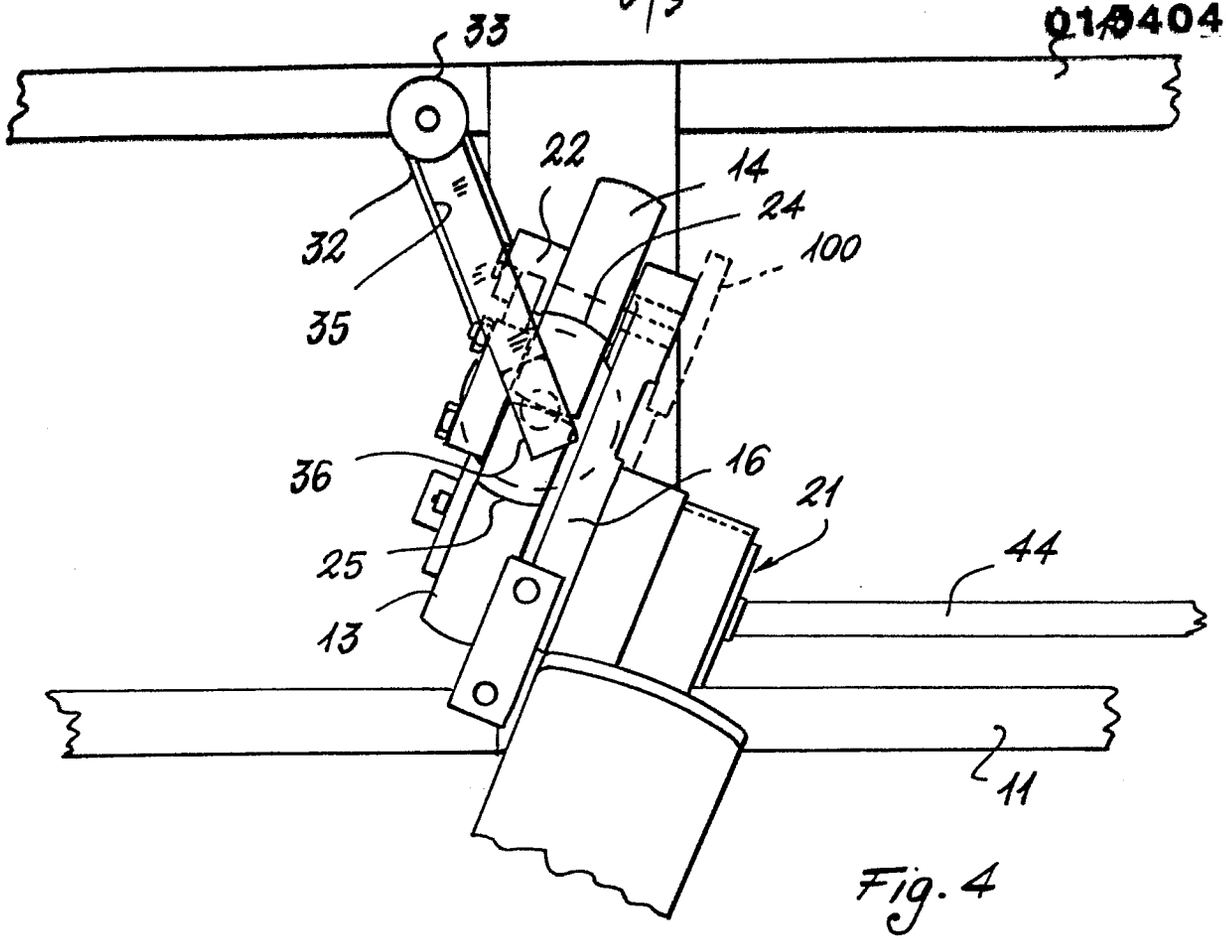
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Fig. 4

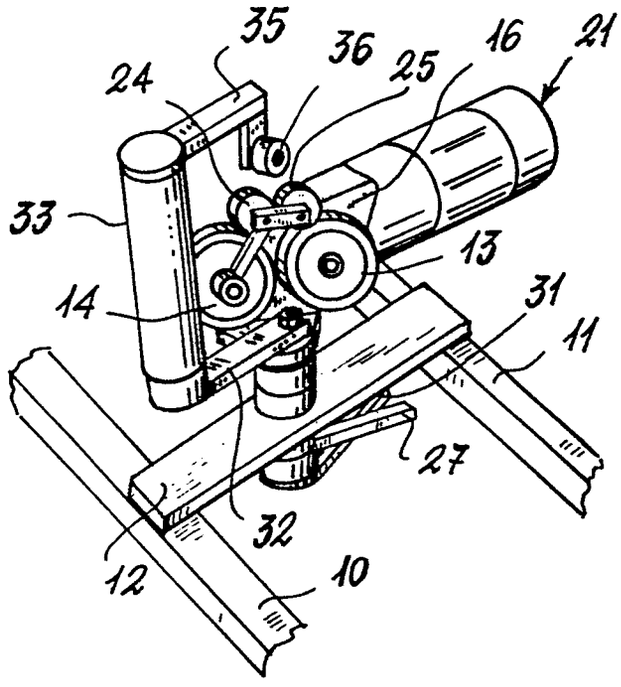
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Fig. 5

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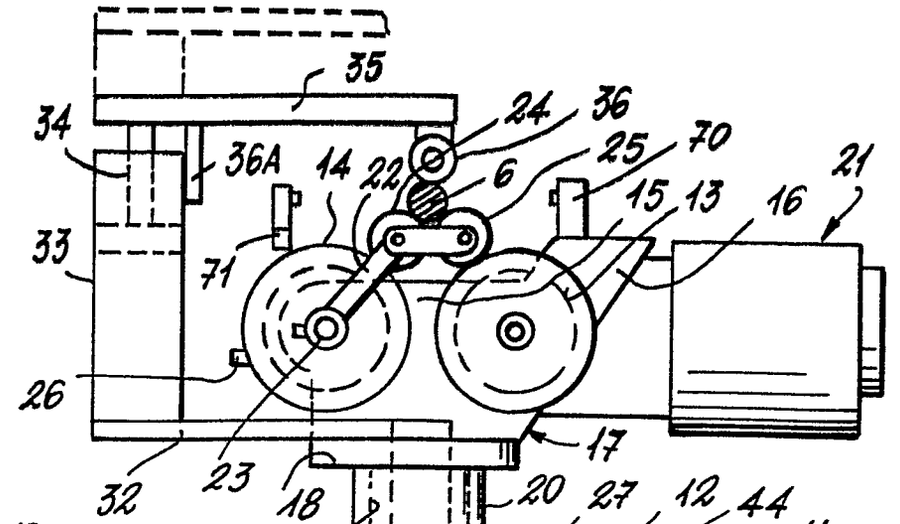

Fig. 3

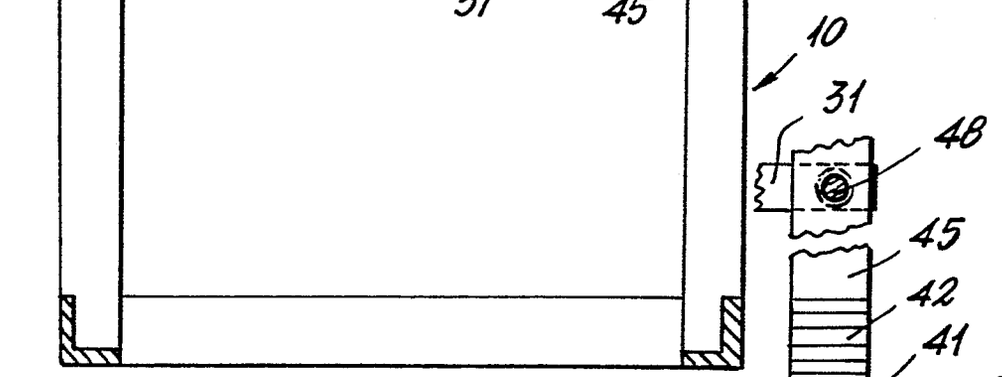

Fig. 7

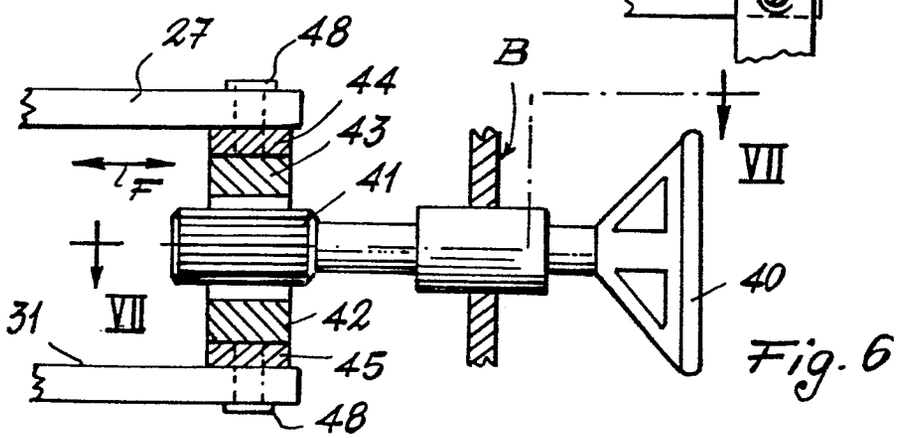

Fig. 6