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(54) Improvements in a machine tool for surface grinding.

(57) Improvements in a machine tool for treating the surface of a workpiece (3) using a grinding wheel (2), wherein the machine has a grinding wheel head (1) that is free to move in a radial direction with respect to the workpiece (3) due to the action of irregularities in the shape of the grinding wheel (2) or workpiece (3) and is attached above a guide plate (8). A device (9) keeps the grinding wheel head (1) pressed against the workpiece. Said guide plate (8) is pivoted onto a bench (12) that reciprocates along the workpiece (3) and can swing about a vertical axis (X-X) that passes through the central plane (M) of the grinding wheel (2) and the line (S) where the grinding wheel (2) makes contact with the workpiece (3) when the axis about which the grinding wheel and workpiece rotate are not parallel.

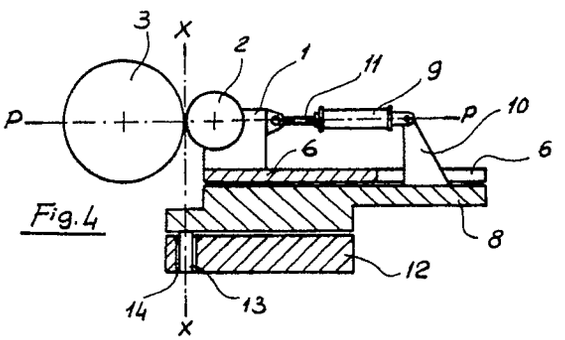

Fig.4

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Improvements in a machine tool for surface grinding.

This invention concerns improvements in a machine tool for treating the surface of a workpiece using a grinding wheel. In particular, the invention concerns improvements in machine tools which grind and finish the surfaces of cylindrical workpieces made of steel or other softer materials. The two above operations can be carried out using machines that are the same as or similar to the kind of machines normally, and for the purposes of this patent application, known as "grinding machines".

The problem a grinding machine has to solve usually is to give a rough-ground workpiece a shape and dimension complying with the design and then to reduce the roughness thereof and improve the appearance of the surface, all the above by removing material from the workpiece surface.

There are four main factors that affect this problem:

a) The circular shape of the operating surface of the grinding wheel;

b) The cylindrical shape of the workpiece ;

c) The position of the grinding wheel rotation axis;

d) The position of the piece rotation axis.

Ideally, the two above shapes would constantly be error free and perfectly parallel, but actually there is a constant conflict between the grinding wheel in a grinding machine and the workpiece being worked caused by irregularities on the surface of the workpiece and the fact that the two aforementioned axis are not perfectly parallel, giving rise to several imperfections on the finished article.

In the description of the invention which follows, for reason of clarity, the axis about which the grinding wheel and workpiece rotate are assumed to be horizontal and on the same horizontal plane, and the plane including the perimeter of the grinding wheel at half of its thickness is referred to as "central plane".

In the invention set out in Italian Patent N° 1187629, the applicant obviates the defects produced in the two aforementioned shapes: the grinding wheel in the invented grinding machine is able to distancing itself from the workpiece in a radial direction, so that any irregularities in the shape of the workpiece or the grinding wheel itself have no undesirable effect, and then returns to touch the workpiece with the correct pressure once the irregularity has been passed. The grinding wheel head is supported by a carriage which can move radially on a horizontal plane, thus enabling the grinding wheel to distance itself radially from the work piece, and is connected to a device that keeps the grinding wheel urging the workpiece at a constant operating pressure.

One aim of the invention described here is to obviate the drawbacks due to the fact that the axis about which the workpiece rotates is not perfectly parallel with that of the grinding wheel.

The invention, as characterized in the claims, is a grinding machine wherein the axis about which the grinding wheel rotates can effect a swinging movement on the plane on which the axis about which the grinding wheel and workpiece rotate. Preferably, the grinding wheel head is supported by the aforementioned carriage. The carriage moves radially on a carriage guide plate which swings on a lower bench reciprocating along the piece. Still preferably, the axis of said swinging movement lays in said central plane of the grinding wheel and is perpendicular both to the line of contact between the grinding wheel and workpiece and to the plane passing through the axis about which the grinding wheel and workpiece rotate. Said swinging movement of the grinding wheel rotation axis can be either free or controlled.

The combination of the aforementioned back and forth and swinging movements gives the grinding machine the ability to adapt to irregularities in the shape of both the workpiece and the grinding wheel and to obviate the event that the axis about which the grinding wheel and workpiece rotate are not parallel.

The main advantages of the invention are the reduction of the time required for producing the piece and a finish quality higher than that obtained by grinding machines that are known in the art.

The invention is now described in greater detail by an example of the way it can be executed and with reference to the attached drawings in which:

FIGG. 1 and 2 are diagrammatic views explaining the position of the grinding head swinging axis;

FIG. 3 is a diagrammatic perspective assembly view ;

FIG. 4 is a vertical diagrammatic partly sectioned view of the assembly in Figure 3; and

FIG. 5 shows one detail of an alternative to the solution shown in Figures 3 and 4.

Both Figures 1 and 2 show that the X-X axis about which the grinding wheel head 1 swings is a vertical axis which passes through the point at which the central plane M of the grinding wheel 2 meets the line S at which the grinding wheel 2 and workpiece 3 touch. The X-X axis is also perpendicular to the plane P which passes through the axis about which the grinding wheel and workpiece rotate.

Figure 3 and 4 both show the grinding wheel head 1, an electric motor 4 and a drive belt 5 which rotates the grinding wheel 2 about its axis in

the direction shown by the arrow F. All of these components are held on a carriage 6 which runs on guides 7 attached to a guide plate 8, so that the carriage 6 can move radially in respect of the workpiece 3. A pneumatic cylinder 9, connected to a compressed-air supply (not shown), is jointed at one end to a bracket 10 attached to the carriage guide plate 8 and the end of the piston rod 11 is jointed to the grinding wheel head 1, so that the carriage 6 can be put under a constant pressure thus keeping the grinding wheel 2 constantly urging the workpiece 3. The aforementioned carriage guide plate 8 is pivoted above the bench 12 which reciprocates along the workpiece 3. The carriage guide plate 8 has a vertical pin 13 on its lower surface which fits into a housing 14 in the bench 12, the X-X axis of which is at the point at which the central plane M of the grinding wheel meets the line at which the grinding wheel and workpiece touch (see Figure 2).

In the example shown, the carriage guide plate 8 is free to swing due to the effect of an irregularity in the shape of the workpiece, or because the axis about which the grinding wheel and workpiece rotate are not parallel. The carriage guide plate 8 swings on the moment an irregularity comes into contact with the grinding wheel, or the rotation axis are no longer parallel, and returns to its normal position once the problem has been passed.

Figure 5 diagrammatically shows an alternative solution wherein the carriage guide plate 8 is not free to swing, but is controlled by a conventional numerical control system C. A section of micrometric toothed wheel 15 is attached to the lower surface of the carriage guide plate 8 and mesches a section of a micrometric toothed wheel 16 driven by a motor 17 attached to a bracked (nos shown), independent of the carriage guide plate 8. The axis (not shown) of the motor 17 lays in the central plane M of the grinding wheel. The swinging of the toothed wheel 16 can be controlled in such a way that the grinding wheel head , and thus the grinding wheel itself, take up the position adapted to possible convexity required by a workpiece, as bench 12 moves along the workpiece.

From time to time, the grinding wheel requires resharpening or replacing and, consequently, the grinding wheel can have different diameters. Thus, the machine is equipped with means designed to ensure that the grinding wheel is always held in a correct position in respect of the aforementioned X-X swinging axis.

It is realized that the invented machine could be executed without the parts that enable the grinding wheel head to move radially.

Claims

1. Improvements in a machine tool for treating the surface of a workpiece (3) using a grinding wheel (2), wherein the grinding wheel head (1) can move in a radial direction and distance itself from the workpiece (3) due to the action of irregularities in the shape of the grinding wheel (2) and workpiece (3) and always urges the workpiece, characterized in that the grinding wheel (2) is connected to devices (1, 6, 8, 12 and 13) that enable a swinging movement for the grinding wheel (2) on a plane that passes through the axis about which the grinding wheel and workpiece rotate,

2. Improvements according to claim 1, characterized in that there is a guide plate (8) on which a carriage (6) holding the grinding wheel head (1) can move in said radial direction, said guide plate (8) being pivoted onto a bench (12) that reciprocates the grinding wheel head (1) along the workpiece (3) so that the grinding wheel (2) can affect said swinging movement.

3. Improvements according to claim 1 , characterized in that the grinding wheel head (1) is pivoted onto the bench (12), so that the grinding wheel (2) can effect said swinging movement.

4. Improvements according to claims 1, 2 and 3, characterized in that the axis (X-X) of said swinging movement of the grinding wheel (2) is on the central plane (M) of the grinding wheel, and perpendicular both to the line (S) at which the grinding wheel and workpiece touch and the plane (P) which passes through the axis about which the grinding wheel (2) and workpiece (3) rotate.

5. Improvements according to previous claims, characterized in that said swinging movement is free.

6. Improvements acording to claims 1 to 4, characterized in that said swinging movement is controlled by a numerical control system (C).

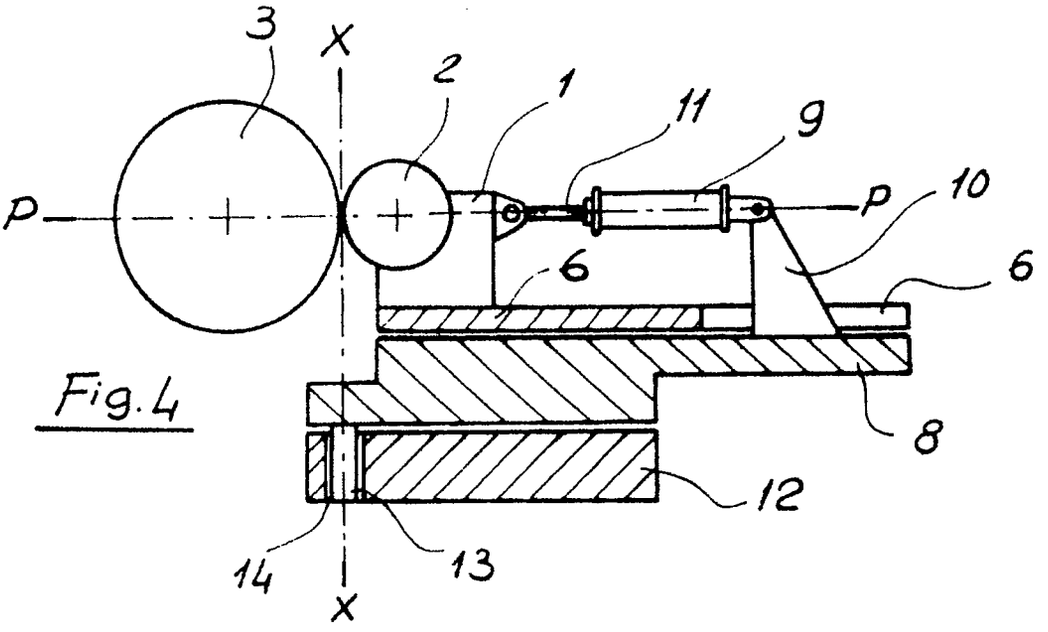


Fig.4

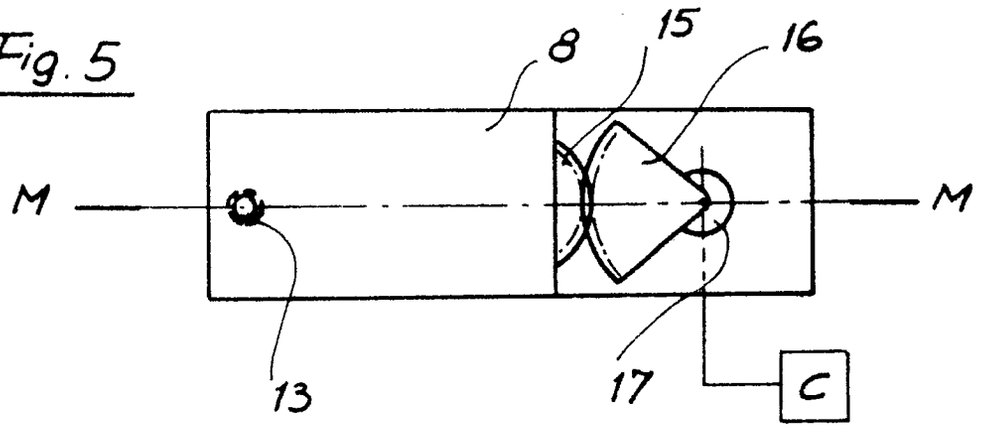


Fig.5

Fig.1

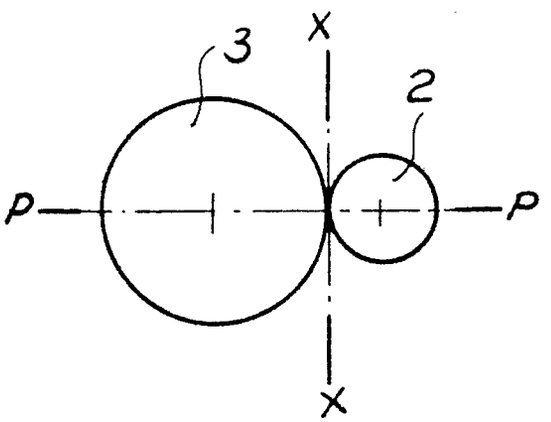
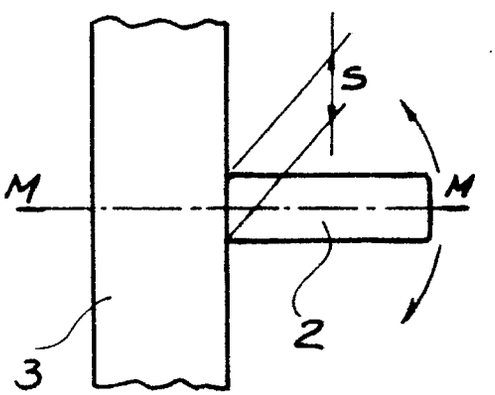


Fig.2



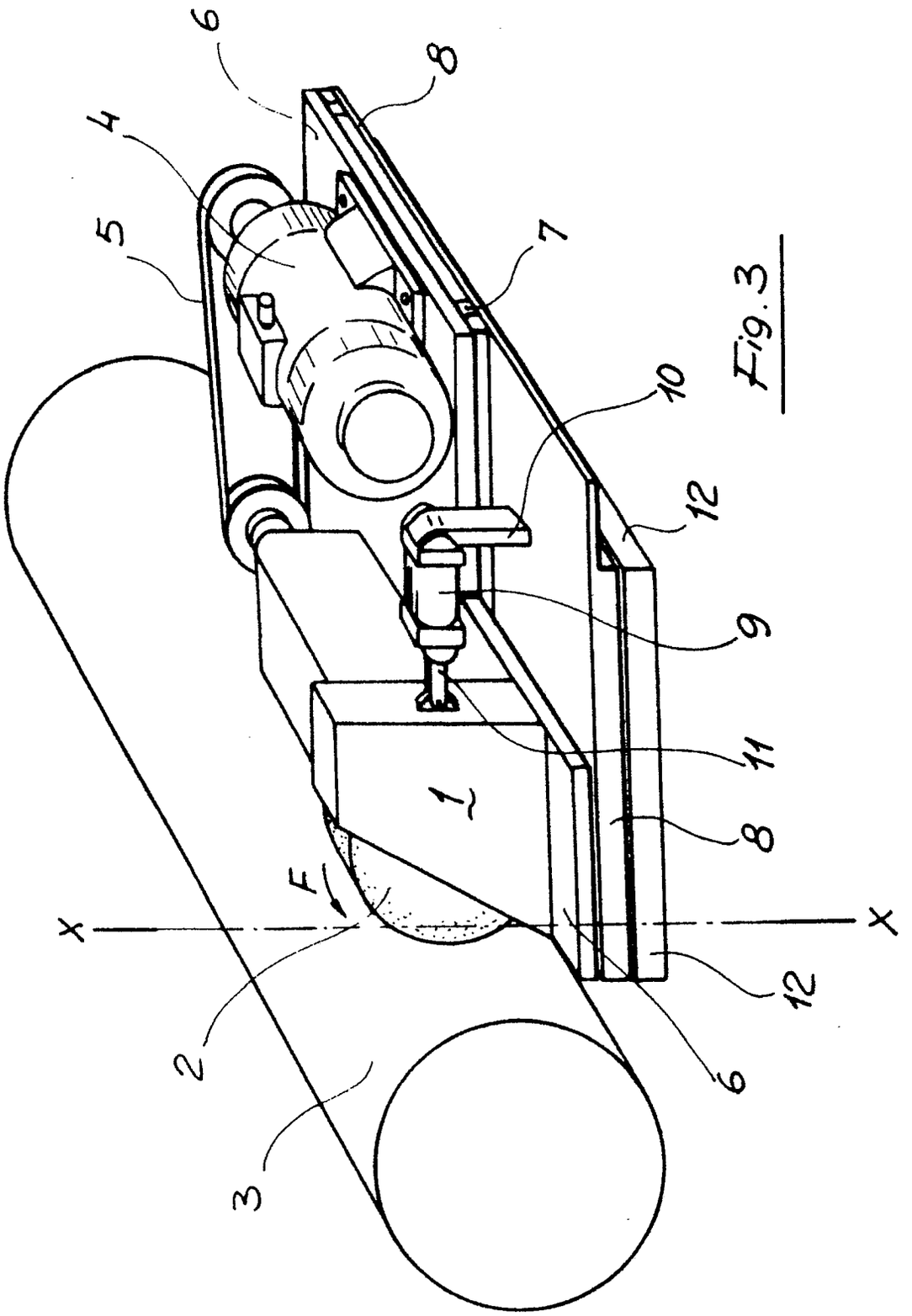


Fig. 3