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(54) Device for providing grinded teeth on an elongated blade

(57) Device for providing ground teeth on an elongate blade, comprising:

- a frame,
- a first grinding unit, which is supported by the frame, which first grinding unit comprises a plurality of grinding-wheel axles which can be driven in rotation, each for holding at least one grinding wheel, as well as grinding-wheel drive means for driving the grinding-wheel axles,
- the first grinding unit furthermore comprising a turret for the grinding-wheel axles, which turret defines a common loop-shaped path for the grinding-wheel axles and furthermore comprises turret drive means for moving the grinding-wheel axles along the path,
- blade-support means which comprise a first blade support for supporting the blade at a first machining position,
- the path defined by the turret being such that the grinding wheels successively move past the first machining position for grinding the blade and are free of the blade at any position along the path apart from at the first machining position.

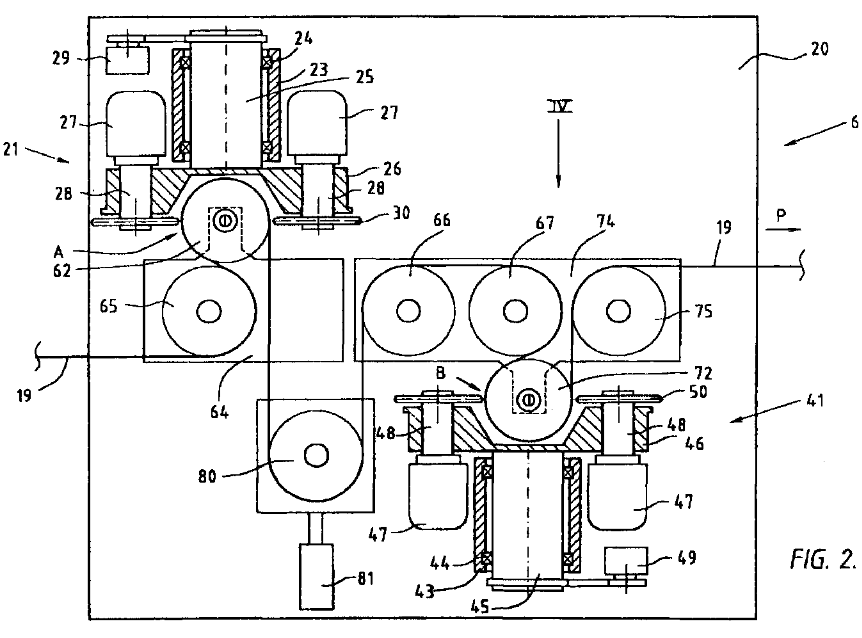

FIG. 2.

EP 0 888 847 A1

Description

The present invention relates to providing ground teeth on an elongate blade, which blade may be virtually non-deformable, but in particular is a flexible strip, for example made of strip steel. The present invention relates in particular to the production of cutting blades from strip steel, which cutting blades are used in machines for cutting bread and similar products. As is known, there are two basic designs of bread-cutting machines, one design having one or more cutting-blade frames with a plurality of parallel cutting blades in each frame, and the other design having at least one pair of parallel rollers with a plurality of loop-shaped cutting blades around them. Examples of cutting blades of this kind and their production are described in US 3 745 869, US 3 859 762, US 4 119 004.

The object of the present invention is to provide a device for producing toothed blades which has a very high production capacity and requires minimum deployment of production staff. Furthermore, the present invention aims to provide a device which optimizes the service life of the expensive grinding wheels, which brings the further advantage that the device seldom has to be shut down for the purpose of exchanging or maintaining the grinding wheels.

The present invention achieves the abovementioned objects by providing a device according to claim 1.

Further advantageous embodiments of the device according to the invention are described in the subclaims and the following description given with reference to the drawing, in which:

Fig. 1 shows a diagrammatic plan view of the layout of an installation for the production of cutting blades with ground teeth from strip steel, which installation comprises a preferred embodiment of the device according to the invention,
Fig. 2 diagrammatically shows a view from above, partially in horizontal section, of a preferred embodiment of the grinding device of Fig. 1,
Fig. 3 shows a diagrammatic, perspective view of the second grinding unit of the grinding device shown in Fig. 2,
Fig. 4 shows a diagrammatic front view, in the direction of arrow IV in Fig. 2, of the second grinding unit of Fig. 2,
Fig. 5 diagrammatically shows a detail of the view shown in Fig. 4, on a larger scale,
Figs. 6a, 6b show a side view of the strip steel, respectively after blanking and after grinding,
Fig. 7 shows a cross-section through a grinding wheel of the grinding device shown in Fig. 2,
Fig. 8 shows a plan view of part of a variant of the grinding device shown in Fig. 2, and
Fig. 9 shows a diagrammatic, perspective view of the conveyor station of the installation shown in Fig. 1.

The installation shown in Figure 1 is designed for the production of toothed cutting blades by providing ground teeth on strip steel. Cutting blades of this kind are intended in particular for bread-cutting machines, but obviously may also be used for cutting other products.

The installation shown in Figure 1 comprises an unwinding station 1 for strip-steel coils delivered by the strip-steel producer. In this example, the strip steel which is to be machined has a uniform rectangular cross-section with two parallel sides which are situated a short thickness apart and a top edge and bottom edge, in which case the strip steel will be machined in the region of the top edge for the purpose of providing teeth. By way of example, the strip steel has a thickness which lies between 0.25 and 0.5 millimetre and a height which lies between 9.6 and 12.7 millimetres. The thin strip steel is flexible and is of a steel grade which is suitable for cutting blades. Preferably, the strip steel supplied is already hardened, so that after the cutting teeth have been provided the strip steel does not have to undergo any further hardening treatment.

With the aid of the unwinding station 1, a plurality of coils of strip steel are unwound and wound on to a single, large stock coil in storage station 2a, the ends of the pieces of strip steel which are to be wound up in succession being welded together using a movable butt-welding device 3.

The installation preferably comprises a plurality of storage stations which are displaceable, so that, as can be seen in Figure 1, one of the storage stations 2a can be used to wind up a new stock of strip steel, while another storage station 2b at the same instant is feeding strip steel to that part of the installation which machines the strip steel.

The strip steel which is supplied by the storage station 2b and throughout the entire installation stands with its side vertically upright passes into an accumulation and tensioning device 4. The accumulation section of the device 4 has the task of allowing the coil in the storage station 2b to be unwound uniformly, while the strip steel further on is conveyed in a stepwise manner, as will be explained below. The tensioning section has the task of maintaining a suitable tensile stress in that part of the strip steel which is to be machined. For the abovementioned dimensions of the strip steel, this tensile stress is approximately 500 N.

A blanking tool 5, which is designed to punch out part of the blade material which is to be removed for the provision of the teeth is disposed downstream of the accumulation and tensioning device 4 and upstream of the at least one grinding unit which is yet to be described. The blanking device 5 has a blanking die on one side of the path for the strip steel and, on the opposite side, a blanking tool which can move to and fro in the horizontal direction transversely to the strip steel and with which the basic shape of the teeth to be produced can be blanked from that area of the strip steel which adjoins the top edge.

The basic shape (cf. Fig. 6a) of the teeth, which is obtained by blanking, is ground on both sides of the strip steel by means of a grinding device 6, which will be described in detail below with reference to Figures 2-7.

An inspection station 7 for the visual inspection of the ground teeth is disposed downstream of the grinding device 6. The inspection station 7 comprises a suitable lamp and a magnifier.

To convey the strip steel in steps along the path through the blanking device 5 and the grinding device 6, a conveyor station 7 is provided, having conveyor means which are to be described in more detail with reference to Figure 9.

The installation is suitable, inter alia, for the production of elongate cutting blades of a certain length which - in contrast to loop-shaped cutting blades - are moved to and fro in a cutting machine substantially in their longitudinal direction, at right angles to the product which is to be cut. These cutting blades are usually disposed substantially vertically in the cutting machine. To produce reciprocating cutting blades of this kind, a hole-punching station 9 is provided, which is disposed downstream of the conveyor station 8 and is designed to make a hole in the strip steel in the region of each of the ends of a cutting blade which is to be produced.

Downstream of the hole-punching station 9, there is another accumulation station 10, in which a stock length of the machined strip steel can be accommodated.

A cutting station 11 for cutting the separate cutting blades to the desired length is disposed downstream of the accumulation station 10. The cutting blades which have been cut to length are collected in groups of the desired number in a collection station 12.

The installation described is also suitable for the production of strip steel which is provided with teeth and is used as starting material for the production of loop-shaped cutting blades. For this purpose, a winding station 13, which is able to wind the machined strip steel on to a coil, is provided at the end of the installation.

Further operations, such as arranging attachment lugs in the holes in the strip steel and providing logos and type designations on the strip steel, may be carried out on the strip steel in the section indicated by dashed lines between the accumulation station 10 and the cutting device 11.

Furthermore, Figure 1 also shows a filtering and cooling device 14 for the oil, which oil cools and lubricates the grinding device 6 and is recycled through the device 14. Furthermore, boxes 16 for the control electronics and an operating panel 17 are shown.

Figure 2 shows a diagrammatic plan view of the grinding device 6. The strip steel is shown as the thick line which is advanced in the direction of the arrow P and is denoted by the reference number 19. The grinding device 6 comprises:

- a frame 20 which is positioned on the ground and in this figure is indicated diagrammatically by a rectangle,
- a first grinding unit 21 for carrying out a grinding operation on one side of the strip steel 19, and
- a second grinding unit 41 for carrying out a grinding operation on the other side of the strip steel 19.

With regard to their structure and operation, the first and second grinding units 21, 41 are substantially identical and, for this reason, will be explained in particular with reference to the second grinding unit 41.

The grinding device 6 comprises support means for the strip steel, which in this embodiment are realized in the form of rotatable support wheels. The support means comprise a first support wheel 62, which supports the strip steel 19 at a first machining position A, where the first grinding unit 21 machines the strip steel 19, and a second support wheel 72 for the strip steel at a second support position B, where the second grinding unit 41 machines the strip steel 19.

The grinding device 6 comprises strip-steel guidance means which define a path for the strip steel 19 between the first support wheel 62 and the second support wheel 72. The strip-steel guidance means are designed to adapt the length of the path in such a manner that the first and second grinding units 21, 41 can machine the strip steel 19 simultaneously. The grinding device 6 will now be explained in more detail, also with reference to Figures 3, 4 and 5.

The first and second grinding units 21, 41 each comprise a bearing support, 23, 43, respectively, which is fixed to the frame 20 of the grinding device 6 and has a horizontal bearing shaft 25, 45, respectively, which is mounted rotatably and without axial play therein via high-quality bearings 24, 44, respectively. Each bearing shaft 25, 45 has a substantial thickness, in order to counteract undesirable deformation. A disc-like carrier 26, 46 is arranged at one end of each bearing shaft 25, 45, with a plurality of, in this example six, attachment locations distributed regularly around its circumference and at an equal, fixed distance from the axis of rotation of the associated bearing shaft 25, 45; each of these attachment locations holds a high-speed grinding-wheel motor 27, 47, which is driven electrically or pneumatically, for example, and has a rotating grinding-wheel axle 28, 48, respectively. A separate drive 29, 49 is provided for driving each bearing shaft 25, 45 in rotation. Thus each of the bearing shafts, together with the associated carrier and the associated drive, forms a turret for a plurality of grinding-wheel axles.

The grinding-wheel axles 28, 48 of the grinding-wheel motors 27, 47 lie parallel to the associated bearing shaft 25, 45 and, on rotation of the bearing shaft 25, 45, move along a circular path around the bearing shaft 25, 45, as can be seen in particular from Figures 3 and 4.

In this example, a single grinding wheel 30, 50 is arranged removably on each grinding-wheel axle 27, 47. Each grinding wheel 30, 50 is provided on its outer circumferential edge with a suitable grinding profile. The grinding wheels 30, 50 which are associated with each of the grinding units 21, 41, with regard to their grinding profile, have accurately the same dimensions and grinding profile; in practice, these dimensions preferably lie within a range of at most one hundredth of a millimetre. Furthermore, the grinding profiles of the grinding wheels 30, 50 associated with a grinding unit 21, 41 lie accurately in one common vertical plane.

In a variant which is not shown, it is possible to provide a common drive for the grinding-wheel axles associated with a grinding unit.

A support wheel 62, 72 for the strip steel 19, which support wheel is mounted such that it can rotate about an associated axle and around which wheel the strip steel 19 lies, is situated inside the circular path of grinding-wheel axles 27, 47 of each of the grinding units 21, 41. Each support wheel 62, 72 as an outwardly projecting shoulder for supporting the bottom edge of the strip steel 19 and, above this, a cylindrical support face against which one of the side edges of the strip steel 19 bears. The cylindrical support face ends at a distance below the top edge of the strip steel 19, so that the grinding wheels 30, 50 do not come into contact with the support wheels 62, 72 in question. This design of the support wheels 62, 72 can be seen in particular from Figure 5, the support wheel having a diameter of approximately 0.2 metre; in this figure, the strip steel around the wheel can be seen only as a thin vertical line.

Each of the support wheels 62, 72 is disposed in such a way that the upper edge region of the strip steel 19, where the teeth are being provided, can be moved into the path of the grinding wheels 30, 50 which are rotating about the associated bearing shaft 25, 45, so that the grinding wheels 30, 50 can machine the strip steel at the corresponding machining position A, B. The grinding wheels are free of the blade at every position along the path apart from at the machining position.

Since the grinding-wheel axles 27, 47 run through a fixed, circular path with respect to the frame 20 of the grinding device 6, there is provision for each support wheel 62, 72 to be adjustable with respect to the circular path of the associated grinding-wheel axles 27, 47. For this purpose, the rotation axle of each support wheel 62, 72 is arranged on a carriage, respectively a first carriage 64 associated with the first grinding unit 21 and a second carriage 74 associated with the second grinding unit 41, which carriages can be displaced horizontally and adjusted vertically with respect to the frame 20 of the grinding device 6.

The first carriage 64 bears the vertical rotation axle of the first support wheel 62 and, furthermore, a first guide wheel 65 for the strip steel 19, which guide wheel can rotate freely about an axle which is vertical with respect to the first carriage 64. On either side of the machining position A, the strip steel 19 preferably bears against the support wheel 62 through an angle of at least 45°, and the same applies to the situation at machining position B. By means of the stress in the strip steel 19 and the curvature in the strip steel 19 at the location of a machining position A, B, the strip steel 19, which is per se thin and flexible, is supported stably and is not subject to any undesirable deformation during grinding.

The support wheel 72 which is associated with the second grinding unit 41 is arranged on the second carriage 74, which is arranged on the frame 20 of the grinding device 6 in such a manner that it can be displaced horizontally and adjusted vertically independently of the first carriage 64. Furthermore, a second guide wheel 66, a third guide wheel 67 and a fourth guide wheel 75 are arranged on the second carriage 74, which guide wheels can each rotate about a vertical axle which is fixed with respect to the second carriage 74.

The grinding device 6 furthermore comprises a fifth guide wheel 80 for the strip steel 19, which fifth guide wheel 80 is arranged movably for the purpose of accurately adjusting the length of the path for the strip steel 19 between the first machining position A and the second machining position B. This adjustment possibility is provided in order to enable the strip steel 19, while the strip steel 19 is at a standstill, to be ground simultaneously at both machining positions A, B. In that case, the length between the two machining positions A, B must precisely correspond to the distance between the teeth to be machined. In the embodiment shown, there is provision for the fifth guide wheel 80 to be displaceable with respect to the frame 20 of the grinding device 6 by means of an associated linear actuator 81.

To produce a cutting blade with scalloped teeth, which is a generally known and widely occurring shape of tooth for cutting blades for bread-cutting machines, the blanking tool 6 punches a part, which is preferably in the form of a segment of a circle, out of the top area of the strip steel 19, as illustrated in Figure 6a. The pitch of the teeth is in this example half an inch. The grinding device 6 then carries out a grinding operation on both sides of the strip steel 19, which grinding operation produces a cutting edge 19a which has scallops and is located accurately in the centre plane of the cutting blade and also produces, on each side of the cutting blade, a surface 19b which is ground at an angle and runs from the cutting edge 19a towards the associated side, as shown in Figure 6b. The mutually opposite bevels 19b are completely symmetrical with respect to the centre plane of the cutting blade. Obviously, the installation is also suitable for producing other tooth shapes, for example with a semi-elliptical or substantially V-shaped or U-shaped recess between two adjacent tooth points.

To obtain the teeth shown in Figure 6 and described above, all the grinding wheels 30, 50 have a grinding profile which, in cross-section in a plane comprising the grinding-wheel axle 27, 47, virtually corresponds to a radius of curvature R about a curvature centre point which lies on the line intersecting the plane of section and the centre plane of the grinding wheel. This is illustrated in Figure 7.

To produce the tooth shape shown, the rotation axle of each of the support wheels 62, 72 of the grinding device 6 lies accurately in the common centre plane of the grinding wheels 30, 50 associated with the grinding unit 21, 41 in question.

In Figure 4, it is indicated by arrows that the direction of rotation of the grinding wheels 50 is such that the grinding force exerted by the grinding wheels 50 presses the bottom edge of the strip steel 19 against the shoulder face of the support wheel 72. The direction of movement of the grinding-wheel axles 47 along the common circular path is opposite to this and therefore, at the machining position B, runs in the direction from the bottom edge of the strip steel 19 towards the top edge. Owing to the high rotational speed of the grinding wheels 50, for example 10,000 revolutions per minute, the effective force on the strip steel 19 is in the direction of the shoulder face of the support wheel 72. The above-described direction of movement of the grinding wheels 50 about the bearing shaft 45 has the advantage that the grinding wheels 50, at the start of grinding, firstly run up against the side of the strip steel 19 and not on to the narrow top edge, which would be the case if the direction of movement of the grinding wheels 50 about the bearing shaft 45 were reversed. In the case of the first grinding unit 21, the direction of rotation of the grinding wheels 30 and the rotation of the bearing shaft 25 are likewise in the same direction. However, opposite directions of rotation of the bearing shaft and the grinding wheels are also possible and, under different production circumstances, may be more advantageous. In a variant of the grinding device 6 which is not shown, the path of a set of grinding wheels could also be other than circular, for example elliptical.

The grinding device 6 is preferably designed in such a way that the bearing shaft 25, 45 of each of the grinding units 21, 41 rotates continuously at a constant speed, for example 25 revolutions per minute. Preferably, in this case, the grinding operation for producing a single bevel 19b on one side of the strip steel 19 is realized by means of one grinding wheel which moves past the machining position in question, after which the conveyor station 8 of the installation, after the said one grinding wheel has moved past, conveys the strip steel 19 further by one step, which corresponds to the length of the pitch between the teeth, and then comes to a standstill, so that the next grinding wheel can grind the following bevel 19b. This means that the conveyance of the strip steel 19 must be accurately synchronized with the movement of the grinding wheels 30, 50 past the machining positions A, B. With a rotational speed of the bearing shafts 25, 45 of 25 revolutions per minute and six grinding wheels 30, 50 per grinding unit 21, 41, it is possible to grind 150 teeth per minute.

In a variant of the grinding device 6 which is not shown, each bevel 19b could be produced by a set of two or more grinding wheels of the same grinding unit which follow one another in the path of the turret and have different grinding profiles. In this case, the strip steel would only be conveyed onwards after all the grinding wheels of the set in question have moved past. Obviously, it is also possible to arrange a plurality of grinding units on one side of the strip steel, each with their own set of grinding wheels.

As is known, a considerable amount of heat is produced when grinding steel. For a number of reasons, this heat has to be dissipated. Firstly, an excessive temperature of the strip steel 19 leads to a loss in strip steel quality, and in particular the structure of the steel obtained by hardening can be lost, with the result that the cutting blades wear quickly on use. Furthermore, a high temperature is disadvantageous for the service life of the grinding profiles of the grinding wheels 30, 50, and the dimensional accuracy of the grinding wheels 30, 50 is also adversely affected. Finally, the build-up of heat in the grinding device 6 can lead to thermal deformation, which has an adverse effect on the accuracy of the grinding process.

In the case of the grinding device 6, the grinding wheels 30, 50 are not in contact with the strip steel 19 over a large part of their orbit about the bearing shaft 25, 45, and effective cooling can take place. This cooling is preferably realized by spraying high-pressure jets of cooled oil on to the grinding wheels 30, 50. The oil pressure is preferably higher than 10 bar, in order in this way to break up the dynamic layer of air which forms around the rapidly rotating grinding wheels 30, 50.
Advantageously, the oil is cooled to a temperature of less than 10°C, preferably to approximately 5°C. The oil which is sprayed on to the grinding wheels 30, 50 is circulated via a filter, in which the metal particles are removed firstly magnetically and then using a centrifuge, and a cooling device which is located downstream of the said filter. The oil also flows over the other parts of the grinding device 6, so that those parts of the grinding device 6 which are relevant to the accuracy of the grinding process do not undergo any temperature fluctuations.

The grinding device 6 described can be used to achieve a very high accuracy of the desired shape of tooth. In particular, it is possible for the ground, inclined surfaces 19b to intersect one another precisely in the centre plane of the cutting blade and for the said ground surfaces 19b to be exactly symmetrical with respect to the said centre plane. This symmetry is of considerable importance, since otherwise the cutting blades are subjected to a higher lateral load in one direction while cutting a product, for example bread, and as a result will bend laterally, leading to an oscillating motion of the cutting blades with respect to the product to be cut and, possibly, to excess wear to and breakage of the cutting blades.

In a variant of the device according to the invention which is shown diagrammatically in Figure 8, there is provision for a single support wheel to be replaced by two adjacent wheels 100, 101, the strip steel 19 lying around the two wheels 100, 101. If the support wheels 100 and 101 each have a diameter of 0.1 metre, the space required is approximately equal to a single support wheel of 0.2 metre as described above. In this case, there is furthermore provision for a plurality of grinding wheels 103 to be arranged on each grinding-wheel axle 102, which grinding wheels simultaneously grind a plurality of teeth in the straight piece of the strip steel 19 between the two support wheels 100, 101. If appropriate, this straight piece of strip steel 19 may be supported by an anvil block 105. This variant with two grinding wheels per grinding-wheel axle is suitable in particular if the installation described is to be used to produce cutting blades with a tooth pitch of 1/4 inch. In this case, the production capacity remains equal to the production capacity described above for cutting blades with a tooth pitch of half an inch. To produce cutting blades with a tooth pitch of 1/8 inch, four grinding wheels may be arranged on a single grinding-wheel axle.

Figure 9 diagrammatically shows the layout of a preferred embodiment of the conveyer means of the conveyor station 8 which conveys the strip steel 19 in steps. The conveyor means comprise two substantially identical threaded-spindle mechanisms 90, 91, each with a threaded spindle 92, 93 which is disposed parallel to the path of the strip steel 19. A nut 94, 95 is arranged on each threaded spindle 92, 93, which nut can be moved to and fro by rotating the threaded spindle. An electronically actuable hydraulic clamp 96 is arranged on each nut 94, 95 for the purpose of clamping the strip steel 19 in place. An electric stepper motor 97, 98 for rotating the threaded spindle in a stepwise manner is provided for each threaded spindle 92, 93. The conveyor station 8 furthermore comprises control means 99, which are designed to convey the strip steel 19 using one of the two threaded-spindle mechanisms 90, 91, while, in the meantime, the clamp of the other threaded-spindle mechanism moves counter to the direction of transport of the strip steel, towards a position where it takes hold of the strip steel 19 and receives it after it has been conveyed. These conveyor means 8 are able to bring about a highly frequent stepwise conveyance of the strip steel with a very uniform step length, all this taking place synchronously with the action of the grinding device 6 and the blanking device 5.

The blade-conveying means therefore comprise a first threaded-spindle mechanism, with at least one threaded spindle disposed parallel to the path of the blade, a blade clamp for holding the blade in place being connected to the threaded spindle and a motor being provided for the purpose of rotating the threaded spindle in steps.

In the drawing, the blade-conveying means furthermore comprise a second threaded-spindle mechanism, which is substantially identical to the first threaded spindle, the blade-conveying means being designed to convey the blade using one of the two threaded-spindle mechanisms, while, in the meantime, the other threaded-spindle mechanism moves counter to the direction of transport of the blade, towards a position where it can take hold of the blade and convey it onwards.

In a variant of the grinding device which is not shown, there is provision for a profiling and conditioning device to be disposed in the region of each grinding unit, by means of which device the grinding wheels of the said grinding unit can be regularly profiled and then conditioned without the grinding wheels having to be removed from their grinding-wheel axle for this purpose.

The installation described can be used to produce toothed cutting blades and the like with a minimal deployment of personnel and with a high production capacity. These cutting blades therefore have a low cost price. Furthermore, the accuracy with which the teeth are provided and the optimum grinding conditions lead to a high quality of the cutting blades, which are characterized by a long service life.

Claims

1. Device for providing ground teeth on an elongate blade, in particular on strip steel, comprising:

   - a frame,
   - a first grinding unit, which is supported by the frame, which first grinding unit comprises a plurality of grinding-wheel axles which can be driven in rotation, each for holding at least one grinding wheel, as well as grinding-wheel drive means for driving the grinding-wheel axles,
   - the first grinding unit furthermore comprising a turret for the grinding-wheel axles, which turret defines a common loop-shaped path for the grinding-wheel axles and furthermore comprises turret drive means for moving the grinding-wheel axles along the path,
   - blade-support means which comprise a first blade support for supporting the blade at a first machining position,
   - the path defined by the turret being such that the grinding wheels successively move past the first machining position for grinding the blade.

2. Device according to claim 1, in which the blade-support means comprise a second blade support for supporting the blade at a second machining position and the device comprises a second grinding unit of the same type as the first grinding unit, the path of the second grinding unit being such that the grinding wheels successively move past the second machining position.

3. Device according to claim 2, in which the first machining position and the second machining position

lie on opposite sides of the blade.

4. Device according to one or more of the preceding claims, in which the device is provided with blade-conveying means for conveying the blade in steps past the at least one machining position.

5. Device according to claim 2, in which the path of the grinding wheels of each of the grinding units is fixed with respect to the frame, and in which blade-guiding means are provided between the first blade support and the second blade support, which blade-guiding means form a path for the blade and are designed to adapt the length of the path.

6. Device according to claim 5, in which the turret drive means are designed to effect a continuous movement of the grinding-wheel axles along the path, and in which the blade-conveying means are designed to convey the blade during the period in which there is no grinding wheel present at a machining position.

7. Device according to claim 5, in which a blade support is separately adjustable with respect to the associated path of the grinding wheels, for the purpose of adjusting the grinding action of the grinding wheels which move past the blade support in question.

8. Device according to one or more of the preceding claims, in which a machining position is situated inside the path of the grinding wheels which is defined by the turret.

9. Device according to one or more of the preceding claims, in which a blade support comprises a support wheel which can rotate about an associated axis of rotation and the outer circumference of which is designed to support a blade which lies over part of the outer circumference.

10. Device according to claim 9, in which a blade support comprises two support wheels which are situated next to one another and are disposed in such a manner that the blade lies around both support wheels and the path of the grinding wheels is situated at the location of the straight part of the blade between the two support wheels.

11. Device according to one or more of the preceding claims, in which a separate drive means is provided for each of the grinding-wheel axles.

12. Device according to one or more of the preceding claims, in which the grinding-wheel drive means are designed to drive the grinding-wheel axles in rotation in a direction opposite to the direction of movement of the grinding-wheel axles along the path.

13. Device according to one or more of the preceding claims, in which the turret comprises a bearing shaft which is mounted at a fixed position in such a manner that it can rotate with respect to the frame, and a grinding-wheel carrier which is attached to the bearing shaft and bears the grinding-wheel axles parallel to one another and at a uniform distance around the bearing shaft, so that the loop-shaped path of the grinding-wheel axles is a circle.

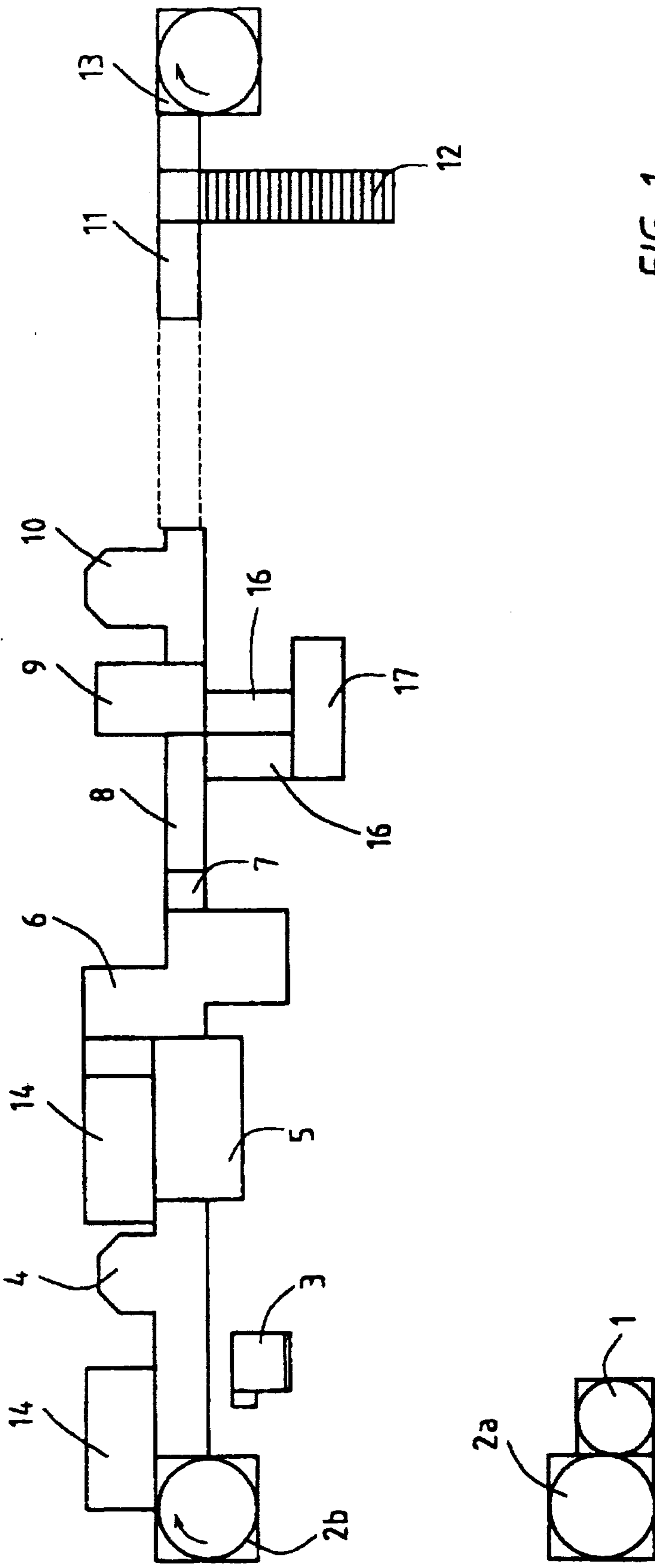

FIG. 1.

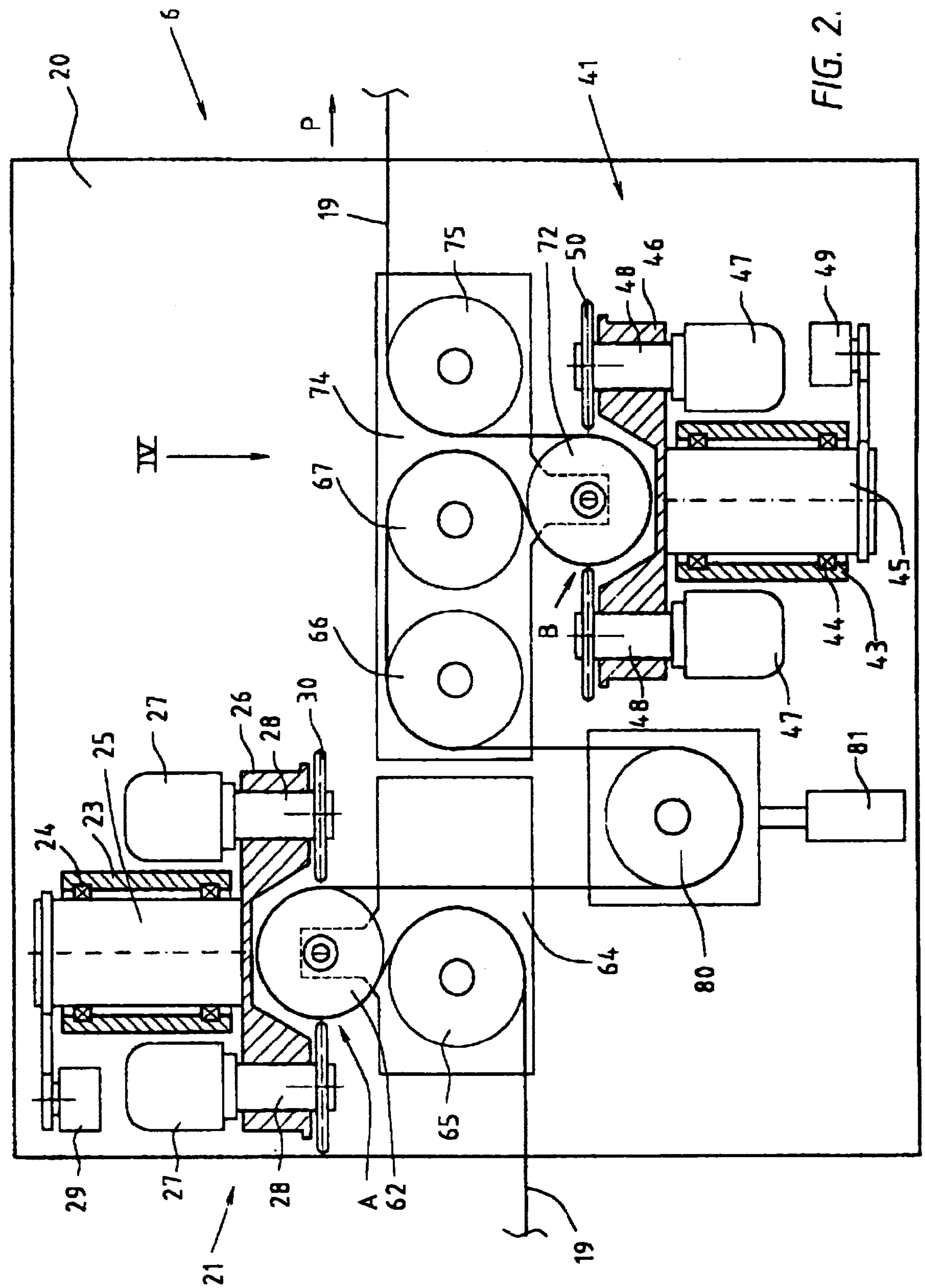
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FIG. 2.

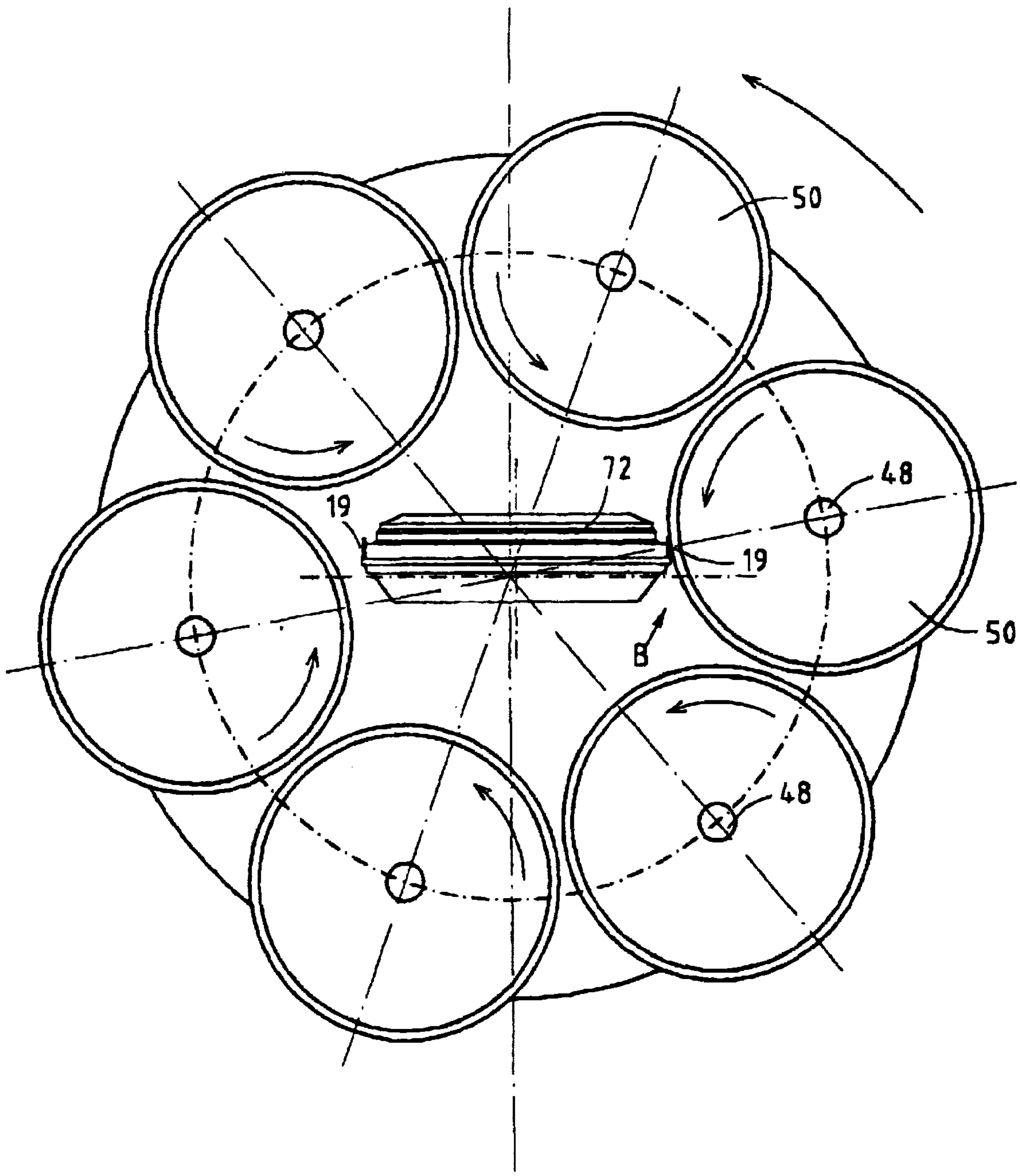

FIG. 4.

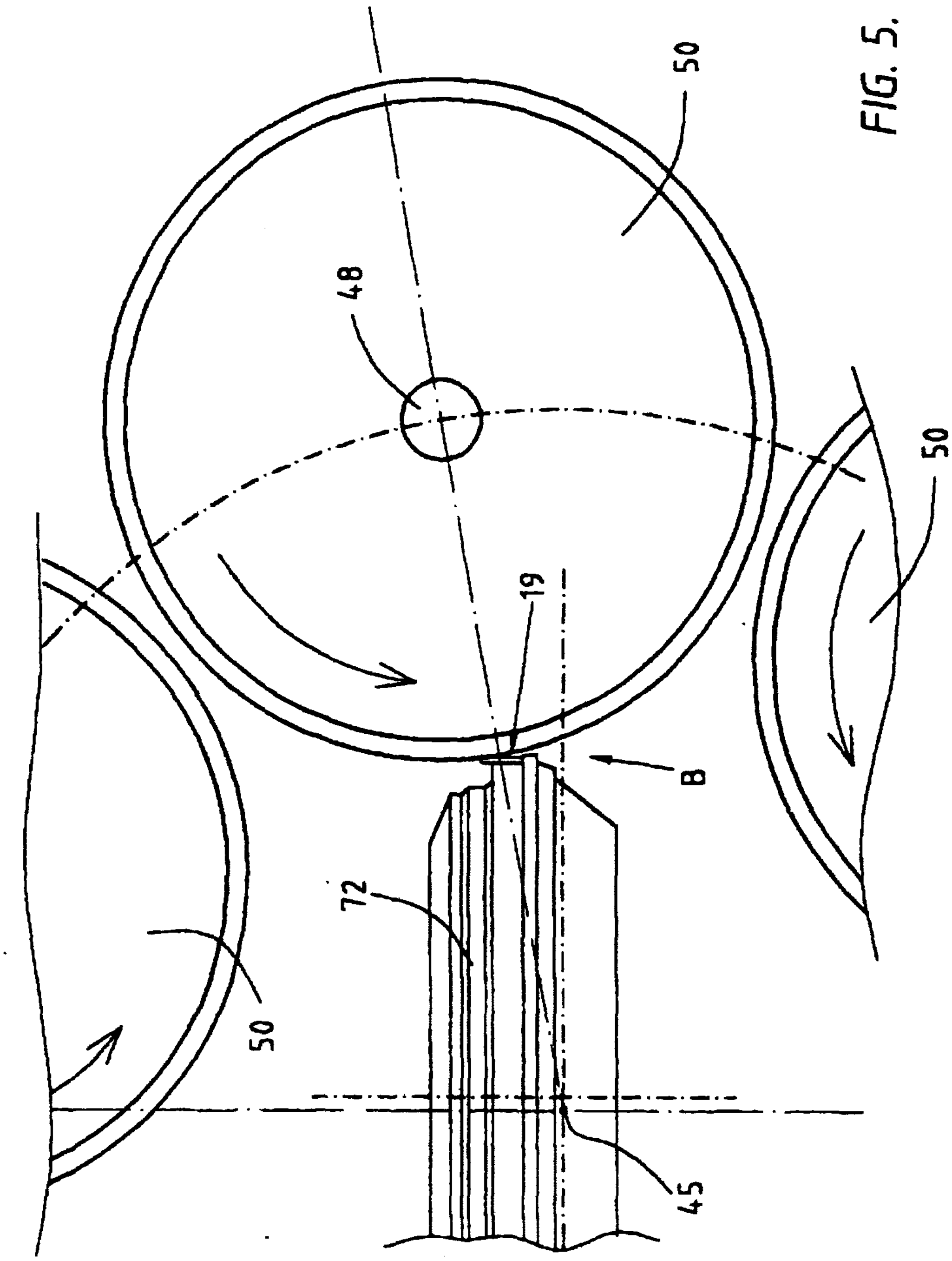

FIG. 5.

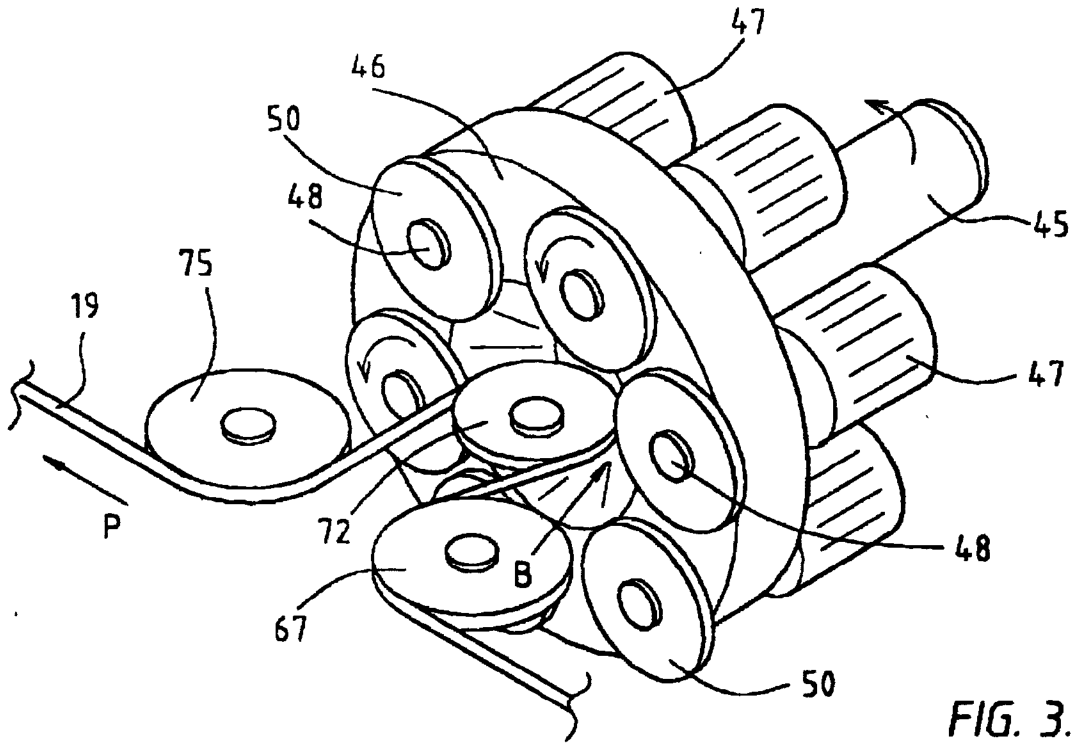

FIG. 3.

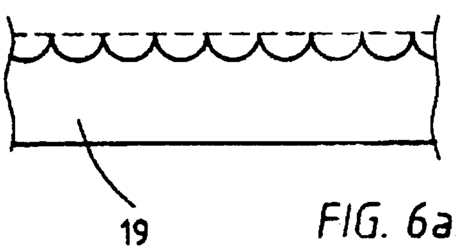

FIG. 6a.

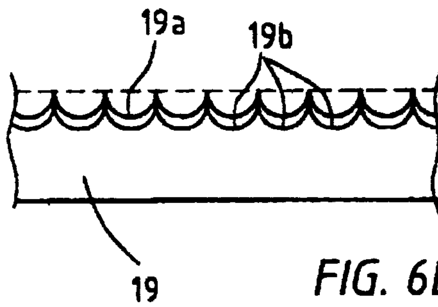

FIG. 6b.

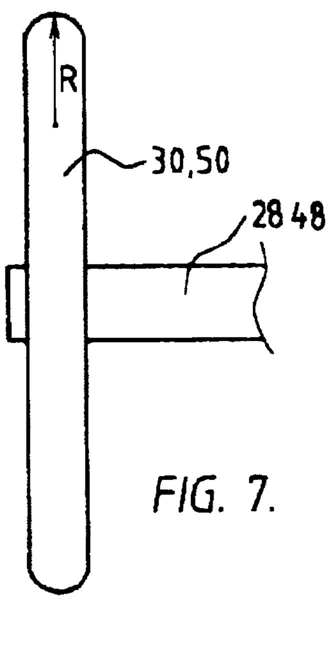

FIG. 7.

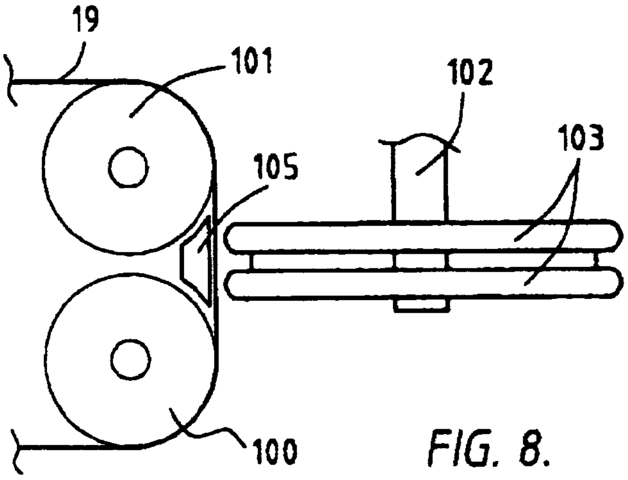

FIG. 8.

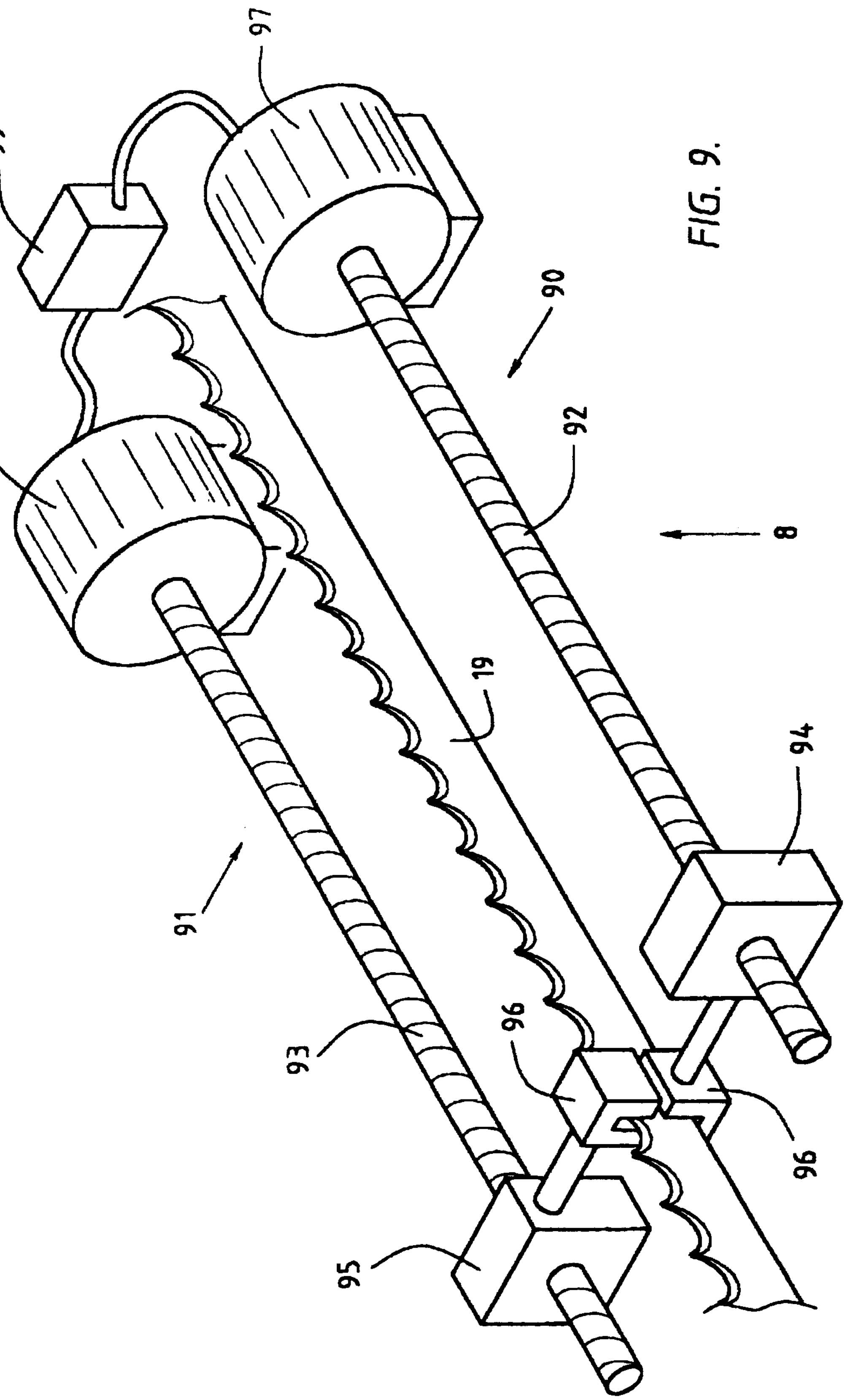

FIG. 9.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 20 2107

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,A	US 3 859 762 A (LUDWIG CLARENCE H) 14 January 1975 * column 5, line 3 - line 23 * ---	1	B24B3/58 B24B27/00
A	US 2 580 778 A (J. HEXTER ET AL.) 1 January 1952 * column 1, line 29 - column 2, line 8; figures 1,2 * -----	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
B24B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	9 October 1998	Eschbach, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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