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(54) **A power transmission device for feed wheels as used in automatic machines, and in through feed moulders for woodworking in particular.**

(57) The device comprises a first shaft (8) disposed parallel with the axis of the feed wheel (5), which also provides the pivot for a rocker (9) fashioned as a yoke and is keyed coaxially to a worm wheel (10, 110) rotating internally of and supported by a housing (11, 111), and a second shaft (12), which incorporates a worm profile in mesh with the wheel (10, 110) and is coupled to a motor (7) in such a manner as to set the first shaft (8) in rotation; drive is transmitted from the first shaft (8) to a parallel third shaft (15), carrying the keyed feed wheel (5), through an idle gear (16) supported in a central position by the yoke (9) and meshing with corresponding gears (8a, 15a) afforded by the two interconnected shafts. The resulting train has the advantage of eliminating any jerkiness that could be transmitted through the three shafts.

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The present invention relates to a device by means of which to transmit power to through feed wheels as used in automatic machinery, and more especially in through feed moulders.

The art field of automatic woodworking machinery embraces a number of devices for transmitting drive to the friction wheels of through feed machines. Automatic machines of the type in question are equipped conventionally with a system by which the work is transferred from one machining station to the next, propelled along a horizontal bed by feed wheels that are disposed transversely to the bed and variable for angle and height in relation to the horizontal surface to accommodate different thicknesses of work.

Each wheel is keyed onto a supporting shaft coupled to a drive system, and thus rotates together with the shaft. The coupling between the single shaft and the drive system is effected in most instances adopting one of two devices accommodated by a back rail disposed parallel with and to the rear of the horizontal bed. A first such device consists in a yoke associated coaxially with the support shaft and coupled at the end farthest from the wheel to a universal constant velocity joint that allows the variations in height of the feed wheel above the horizontal bed and connects the supporting shaft to the low speed shaft of a speed reducer. The speed reducer will consist in a conventional train of cylindrical or worm gears, and is connected on the input side to a drive motor.

The speed reducer serves to adapt the high angular velocity at the output of the drive motor to the low speed requirement of the feed wheels. The yoke is also hinged to a vertically disposed pneumatic cylinder, through which pressure is applied to the supporting shaft in order to keep the feed wheel permanently and firmly in contact with the work. The second device is similar in structure to the first, but dissimilar as regards the type of power transmission adopted. In this instance, drive is transmitted to the feed wheels by a single chain positioned to the rear of the wheels, which extends parallel to the horizontal bed and is connected to the speed reducer of each feed wheel. The coupling in this system consists in two universal joints, synchronized one with the other and interconnected by a flexible element that permits the transmission of drive from the chain to the supporting shaft while allowing variations in angle to accommodate the passage of the work.

Whilst reflecting the feed drive arrangements most widely adopted for through feed moulders, devices of the type thus outlined betray certain drawbacks, from engineering and cost standpoints alike. The first device is encountered normally in automatic machines constructed to high output and efficiency specifications, as drive can be transmitted from the speed reducer to the supporting shaft without subjecting the feed wheel to sudden acceleration (for example, due to the gear geometry of the speed reducer), any jerkiness being absorbed through the splined coupling of the constant velocity joint. Thus, one has a high efficiency power transmission, but also a high capital outlay and in consequence a restricted market.

The second device is certainly the more economic option, and may be found incorporated into machines of more modest specifications, given its relatively lower efficiency and shorter working life. A chain drive is the poorer option in engineering terms however, as a higher drive ratio is required to give the correct angular velocity at the support shaft, hence a greater number of speed reductions; moreover, chain drive is not always acceptable to the users of such machinery.

Accordingly, the object of the present invention is to overcome the drawbacks mentioned above through the adoption of a device that affords economy, and at the same time ensures high operating efficiency by virtue of the engineering expedient adopted in embodiment of the element that ultimately supports the feed wheel, which ensures that no unnecessary torque is transmitted to the wheel.

The stated object is fully realized in a device as characterized in the appended claims

Such a device essentially comprises a first drive transmission shaft disposed parallel to the axis of a feed wheel and rotatably supporting a yoke; this shaft is keyed coaxially to a worm wheel rotating internally of a support housing and in mesh with a second transmission shaft that incorporates a worm profile and is coupled mechanically to driving means in such a way as to permit of transmitting rotation from the driving means to the first shaft; the feed wheel is keyed to a third shaft disposed parallel with the first, which thus supports and transmits drive ultimately to the wheel. The device further comprises an idle gear supported centrally in the yoke, positioned between and meshing with corresponding gears afforded by the first and the third shafts in such a way as to transmit rotation from the first to the third shaft while creating a mechanical linkage such as will eliminate vector forces acting on the two shafts.

One of the advantages afforded by the invention consists essentially in the fact that the structure and arrangement of the components by which power is transmitted from the drive motor to the feed wheel are such as to provide the user of the machine with a high transmission ratio, thus giving high torque values at high speeds; this is attributable mainly to the worm gear pair (worm drives are capable of notably high transmission ratios), but also to the idle gear, which eliminates any rotational forces deriving from sudden acceleration

that often affect drive shafts, the result being to produce a machine of high operating efficiency.

The invention will now be described in detail, by way of example, with the aid of the accompanying drawings, in which:

- fig 1 illustrates a feed station in a through feed moulder incorporating the device according to the invention, viewed in perspective from above with certain parts omitted better to reveal others;
- fig 2 is the section through II-II, fig 1;
- fig 3 is the section through III-III, fig 1;
- fig 4 is a frontal elevation showing a feed wheel associated with the device of fig 1, with certain parts omitted better to reveal others and with the addition of a further constructional feature;
- fig 5 illustrates an alternative embodiment of the device according to the invention, shown in frontal elevation and with certain parts omitted better to reveal others;
- fig 6 shows the device of fig 5 in side elevation with certain parts omitted better to reveal others. Referring to the drawings, the power transmission device disclosed is designed for use in automatic machines such as are employed for woodworking, and in particular a through feed moulder (visible in part in fig 1), of the type comprising at least one station denoted 1 in its entirety, through which workpieces 2 are fed along a horizontal bed 3, thus passing from one machining station to another.

The feed station 1 is flanked by a rail 4 extending parallel with and to the rear of the horizontal bed the purpose of which is to carry a set of wheels 5 serving to feed the work 2 horizontally along the bed 3; this same back rail 4 also carries the tools (conventional, and therefore not illustrated) by which the work 2 is machined at further stations of the moulder.

The feed wheels 5 are disposed transversely with respect to the horizontal bed 3 and associated each with means, denoted 6 in their entirety, by which rotation originating at driving means 7 installed behind the rail 4 is transmitted to the wheels 5; such means 6 are accommodated for the most part within or beneath the back rail 4.

Transmission means 6 comprise a first cylindrical shaft 8 (fig 2), disposed parallel to the axis of the feed wheel 5 and rotatably supporting a yoke 9 at two journal points, of which the end positioned farthest from the horizontal bed 3 carries a keyed worm wheel 10 accommodated internally of a support housing 11; to advantage, the housing will be of substantially arched embodiment (see figs 1 and 2) to the end of supporting the first shaft 8 with maximum rigidity.

12 denotes a second transmission shaft accommodated partly by the support housing 11 (figs 2 and 3), which incorporates a worm profile in mesh with the worm wheel 10 of the first transmission shaft 8; in the example of figs 2 and 3, the worm shaft 12 is disposed vertically with one end (the topmost end) projecting from the support housing 11 and carrying two coaxial keyed pulleys 13a and 13b.

14a and 14b denote two belt loops passed around the respective pulleys 13a and 13b, of which the first also passes around an expanding pulley 20 keyed to the driving means 7 behind the back rail 4 and the second around the corresponding pulley of a further second shaft constituting part of the transmission means 6 for a successive feed wheel; in this way, drive is relayed to all the wheels 5 constituting the feed station 1 (as discernible from fig 1).

The feed wheel 5 is keyed to and rotatable about the axis of a third shaft 15, carried by the yoke 9 in a position parallel to the first shaft 8 (see fig 2), which is coupled to and driven from the first shaft 8 by way of an idle gear 16 supported rotatably by the yoke 9 in a substantially central position, between the two shafts 8 and 15; meshing contact occurs by way of gears 8a and 15a keyed to the respective shafts in alignment with the idle gear 16. With this arrangement, the first and third shafts 8 and 15 are caused to rotate in the same direction, and the resulting mechanical linkage is capable of eliminating unwanted rotational forces transmitted through the assembly 6.

As shown in fig 4, the device further comprises means denoted 17 in their entirety, by which to select a degree of rocking movement allowed to the yoke 9 about the axis of the first shaft 8 (see arrow F) during passage of the work 2 beneath the feed wheel 5. More exactly, such means 17 comprise a bifurcated pin projecting toward the back rail 4 and associated with the part of the yoke 9 occupied by the first shaft 8, which serves to establish the lower limit of the arc of rotation allowed to the yoke 9, and a second pin 21, located alongside the bifurcated pin 17 and nearer to the outermost end of the first shaft 8, extending likewise toward the rail 4, which is set at angle and height different to those of the bifurcated pin 17 (in relation to the horizontal bed 3), and positioned to enter into contact with the bottom face of the back rail 4, thereby establishing the upper limit of the arc of rotation allowed to the yoke 9.

18 denotes means fixed to the support housing 11, by which to adjust the travel limit of the yoke 9; in the example of fig 4, such means 18 appear as a fixed horizontal screw 22 of which the projecting thread end is freely accommodated by the bifurcated pin 17. The screw 22 carries a threaded

collar 23 that permits of selecting an exact setting for the lower limit of the rotation allowed to the yoke 9. In practice therefore, the bifurcated pin 17 serves to determine a maximum descent angle of the yoke 9 in relation to the horizontal bed 3, by striking against the stop collar 23, while the second pin 21 establishes a maximum ascent angle by striking against the rail 4.

Still in fig 4 of the drawings, 19 denotes a small, vertically disposed hydraulic cylinder rigidly associated with the support housing 11, of which the reciprocating end impinges on the part of the yoke 9 occupied by the third shaft 15 (a trunnion type connection might also be used if appropriate). The cylinder 19 is adjustable, and serves to keep the wheel 5 steadily in contact with the work 2 during its passage, avoiding any possible slippage (due, for example, to irregularities in the surface of the workpiece).

As discernible from the foregoing description, the operation of a device according to the invention will occur substantially in this manner: power is supplied to the driving means 7 (depicted in fig 1 as a motor mounted to the back rail 4, and keyed to its spindle, the expanding pulley 20 which permits of varying the input speed), whereupon rotation is transmitted by the belt 14a to the pulley 13a of the first worm shaft 12 (or indeed to any one of the linked worm shafts), and relayed by way of the individual linked pulleys 13a and belt loops 14b to all remaining worm shafts 12; drive is transmitted by each worm shaft 12 to the corresponding worm wheel 10 and the keyed first shaft 8, thence by way of the idle gear 16 to the third shaft 15. The feed wheel 5 is thus set in rotation, and, engaging each workpiece 2 fed forward by the wheels of preceding stations, adapts to the thickness of the wood by virtue of the angle of the yoke 9 while remaining firmly in contact with the work 2 as the result of pressure applied through the yoke by the hydraulic cylinder 19.

Sliding movement of the work 2 along the horizontal bed 3 can be optimized further by elongating the worm shaft 12 down beyond the support housing 11 and below the horizontal bed 3 to permit of meshing with a second worm wheel 10'. Thus, it becomes possible to provide a structure below the bed 3 similar to that above (as illustrated schematically by the phantom lines of fig 4), comprising yoke 9', transmission shafts 8' and 15', housing 11' and feed wheel 5', all driven synchronously by the one shaft 12. Naturally enough, the bottom yoke 9' will be subject to respective travel limiting means 17' and 21' allowing the wheel 5' a degree of rocking movement such as will ensure continuous contact with the work 2 above. Sandwiched thus between two wheels 5 and 5' in this manner, the work 2 can be effectively pinch driven along the bed 3, ensuring a steady and accurate rate of feed that can also be governed to suit subsequent machining operations. It will be observed from the foregoing description that a device structured according to the invention affords advantages of economy, together with higher performance; the adoption of a belt drive signifies the elimination of chains, and of costly and bulky gear trains, whilst the inclusion of an idle member has the effect of absorbing any sudden acceleration attributable to the operating characteristic of the high ratio worm gear pair.

In an alternative embodiment of the device shown in figs 5 and 6, the second transmission shaft or worm shaft, denoted 112, is horizontally disposed above the first shaft 8, parallel with the bed 3 and in mesh with a worm wheel 110 occupying the vertical plane directly beneath. In this instance, the worm wheel 110 is keyed coaxially to an intermediate gear 31 of smaller diameter located between and in mesh with a pair of gears denoted 110a, each keyed in turn to a relative first shaft 8; to advantage, the entire train comprising worm shaft 112, worm wheel 110, intermediate gear 31 and driven gears 110a will be accommodated internally of a removable support housing 111 carrying two first shafts 8 and two feed wheels 5.

The worm shaft 112 is fitted at its opposite ends with respective flexible couplings 32a and 32b emerging from the housing 111, which permit of connecting the shaft permanently in rotation both to the power shaft 33 of driving means 7 (e.g. a geared motor not illustrated in the drawings), and to the worm shafts 112 of successive and preceding housings 111.

The alternative embodiment thus described affords distinct mechanical advantages, in that with two ratios established by the first reduction stage (worm gear pair) and the second (intermediate gear and driven gears), one obtains high torque at the feed wheels deriving from a nonetheless relatively limited torque value at the worm gear pair, this by reason of the high input speed. Advantage is gained also from the constructional standpoint in that each housing 111, easily replaceable if need be, carries two drive shafts with two corresponding feed wheels as a modular assembly.

Claims

1. A power transmission device for feed wheels as used in automatic machinery, in particular a woodworking machine of the through feed moulder type comprising at least one feed station (1) by which work (2) is propelled along a horizontal bed (3), flanked by a back rail (4) extending parallel to the bed and supporting a

plurality of feed wheels (5) revolving about axes disposed transversely to the bed, each connected by way of means (6) located substantially within the back rail and enabling the transmission of rotation to the wheels (5) from driving means (7) positioned to the rear of the rail,
characterized
in that such transmission means (6) comprise:

- a first cylindrical shaft (8) disposed parallel to the axis of the feed wheel (5), serving to transmit rotation and rotatably supporting a yoke (9), of which the end located farthest from the horizontal bed (3) and directed toward the back rail (4) is associated with a worm wheel (10) accommodated internally of a support housing (11, 111);
- a second transmission shaft (12, 112) affording a worm profile in mesh with the worm wheel (10, 110), accommodated substantially within the support housing (11, 111) and coupled mechanically to the driving means (7) in such a way as to permit of transmitting rotation from the driving means to the first cylindrical shaft (8) at a high ratio of speed reduction;
- a third cylindrical shaft (15) keyed to the feed wheel (5), disposed parallel to the first shaft (8) and supported by the yoke (9); and
- an idle gear (16), supported substantially in a central position by the yoke (9), located between and in mesh with gears (8a, 15a) keyed respectively to the first and third shafts (8, 15) in such a way as to permit of transmitting rotation from the first shaft (8) to the third shaft (15) by way of a train capable of cancelling out angularly generated vector forces acting on the two shafts.

2. A device as in claim 1, wherein the second shaft or worm shaft (12), in mesh with the worm wheel (10), is disposed vertically and orthogonal to the first shaft (8) with the topmost end extending upward to support at least one coaxially keyed pulley (13a) about which to loop belt means (14a) connected with the driving means (7), in such a way as to permit of transmitting rotation from the driving means to the first cylindrical shaft (8) at a high ratio of speed reduction, and a second coaxial keyed pulley (13b) about which to loop further belt means (14b) connecting with the worm shaft (12) of a successive or preceding feed wheel (5).

3. A device as in claim 1, wherein the yoke (9) is able to oscillate about the axis of the first shaft (8) in relation to the horizontal bed (3) within a given arc of rotation restricted by means (17) comprising a bifurcated pin, associated externally with the part of the yoke occupied by the first shaft (8) and projecting toward the back rail (4) in such a manner as to interact with adjustable travel limiting means (18) associated with the support housing (11), positioned in alignment with and slidably and horizontally accommodated by the bifurcated pin (17), to the end of establishing the lower limit of the arc of rotation allowed to the yoke (9).

4. A device as in claim 1, further comprising a vertically disposed hydraulic cylinder (19) mounted to the back rail (4) and impinging on the end of the yoke (9) farthest from the first shaft (8), of which the purpose is to maintain the feed wheel (5) in uninterrupted contact with the work (2).

5. A device as in claim 2, wherein the second shaft or worm shaft (12) extends externally of and beyond the support housing (11) and below the horizontal bed (3) in such a way as to mesh with a worm wheel (10') constituting a part of transmission means comprising a first shaft (8'), a third shaft (15') and a yoke (9'), substantially identical to the transmission means (6) located above the horizontal bed (3).

6. A device as in claim 3, wherein means by which to restrict the rotation of the yoke (9) further comprise a second pin (21) associated with the yoke, positioned alongside the bifurcated pin (17) and extending toward the back rail (4), which is of length such as to establish the upper limit of the arc of rotation allowed to the yoke by locating against the bottom face of the rail (4).

7. A device as in claim 1, wherein transmission means (6) comprise a second shaft or worm shaft (112) disposed orthogonal to and above the first shaft (8) and parallel to the horizontal bed (3), a worm wheel (110) in mesh with the worm shaft (112) and occupying a vertical plane, an intermediate gear (31) keyed to and coaxial with the worm wheel, and two gears (110a) positioned one on either side of the intermediate gear and keyed to two respective first shafts (8), all of which are accommodated internally of a single removable housing (111).

8. A device as in claim 7, wherein the two op-

posite ends of the second shaft or worm shaft (112) are associated with respective flexible couplings (32a, 32b) projecting from the support housing (111), by which the shaft (112) is connected to further shafts (33) constituting driving means (7) and coupled to the worm shafts (112) of successive and preceding support housings (111).

FIG1

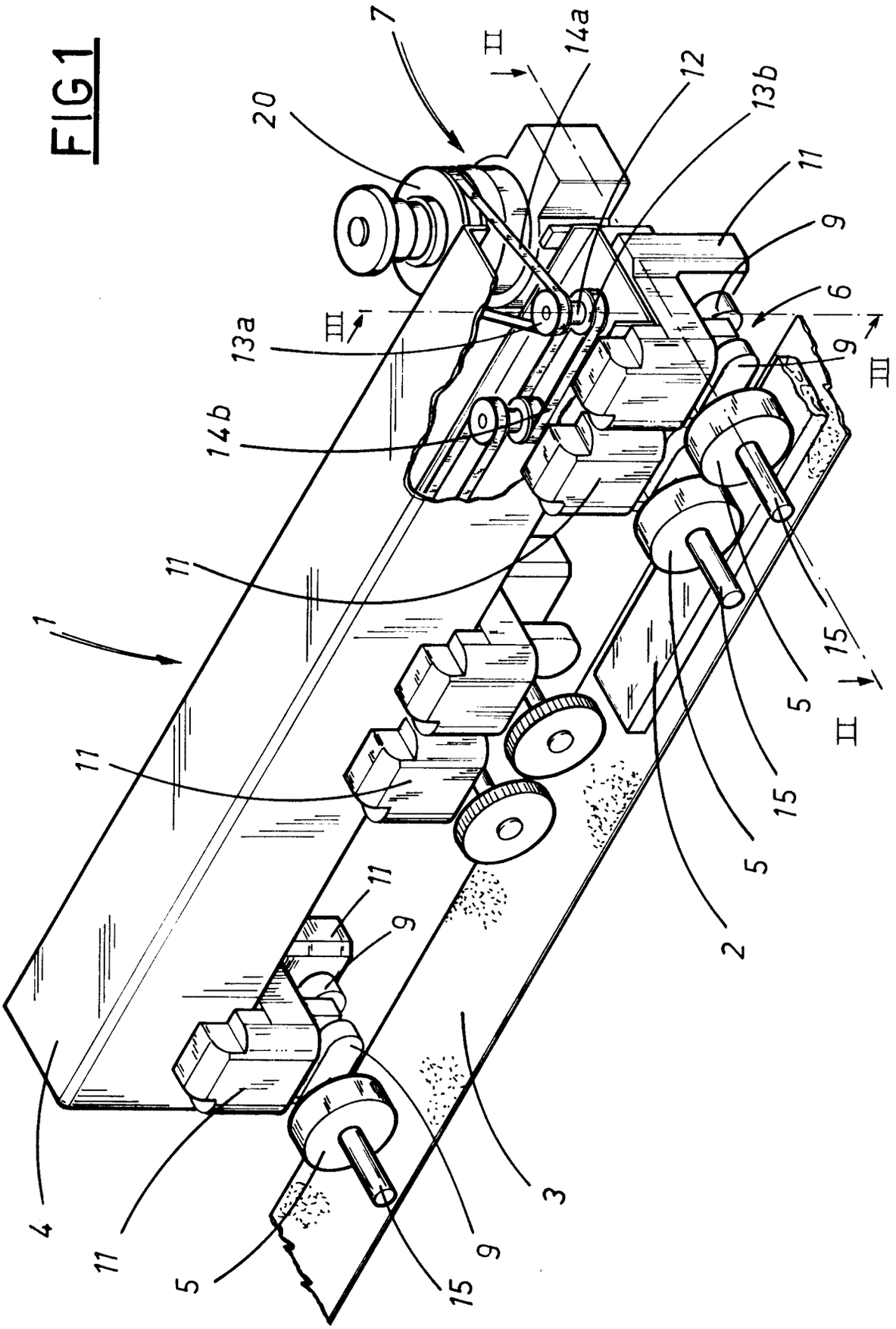
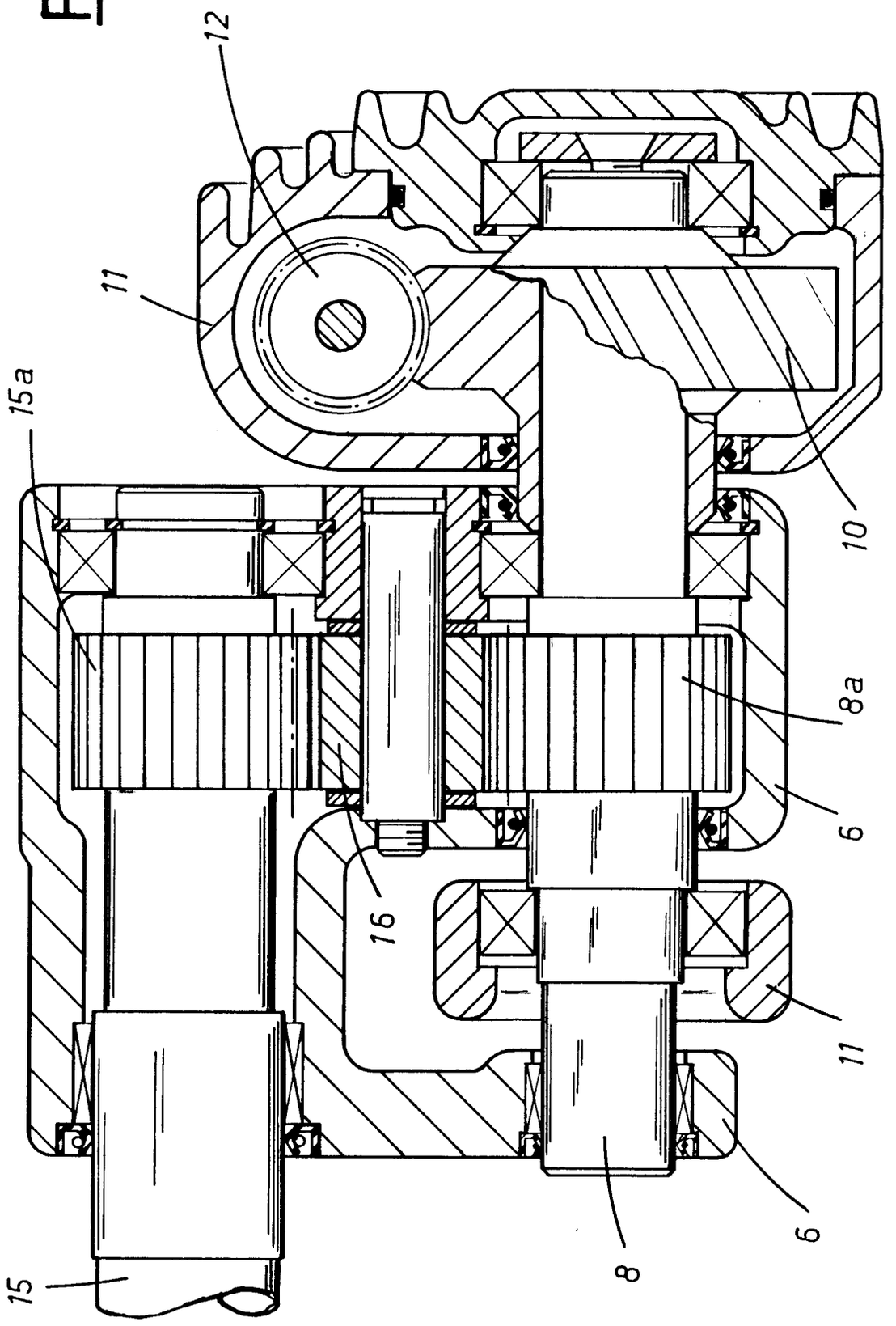

7
II
14a
12
13b
20
11
9
6
III
13a
14b
9
III
11
1
15
II
5
11
15
5
11
9
2
4
11
5
15
9
3

FIG2



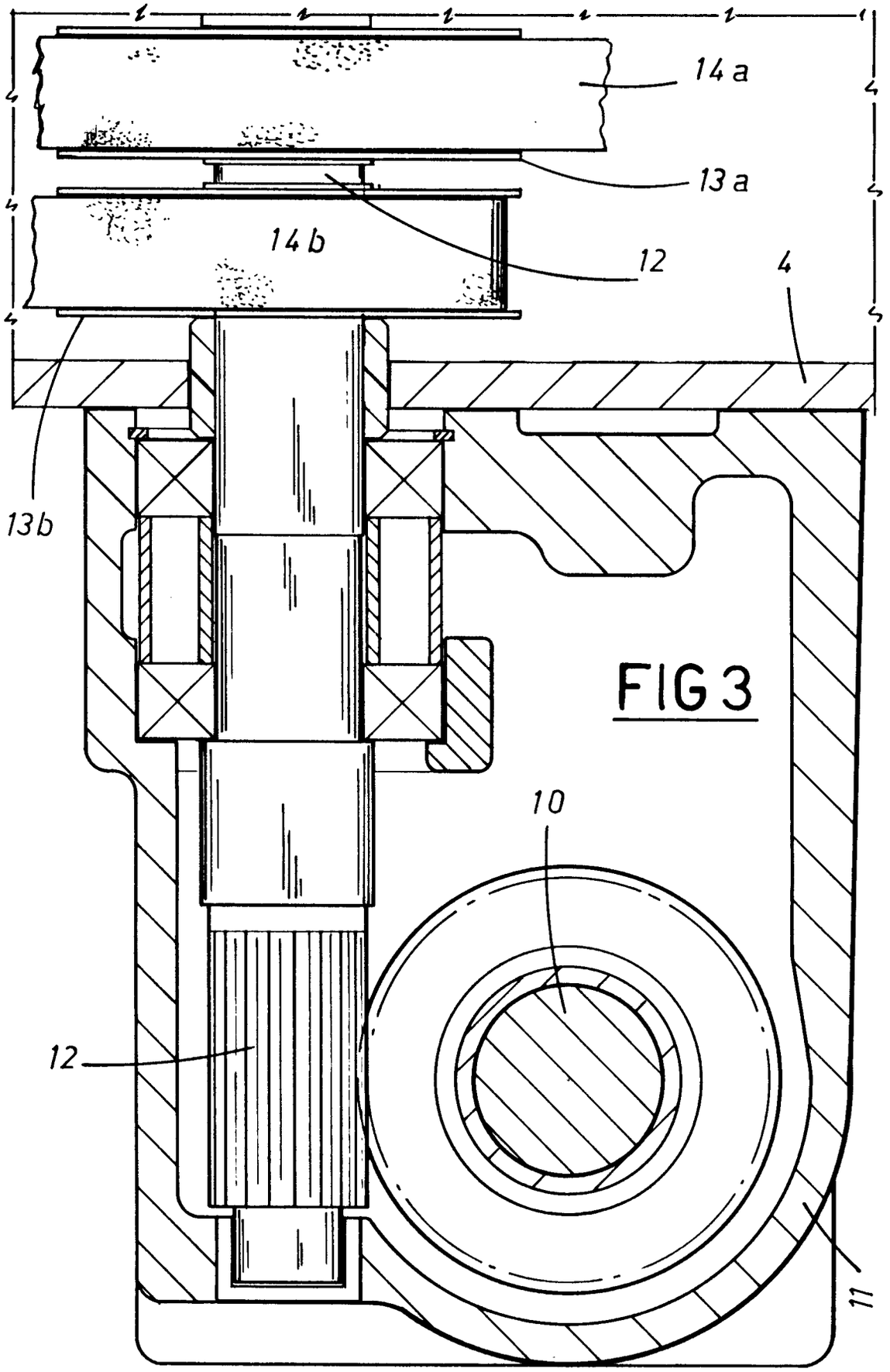
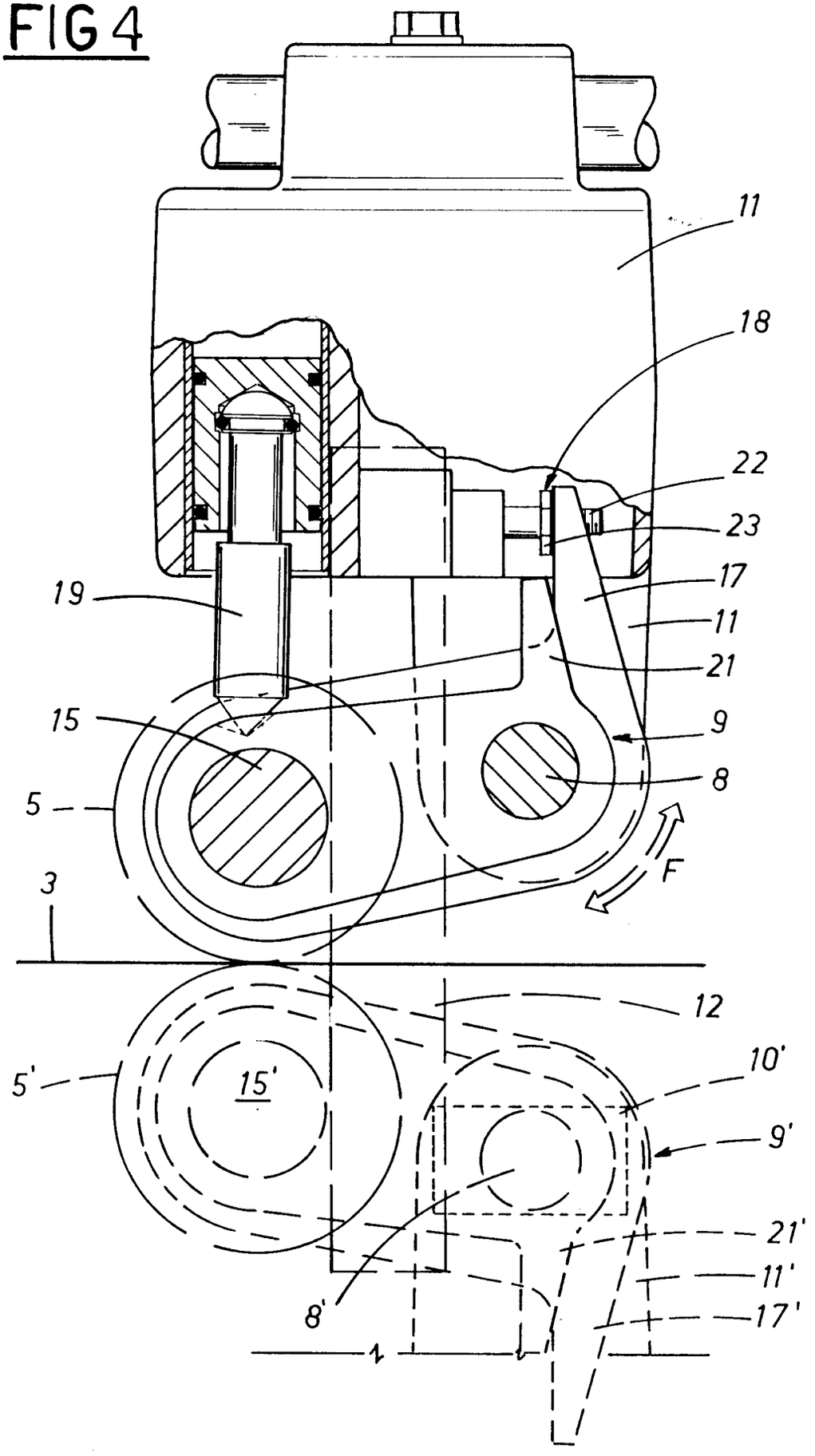


FIG 3

FIG 4



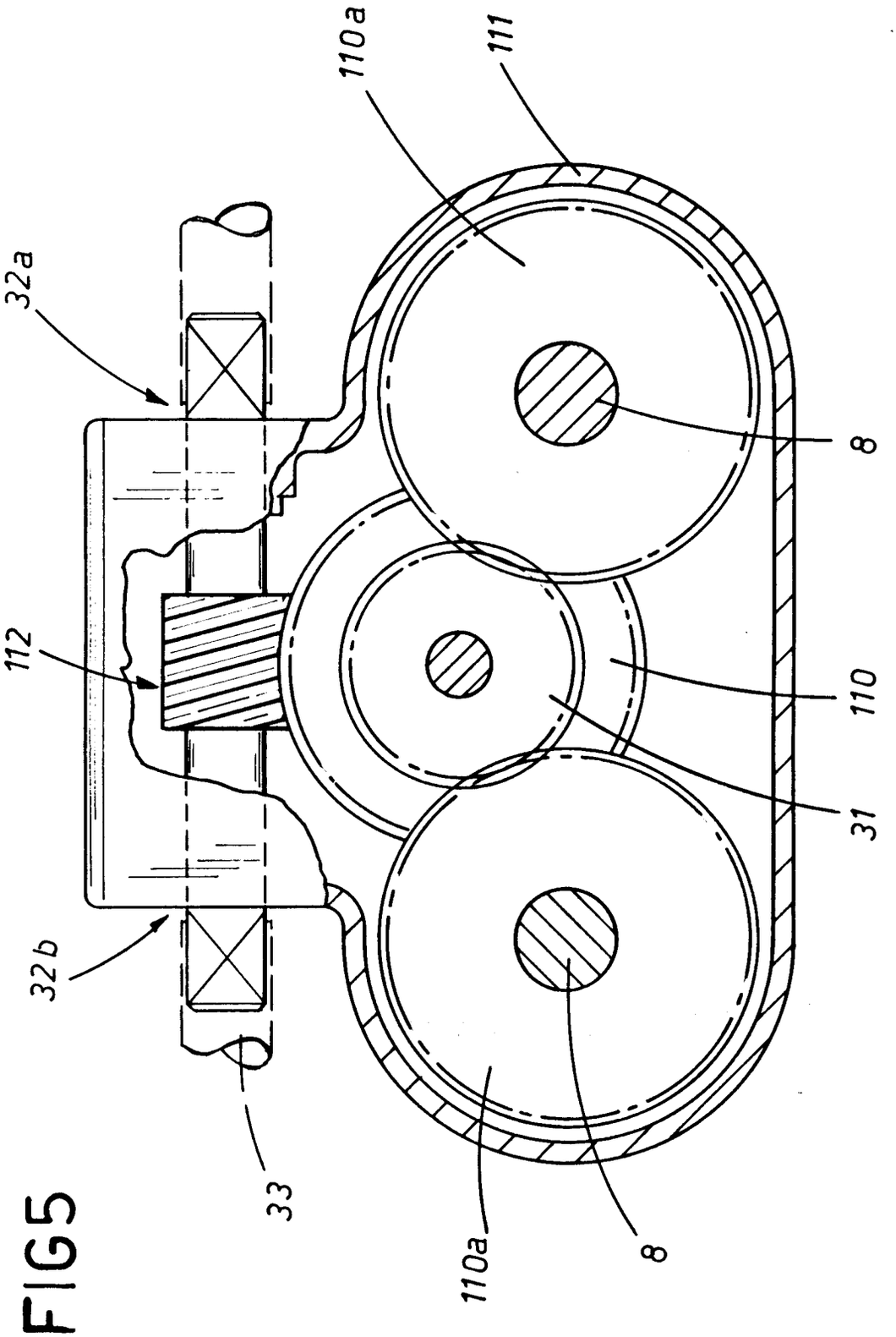


FIG5

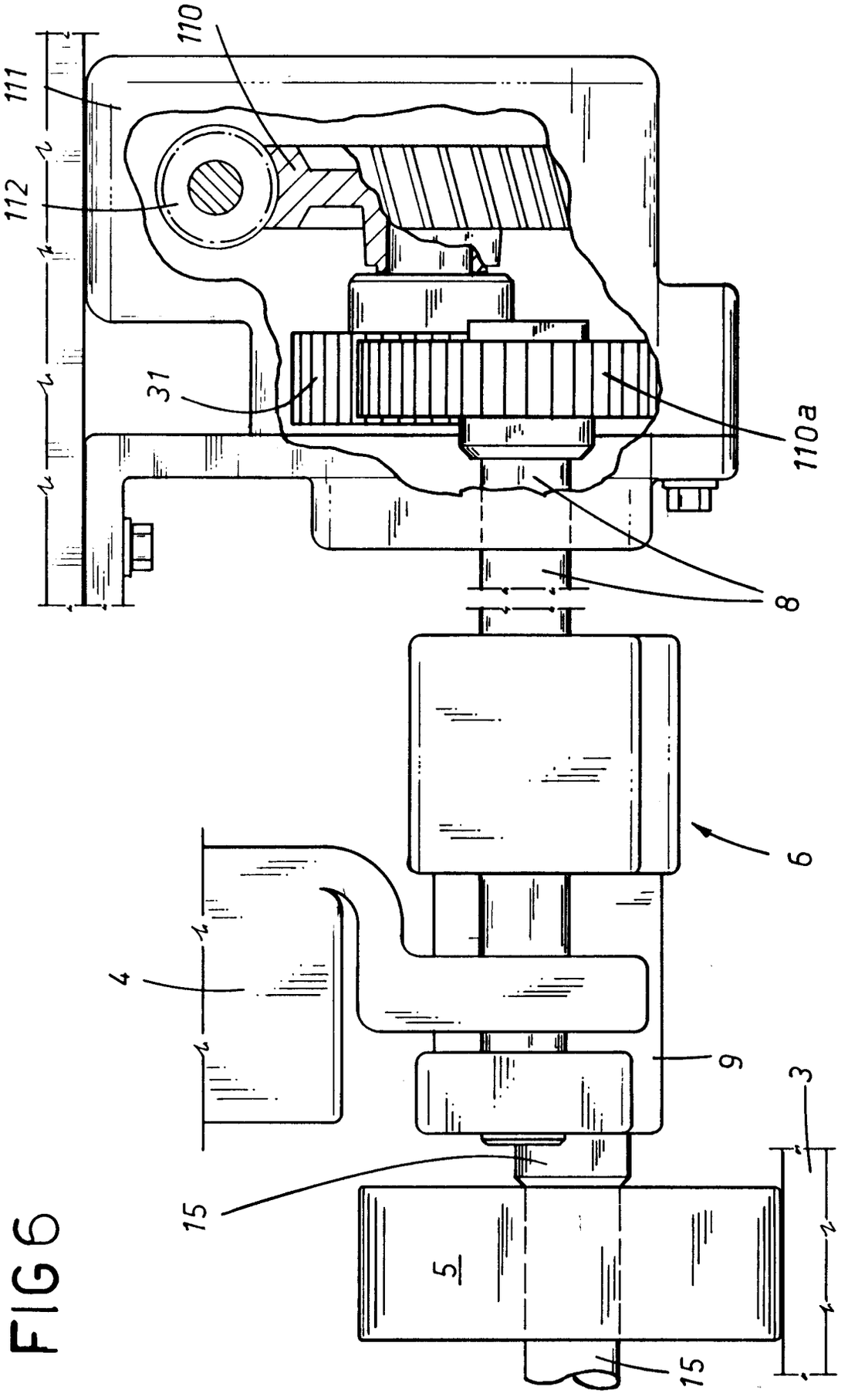


FIG6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 83 0620

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.5)
A	EP-A-0 203 893 (SAMCO INDUSTRIA) * Abstract; figures 1,2 *	1-3,5,7	B 23 Q 3/00 B 27 C 5/06
A	EP-A-0 058 369 (OKOMA)		
A	EP-A-0 130 948 (SCHIAVI CENTRO LAVORAZIONI)		
A	DE-B-1 081 210 (REICH)		
A	EP-A-0 374 106 (PERTICI)		
A	FR-A-1 206 083 (CHUET)		
A	DE-C- 514 678 (SIEMENS)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 23 Q
B 27 C
B 27 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27-08-1991	KORTH C-F.F.A.

CATEGORY OF CITED DOCUMENTS

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