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(11) **EP 0 769 356 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.04.1997 Bulletin 1997/17

(51) Int. Cl.⁶: **B28B 1/087**, B06B 1/16

(21) Application number: **95830442.0**

(22) Date of filing: **18.10.1995**

(84) Designated Contracting States:
**AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL
PT SE**
Designated Extension States:
LT LV SI
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(54) **A block-making machine**

(57) A block-making machine (1) which is distinguished by notably economical operation, both in terms of energy consumption and in terms of the duration of the production cycle of artificial concrete blocks (C), and at the same time maintains a high level of quality of the blocks (C) produced, comprises a vibrator plate (18) and at least one vibration generator (21) connected to

the vibrator plate (18) and having a rotating eccentric element (37) which comprises a first mass (39) rotating on an axis (A), a second mass rotating on the axis (A), and means (47, 52, 57) for varying the relative angular positions of the first and second masses (39, 42).

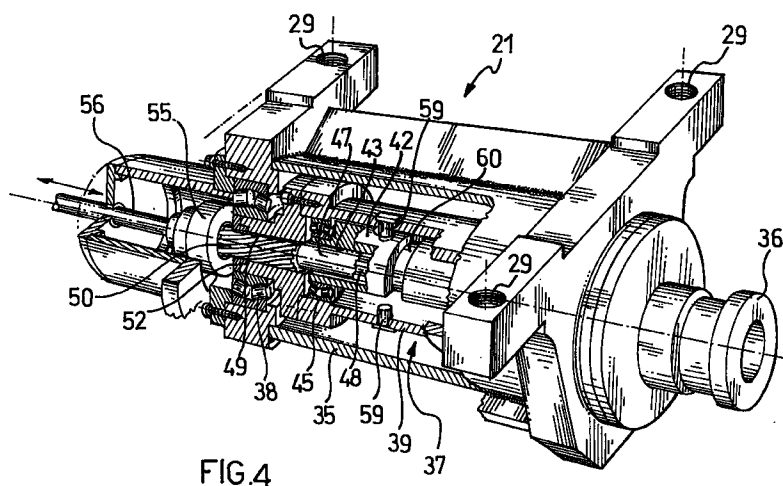


FIG.4

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Description

The present invention relates in general to a block-making machine for the manufacture of artificial concrete blocks.

In particular, it relates to a block-making machine comprising a vibrator plate, at least one vibration generator connected to the vibrator plate and comprising a rotating eccentric element, and drive means for rotating the eccentric element.

As is known, a block-making machine generally comprises a form which is divided into moulds and is filled with a moist mixture of concrete, aggregate and other inert materials, and which is fixed to the vibrator plate and subjected to vibration to compact the mixture.

The mixture is then subjected to a pressure by means of a press and, at the same time, is subjected to vibrations such as to compress the mixture to form compact blocks which, after suitable curing, can be used as building construction materials, for example, perforated or solid blocks, hollow building tiles, kerbstones or paving.

The vibration is usually imparted by one or more vibration generators which are generally rotated by one or more electric motors arranged in parallel.

A requirement generally recognized in the field of block-making machines, in order to achieve ideal compression of the blocks, is that of controlling the parameters of the vibration imparted, that is, its intensity and frequency.

At the same time, it is necessary to cancel out the vibration during the stage in which the concrete blocks are removed from the form and during the stage in which the press is lowered into the moulds of the form.

These requirements are of fundamental importance since the homogeneity of the product, its surface finish and its mechanical strength depend directly upon these parameters.

For this reason, known block-making machines have vibration generators driven by asynchronous electric motors which transmit the rotation through mechanical speed variators.

For each block-production cycle, the motors are stopped and restarted twice by the interruption of their electrical supply.

It is known that mechanical speed variators do not have good mechanical performance and are delicate components which are damaged in particular by operation in atmospheres rich in dust and other pollutants.

It is also known that the running of an asynchronous electric motor with a large number of stops and starts involves a very large wastage of energy.

Moreover, block-making machines have a particularly heavy structure to prevent the electric motor from imparting frequencies corresponding to the natural frequencies of the structure of the block-making machine during starting, with a consequent risk of structural damage.

To overcome the aforesaid disadvantages, block-

making machines having brushless direct-current motors supplied electronically with a variable voltage have been proposed.

In order to cancel out the compacting vibration during programmed stops, these block-making machines also comprise at least four vibration generators which can operate so as to cancel each other out.

However, this scheme of operation has the disadvantage of stressing the transmission throughout the operating cycle and of requiring a current absorption equal to the maximum.

Block-making machines of this design are also extremely complex and difficult to manage and control, especially by personnel not particularly skilled with electronic components.

Moreover, as well as being sensitive to operation in a dusty atmosphere, the components of the aforesaid block-making machines are also quite expensive.

The technical problem upon which the present invention is based consists of devising a block-making machine having structural and functional characteristics which can prevent the problems mentioned with reference to the prior art.

This problem is solved by a block-making machine of the type specified which is characterized in that the eccentric element comprises a first eccentric mass rotating on an axis, a second eccentric mass rotating on the axis, the eccentric element having an overall eccentricity dependent upon an angular offset between the first and second masses, and means for varying the angular offset between the first and second masses.

The main advantage of the block-making machine according to the invention lies in of the fact that it is distinguished by notably economical operation, both in terms of energy consumption and in terms of the duration of the block-production cycle, at the same time maintaining a high level of quality of the blocks produced.

Further characteristics and advantages of the block-making machine according to the invention will become clear from the detailed description of a preferred embodiment thereof, given by way of non-limiting example with reference to the appended drawings, in which:

- figure 1 is a partially-sectioned perspective view of a block-making machine according to the invention,
- figure 2 is a longitudinal section of the block-making machine of figure 1,
- figure 3 is a partial longitudinal section of the block-making machine of figure 1 in a different operating condition,
- figure 4 is a partially-sectioned perspective view of a detail of the block-making machine of figure 1,
- figure 5 is a cross-section of two of the details of figure 4, as arranged in the block-making machine of figure 1,
- figure 6 is a longitudinal section of the detail of figure 4,

- figure 7 is a perspective view of an element of the detail of figure 4, in longitudinal section, and
- figure 8 is a perspective view of the element of figure 7.

In the drawings, with particular reference to Figures 1, 2 and 3, a block-making machine according to the invention is generally indicated 1.

It comprises a substantially parallelepipedal outer frame 2 formed by beams 3 and defining a loading side 4 and an unloading side 5.

On the loading side 4, the block-making machine 1 comprises a first conveyor 6 which supplies the block-making machine 1 with board-like supports 8, preferably of wood.

On the loading side 4, the block-making machine 1 also comprises an inner frame 2' supported by a plurality of elevating uprights 10 of variable height.

The inner frame 2' supports a bearing surface 9 on which a feed box 11 with an open bottom 11' is disposed.

The feed box 11 is connected to the inner frame 2' by means of a first articulated system 12 supported by the inner frame 2' and comprising a first cylinder-and-piston actuator 13, a first lever 14a operated by the actuator 13, and a second lever 14b pivotably connected to the first lever 14 and to the box 11 in order to move the latter.

Above the feed box 11 and the bearing surface 9, the block-making machine 1 comprises a hopper 16 which is intended to fill the feed box 11 with a mixture based on semi-dry concrete and is closed at the bottom by a shutter 17 (Figure 2).

On the unloading side 5, the block-making machine 1 comprises a vibrator plate 18 which is enclosed by the outer frame 2 adjacent the bearing surface 9 and is supported by a plurality of resilient elements, for example, of rubber, connected in turn to bases 20 of considerable mass fixed to the outer frame 2.

The block-making machine 1 comprises a form 70 (Figure 1) connected to the vibrator plate 18 and divided by a plurality of partitions 15' into moulds 15 for the artificial concrete blocks, indicated C.

The first conveyor 6 is positioned beneath the bearing surface 9 and supplies the vibrator plate 18 with the wooden supports 8 which are inserted between the vibrator plate 18 and the form 70, constituting the bottom of the latter.

Beside the vibrator plate 18, the block-making machine 1 comprises pneumatically-operated clamps 22 for clamping the vibrator plate 18, the wooden support 8 and the form 70 together.

Below the vibrator plate, the block-making machine 1 comprises a pair of vibration generators 21 (Figure 5) which are connected mechanically to the vibrator plate 18 and are described in detail, together with their operation, below.

Above the vibrator plate 18, the block-making machine 1 comprises a press 23 (Figure 3).

The press 23 comprises a plurality of second uprights 24 which are disposed beside the vibrator plate 18 and along which a pressure element 25, carrying on its bottom a plurality of combs for insertion in the corresponding moulds 15 of the form 70, is free to slide vertically.

The press 23 is operated by a second articulated system 26 comprising a second actuator 27, for example, a hydraulic actuator.

Downstream of the vibrator plate 18, the block-making machine 1 comprises a second conveyor 28 for forwarding the artificial blocks C disposed on the wooden supports 8 (Figure 1).

The block-making machine 1 comprises drive means 30 which, in this preferred embodiment, are an asynchronous electric motor kept continuously in rotation and supplied by a conventional electronic mains-frequency variator, not shown.

The electric motor 30 is connected to a reversing unit 31 by means of a belt transmission 31'.

The reversing unit 31 rotates a pair of contrarotating shafts 32 at the same angular velocity.

Each shaft 32 comprises, at its ends, universal joints 34 which, together with the shaft 32, constitute a double universal connection which connects the electric motor 30 to each vibration generator 21 by means of the reversing unit 31, in order to transmit the rotation.

One of the two structurally identical vibration generators 21 (Figures 4 and 6) will be described below.

The vibration generator 21 comprises a cylindrical framework 35 on one end of which is engaged a hub 36 connected to one of the joints 34 of the corresponding shaft 32.

The framework 34 is connected, at its ends, to the overlying vibrator plate 18 by through-holes 29 in which conventional bolts are engaged.

The vibration generator 21 also comprises, inside the framework 35 and connected to the hub 36, a rotating eccentric element 37 which has a predetermined overall mass and an eccentricity which is defined as the distance between its axis of rotation, indicated A (Figure 6), and its overall centre of mass, and which is proportional to a vibration generated and transmitted to the vibrator plate 18.

The two vibration generators 21 operate in phase synchronism and in contrarotation, that is, the rotations imparted to the respective eccentric elements 37 by the respective shafts 32 take place in opposite senses.

The axes of rotation A of the two generators 21 are parallel to one another and to the vibrator plate 18 so that the components of the stresses caused by each of the two eccentric elements and not directed vertically relative to the vibrator plate cancel one another out.

The vibrator plate 18 is therefore distinguished by a jerky vertical motion during the stages in which a vibration is imparted thereto.

The eccentric element 37 is supported on the framework 35 by main bearings 38 at its ends, the positions of the bearings determining the position of the axis

A defined above.

The eccentric element 37 comprises a first eccentric mass 39 which is rotated on the axis A. In fact, the joint defined by the shaft 32 and by the joints 34 connects the first mass 39 and the drive means 30 by means of the hub 36 and the reversing unit 32.

The first mass 39 is constituted by a tubular segment 40 which has a longitudinal open side 41 and an inner wall 40'.

The first mass thus has a constant eccentricity with respect to the axis A during its rotation.

The eccentric element 37 also has a second eccentric mass 42 (Figure 8) which, as will become clearer from the following, is fixed mechanically to the first mass 39 by which it is rotated on the same axis A. The second mass 42 is housed inside the tubular segment 40.

The overall eccentricity of the eccentric element 37 depends upon an angular offset between the first and second eccentric masses 39 and 42.

The second mass 42 is constituted by a semicylindrical shaft which has a coaxial cylindrical through cavity 43 with grooves 44 on its inner walls (Figure 7), parallel to the axis A.

The second mass 42 is supported at its ends by secondary bearings 45 connected to the inner wall 40' of the tubular segment 40 and also has a constant eccentricity with respect to the axis A.

A first portion 46 of a guide shaft 47 is housed inside the cavity 43, throughout the length thereof, and has splines 48 which engage for free axial sliding in the grooves 44 to constitute a prismatic coupling.

At the end opposite the hub 36, the eccentric element 37 has a hole 49 through which a second portion 50 of the guide shaft 47 extends.

The second portion 50 has external helical splines 51 and is engaged in a bush 52 of the eccentric element 37 which has internal helical splines 53 corresponding to the external helical splines 51 of the second portion 50 of the guide shaft 47.

As a result of the engagement between the helical splines 51, 53, the bush 52, which is connected mechanically to the eccentric element 37, rotates the guide shaft 47 and this in turn rotates the second mass 42 which is fixed to the first mass 39.

The guide shaft 47 (Figure 7) has a free end 54 on the first portion 46 inside the through cavity 43 of the second mass 42 and a further end with an articulated joint 55 connected to an axial drive rod 56.

The rod 56 is connected to a third actuator 57, for example, an oleodynamic actuator, by means of which the guide shaft 47 can be moved axially.

The third actuator 57, the guide shaft 47 and the bush 52 constitute means for varying the angular offset between the first mass 39 and the second mass 42.

In fact, the translation of the guide shaft 47 inside the bush 52 by means of the third actuator 57 brings about a rotation of the guide shaft 47 by virtue of the helical splines 51, 53 of the bush 52 and the second portion 50 of the guide shaft 47.

The rotation of the guide shaft 47 causes the second mass 42 to rotate in the secondary bearings 45 relative to the first mass 39 and varies the angular offset between the rotational vectors which define the eccentricities of the masses 39, 42, thus varying the overall eccentricity of the eccentric element 37.

The eccentric element 37 also has means 58 for stopping the rotation of the second mass 42 relative to the first mass 39 (Figures 7 and 8).

The stopping means 58 include a pair of pins 59 fixed to the tubular segment 40, projecting into its interior, and engaged in respective circumferential grooves 60 of the stopping means 58 formed on the second mass 42.

The circumferential grooves 60 in the second, semicylindrical mass 42 are arranged in a manner such that its centre of gravity falls on a straight line resulting from the intersection of two planes perpendicular to the plane which sections the second mass 42, one of them including the axis of rotation A and the other being perpendicular and disposed on the geometrical midpoint of the semicylinder which defines the second mass 42.

The rotation-stopping means 58 determine a position in which the overall eccentricity is zero and another position in which the eccentricity is limited to a maximum value established at the design stage.

In the currently-preferred version of the block-making machine 1 according to the invention, the maximum angular offset of the second mass 42 relative to the first mass 39 is 90°.

This value makes use of the angular offset between the first and second masses 39 and 42 within a range in which the relationship between eccentricity and angular offset is almost linear, whilst using more than 70% of the possible variation in eccentricity.

The operation of the block-making machine 1 according to the invention will be described below with reference to the drawings.

The block-making machine 1 is supplied continuously, by means of the first conveyor 6, with wooden boards 8 which are placed one at a time on the vibrator plate 18 on which the form 70 is disposed.

When the shutter 17 is opened, the hopper 16 fills the feed box 11 until it is completely full, whilst the vibration generators 21 do not impart any vibration to the vibrator plate 18 although they are kept in rotation, as will become clearer from the following.

At this stage, the open base 11' of the box 11 is closed since it rests on the bearing surface 9.

Upon completion of the filling, the feed box 11 is translated along a path comprising a horizontal portion from the bearing surface 9, by the action of the first articulated system 12, so as to rest on the form 70 (Figure 3).

In this connection, in order to adapt the block-making machine 1 to various types of form for the production of blocks C of different dimensions, the height of the bearing surface 9 and of the entire inner framework 2' is adjusted by the action of the elevating uprights 10.

Once the advance of the box 11 is completed, the open base 11' is then above the form 70 and the moulds 15 of the form are thus filled whilst the vibration generators 21 impart a vibration of an intensity and frequency suitable for the type of form 70.

The form 70 and its contents are subjected to this first vibration stage in order to render the filling of each mould 15 uniform. This stage will have a variable duration of the order of 4-5 seconds, depending upon the type of mould used.

Upon completion of this first stage, the vibration of the vibrator plate is cancelled out and the box 11 returns to its position under the hopper 16 whilst the pressure element 25 of the press 23 is moved downwards onto the form 70 by means of the second articulated system 26 (Figure 2).

The mixture in the moulds 15 is thus subjected to compression by means of the combs of the pressure element 25.

Simultaneously with the compression, the form 70 is subjected to a second vibration stage by the vibration generators 21, with different intensity and frequency parameters.

The combined effect compacts the blocks C on their support 8.

Upon completion of the second stage, which is also of variable duration and depends upon the type of blocks C produced and the type of mixture used, the form 70 is lifted vertically, leaving the board 8 and the blocks C on the vibrator plate 18 which is now stationary and from which the board 8 is unloaded onto the second conveyor 28.

The pressure element is kept in the lowered position to ensure separation of the blocks C and the form 70.

During the various stages of the manufacturing cycle of the block C, the electric motors take up various angular velocities selected on the basis of the type of block C to be produced.

Moreover, the intensity of the vibration imparted to the vibrator plate 18, which depends upon the overall eccentricity of the eccentric element 37, is adjusted by means of the third actuator 57, according to the mixture used and the type of block C to be manufactured.

During the filling of the form 70 and during the descent of the pressure element 25 of the press 23, the vibration is cancelled out simply by bringing the second mass 42 to its travel limit relative to the first mass 39, closing the open side 41 of the tubular segment 40. In this configuration, the overall eccentricity of the element 37 is zero.

It is also possible to provide an automatic control system which can automatically detect any of the operating parameters of the block-making machine 1 according to the invention and consequently vary the intensity and duration of the vibrations imparted in the first and/or second stages.

With the use of this system, it is easy to optimize the entire production cycle, achieving a considerable

saving in terms of energy and time.

In particular, the fact that the supply to the electric motors does not have to be interrupted enables them to be used more economically and lengthens their life, enabling use to be made of the flywheel of the electric motor which thus achieves maximum power in the minimum time.

In addition to the advantages mentioned above, the block-making machine according to the invention is structurally simple, achieving the optimization of more expensive machines by simple mechanical measures.

Moreover, the weight of the block-making machine can also be reduced, owing to the elimination of the repeated stopping and starting of the electric motors.

Furthermore, the block-making machine has improved qualitative performance and requires less maintenance and a smaller number of personnel.

In order to satisfy particular requirements and contingencies, an expert in the art may apply many variations to the block-making machine described above, all of which, however, are within the scope of protection of the invention as defined in the following claims.

Claims

1. A block-making machine (1) comprising a vibrator plate (18), at least one vibration generator (21) connected to the vibrator plate (18) and comprising a rotating eccentric element (37), and drive means (30) for rotating the eccentric element (37), characterized in that the eccentric element (37) comprises a first eccentric mass (39) rotating on an axis (A), a second eccentric mass (42) rotating on the axis (A), the eccentric element (37) having an overall eccentricity dependent upon an angular offset between the first and second masses (39, 42), and means (47, 52, 57) for varying the angular offset between the first and second masses (39, 42).
2. A block-making machine (1) according to Claim 1, in which the first mass (39) has a constant eccentricity with respect to the axis (A).
3. A block-making machine (1) according to Claim 1, in which the second mass (42) has a constant eccentricity with respect to the axis (A).
4. A block-making machine (1) according to any one of the preceding claims, comprising a joint (32, 34) which connects the drive means (30) to the first mass (39) of the rotating eccentric element (37), the second mass (42) being fixed mechanically to the first mass (39) by which it is rotated.
5. A block-making machine (1) according to Claim 1, in which the first mass (39) is constituted by a tubular segment (40) which has an longitudinal open side (41) resulting from the intersection of the tubular segment (40) and a plane parallel to the axis (A),

and the second mass (42) is housed within the tubular segment (40) and is constituted by a semi-cylindrical shaft supported at its ends by bearings (45), the tubular segment (40) having an inner wall (40') to which the bearings (45) are connected.

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chronous electric motor supplied with variable-frequency alternating current.

6. A block-making machine (1) according to Claim 5, in which the semicylindrical shaft (42) has a cylindrical cavity (43) parallel to the axis (A) and comprising grooves (44) parallel to the axis (A) in its inner walls, a first portion (46) of a guide shaft (47) being housed inside the cylindrical cavity (43) throughout the length thereof and having projections (48) corresponding to the grooves (44) in which they are engaged, the eccentric element (37) having a hole (49) through which a second portion (50) of the guide shaft (47) extends, the second portion (50) having external helical splines (51) and being engaged in a bush (52) of the eccentric element (37) which has internal helical splines (53) corresponding to the external helical splines (51) of the second portion (50) of the guide shaft (47), the bush (52) being connected mechanically to the eccentric element (37).

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7. A block-making machine (1) according to Claim 6, in which the guide shaft (47) has a free end (54) on the first portion (46) inside the through cavity (43) and a further end with an articulated joint (55) connected to an axial drive shaft (56) which in turn is connected to an actuator (57) by means of which the guide shaft (47) can be moved axially, the actuator (57), the guide shaft (47) and the bush (52) constituting the means for varying the angular offset between the first mass (39) and the second mass (42).

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8. A block-making machine (1) according to Claim 6, in which the eccentric element (37) also has means (58) for stopping the rotation of the second mass (42) relative to the first mass (39).

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9. A block-making machine (1) according to Claim 8, in which the stopping means (58) comprise a pair of pins (59) fixed to the tubular segment (40), projecting into its interior and engaged in circumferential grooves (60) of the stopping means (58) formed in the second mass (42), the rotation-stopping means (58) determining a position in which the overall eccentricity is zero and another position in which the eccentricity is limited to a maximum value established at the design stage.

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10. A block-making machine (1) according to Claim 9, in which the angular offset between the first and second masses (39, 42) is limited to 90°.

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11. A block-making machine (1) according to Claim 1, in which the drive means (30) comprise an asyn-

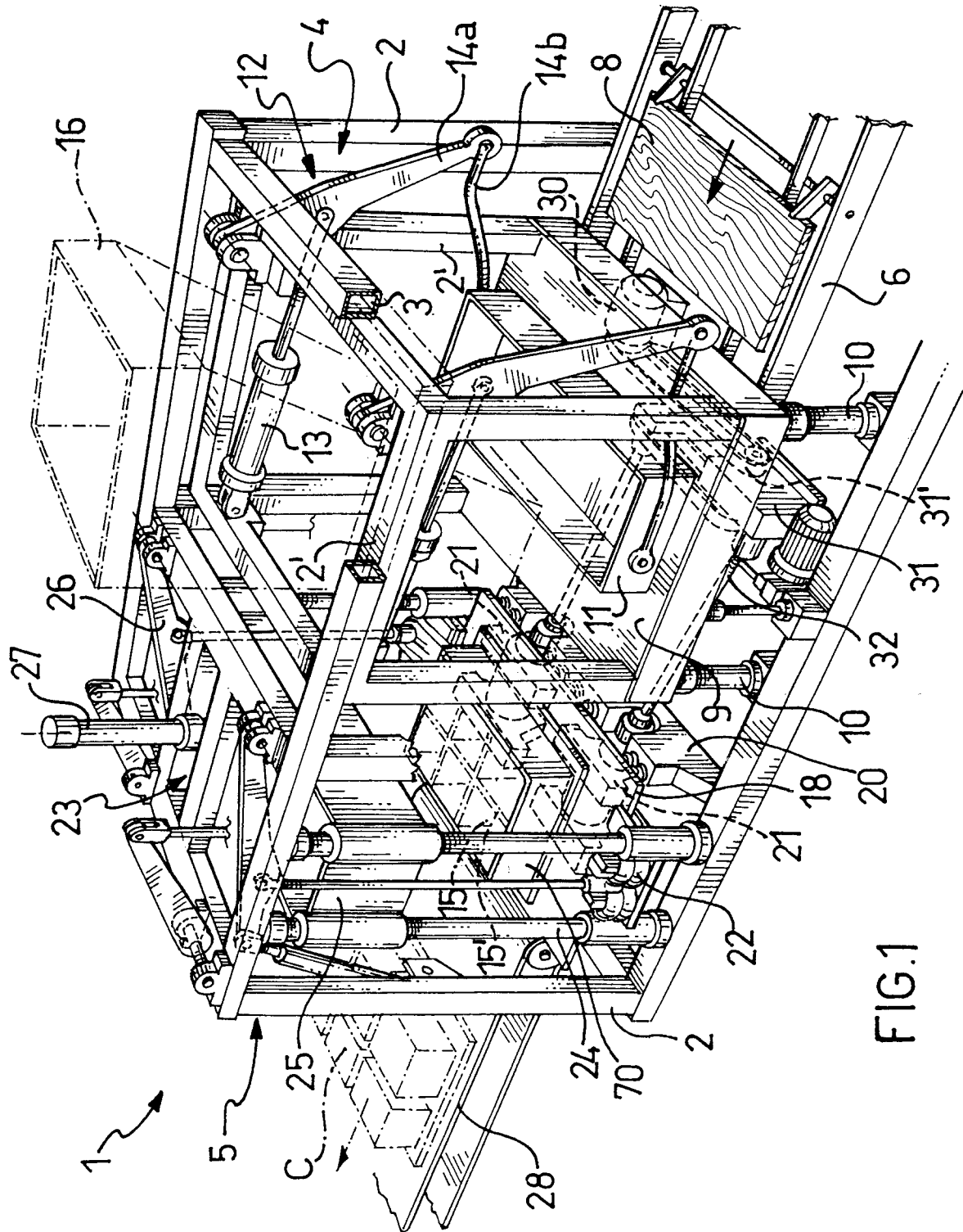


FIG.1

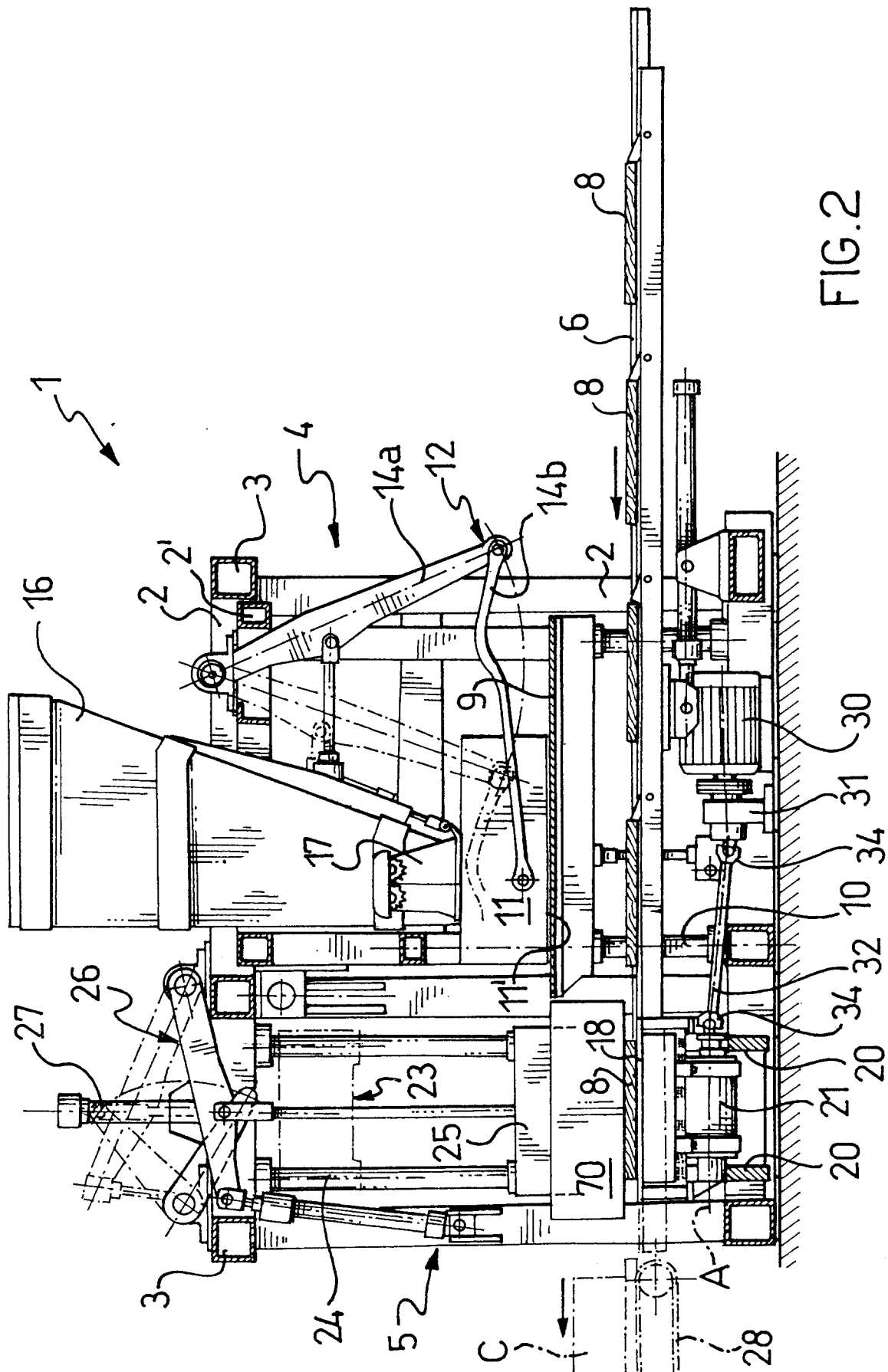


FIG. 2

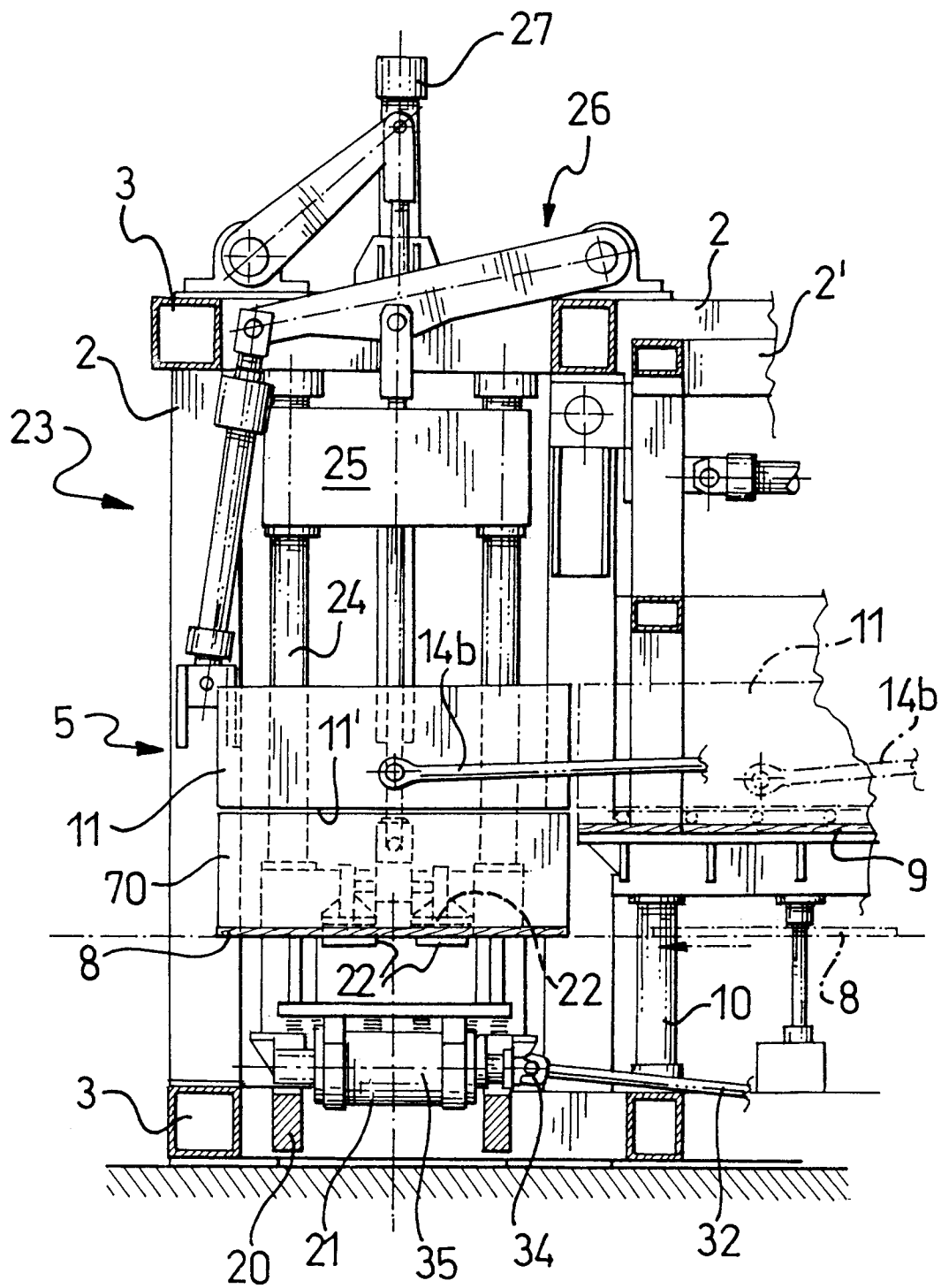
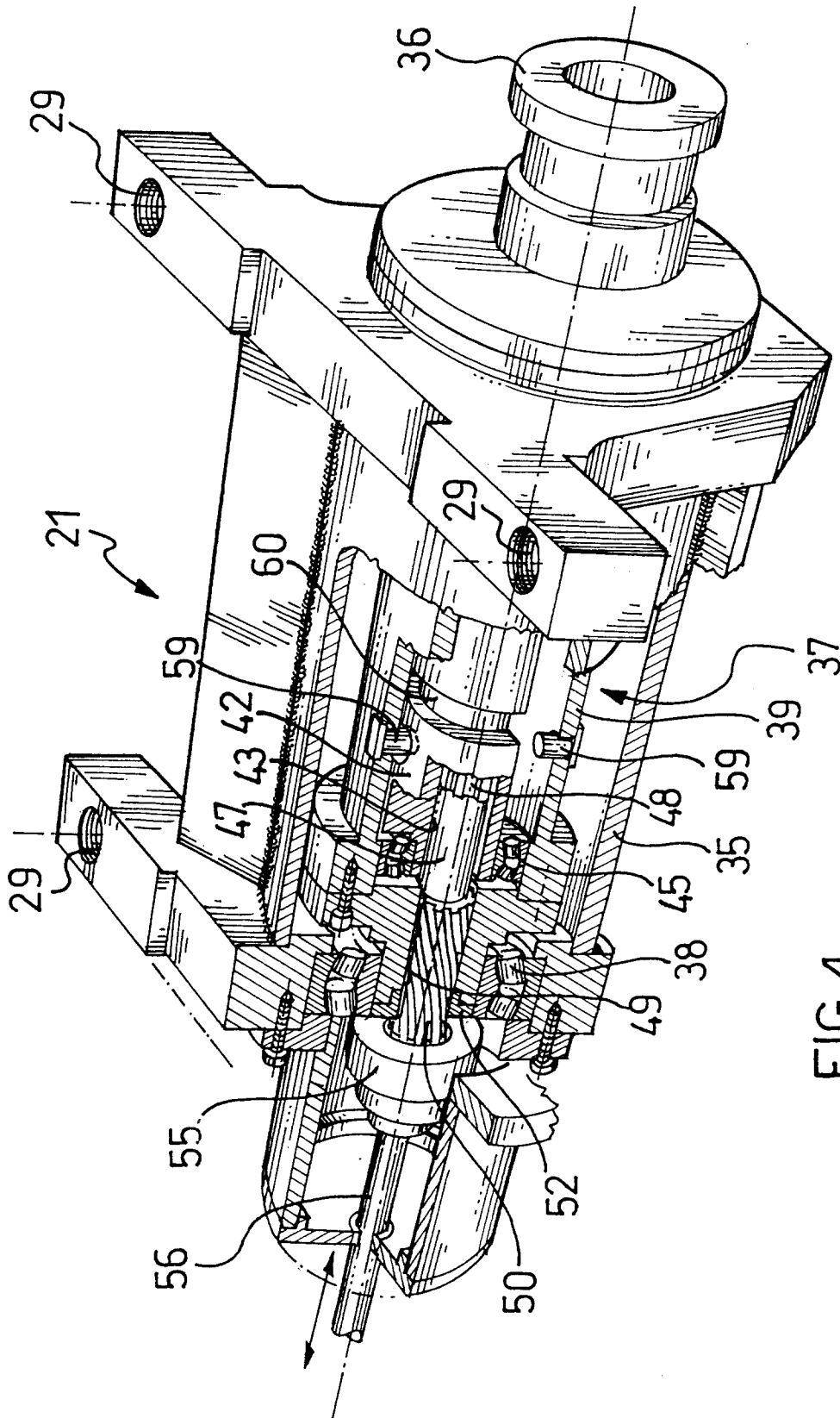
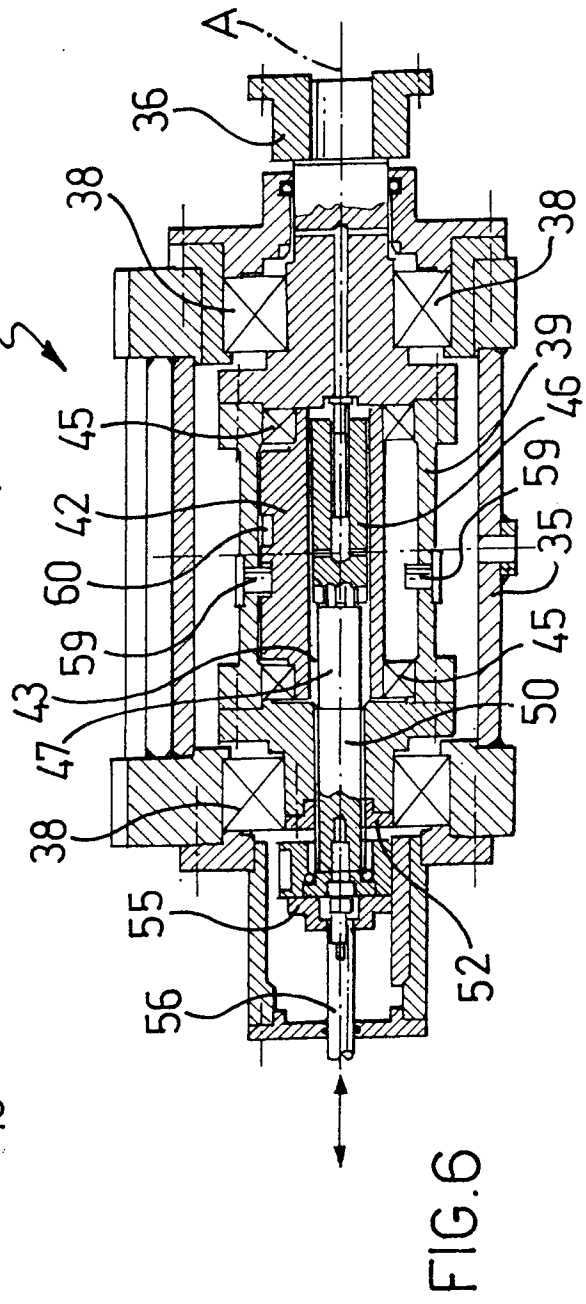
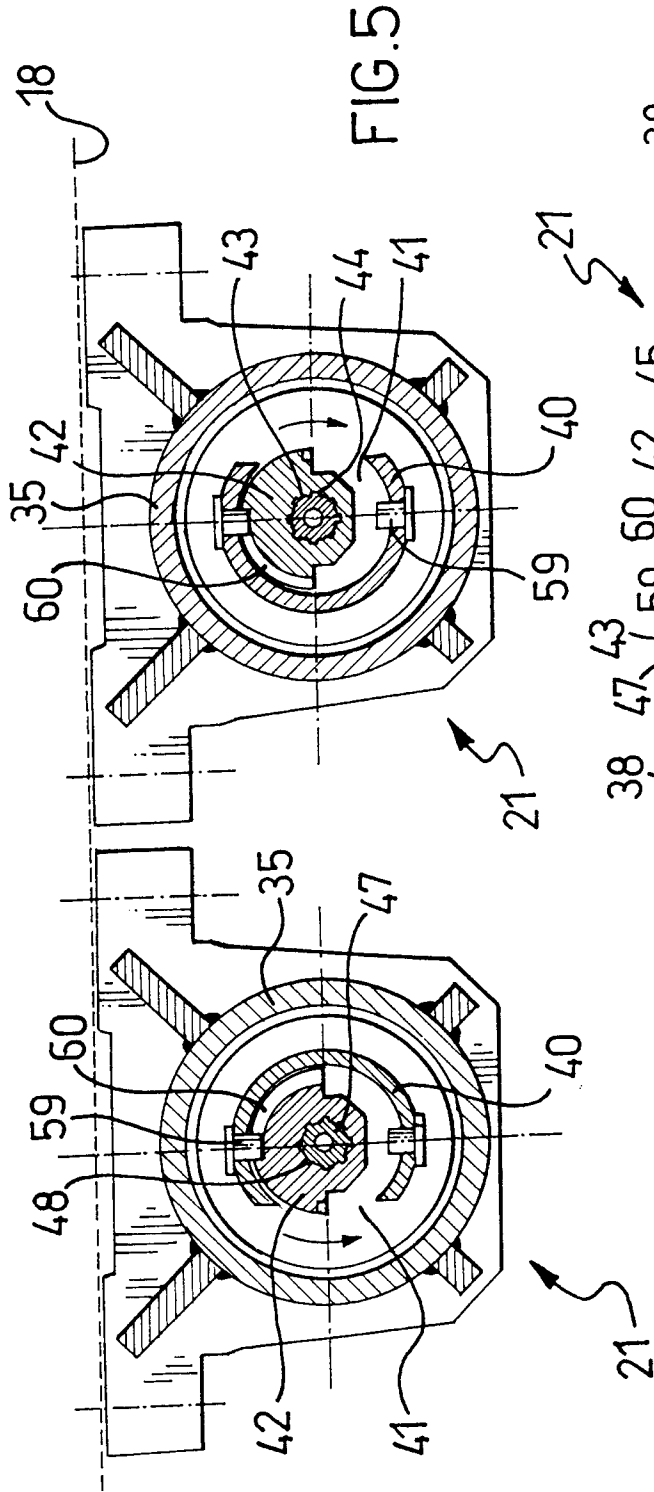
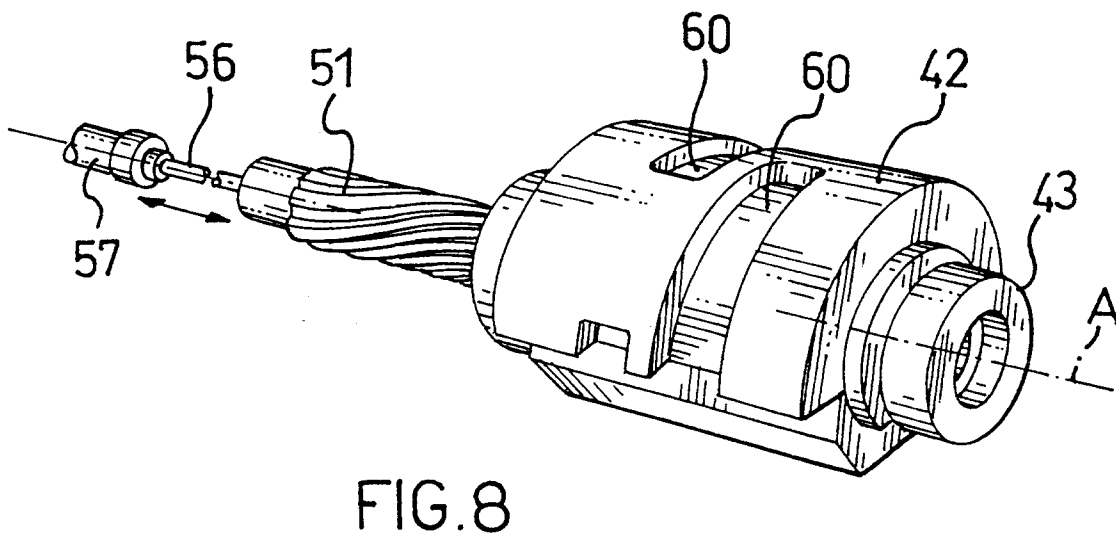
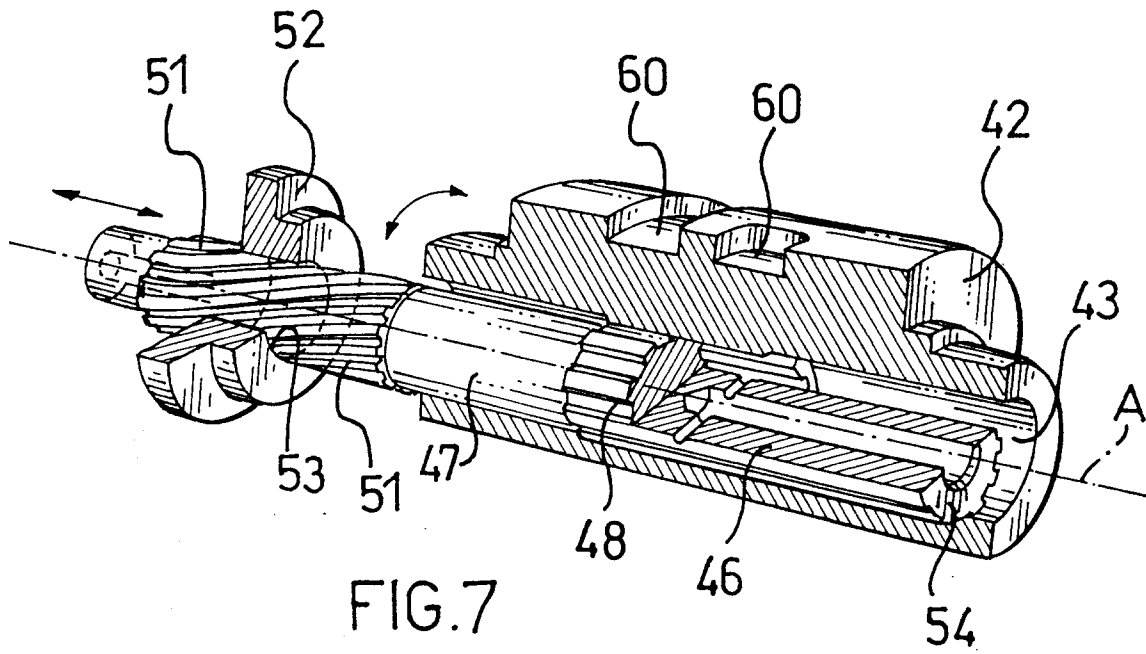


FIG.3









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EUROPEAN SEARCH REPORT

Application Number
EP 95 83 0442

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)
X	EP-A-0 353 661 (BESSER COMPANY) * the whole document *	1-4	B28B1/087 B06B1/16
Y	---	5-11	
X	EP-A-0 600 526 (A. POYATOS DIAZ) * the whole document *	1-3	
A	---	4,5	
Y	FR-A-1 146 454 (S. A. ANCIENS ETABLISSEMENTS PIQUARD FRERES & DUREY SOHY REUNIS) * the whole document *	5-8	
A	---	1-4	
Y	FR-A-1 340 730 (FIRMA WALTHER-TECHNIK CARL KURT WALTHER) * the whole document *	5-9	
A	---	1-4	
Y	GB-A-2 108 235 (DYNAPAC MASKIN AB) * the whole document *	5-10	
A	---	1-4	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
Y	FR-A-2 247 294 (ROBERT BOSCH G.M.B.H.) * page 1, line 1 - page 1, line 12 *	11	B28B B06B
A	-----	1	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 12 March 1996	Examiner Gourier, P
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