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(54) **Mechanical starter for internal combustion engines.**

(57) A mechanical starter for internal combustion engines according to the present invention comprises a pair of disc-shaped elements (2, 3) rotatable in respect of each other to place under traction at least a strip of elastomeric material, (18, 19) under the action of a mechanism for driving the rotation which can be drawn near or moved away from said pair of disc-shaped elements. Moreover, the starter provides a mechanism capable of being connected or disengaged with the shaft or an internal combustion engine.

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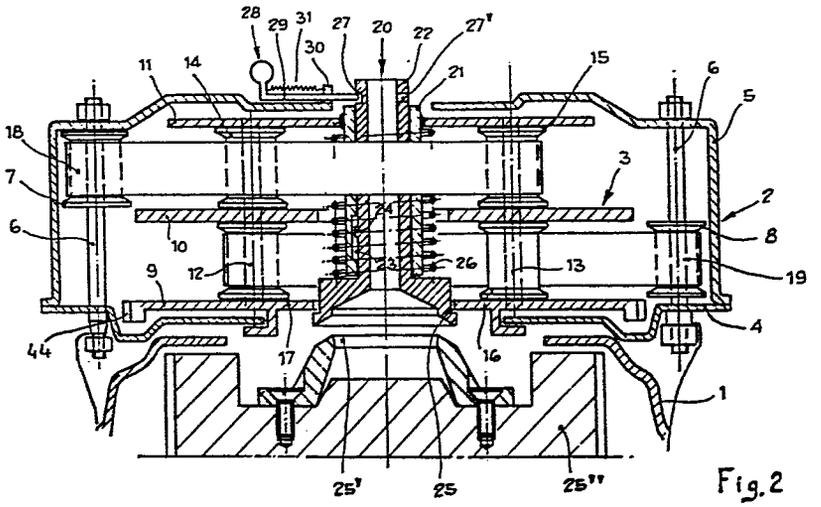
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Fig. 2

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MECHANICAL STARTER FOR INTERNAL COMBUSTION ENGINES

The present invention relates to a mechanical starter for internal combustion engines and more particularly to a mechanical starter of the type in which the energy necessary for starting the engine is stored through the deformation of a spring and more particularly of a spring in the form of a deformable body of elastomeric material.

Different types of mechanical starters for internal combustion engines are known.

The known mechanical starters for internal combustion engines are substantially of three types.

A first type is simply manual and consists in the presence of a crank applicable directly or indirectly to the shaft of the engine in order to rotate it around its own axis. Thus the energy necessary for the starting is supplied through a manual action by the operator.

Always in this first type of known mechanical starter, in place of the crank there can be provided a grooved pulley connected to the shaft of the internal combustion engine. To said pulley there can be associated a rope which is wound within the groove of the pulley after having fixed one end of the rope to the pulley itself and which is drawn by an operator by holding it at the other end, supplying in this way the energy for the starting.

The first known type of mechanical starter for engines has the very serious drawback of being dangerous for the user since during the actuation for the starting of the engine, there can be originated kicks on the crank with consequent risk for the operator.

A second type of mechanical starter for internal combustion engines comprises a fluid-dynamic mechanism in which the

energy is stored in the form of the pressure of a fluid.

This second type of mechanical starter results very heavy per se and is difficult to start in unfavourable climatic conditions since these latter affect negatively the physical characteristics of the fluid.

Moreover, this second type of mechanical starter has a very high ratio between the weight of the starter and the energy deliverable from it and further it is of delicate condustruction and, therefore, less reliable.

A third type of known mechanical starter for internal combustion engines comprises a body of elastomeric material having the function of a spring, said body being deformed through a device movable by a manually driven crank in order to deform the spring and to store in this way energy which can be transmitted to the engine for its set in motion by releasing the deformation of the spring.

The known mechanical starters belonging to this third type are very heavy and encumbering and therefore less suitable for a mass industrial use.

The present invention aims to overcome all the above mentioned drawbacks of the known mechanical starters for internal combustion engines so as to have mechanical starters of long lifetime, reliable in their working and able to produce the maximum degree of safety for the operators of the same.

One object of the present invention is a mechanical starter for internal combustion engines comprising elastically deformable means for storing and delivering energy, charaterised by the fact of comprising at least a pair of disc-shaped elements coaxial with and rotatable in respect of each other, at least an elastically deformable body connected with one of its own ends to one of said disc-shaped elements of the

pair and with the other end connected to the other disc-shaped element of the pair, means capable of being drawn near or moved away from one of the disc-shaped bodies to permit relative rotation of one disc-shaped element with respect to the other so as to deform the elastically deformable body and means for transferring the energy from the elastically deformable body to the shaft of the internal combustion engine.

The present invention will be better understood by the following detailed description made only by way of non limiting example with reference to the figures of the accompanying sheets of drawing in which:

Figure 1 shows in perspective view a mechanical starter according to the invention applied to an internal combustion engine;

Figure 2 shows, in enlarged scale, a section view of the starter according to trace II-II of figure 1;

Figure 3 shows in enlarged scale the particular of the loading mechanism of the starter according to the invention.

In its more general aspects a starter for internal combustion engines according to the present invention comprises a pair of disc-shaped elements rotatable in respect of each other and at least a strip of elastomeric material having one end secured to one of the disc-shaped elements and the other end secured to the other disc-shaped element so that with the relative rotation of the two disc-shaped elements the strip of elastomeric material can get deformed storing energy.

The execution of the relative rotation between the two disc-shaped elements is accomplished through a mechanism essential to the effects of the present invention to be drawn near said disc-shaped elements in order to engage with one of them and

to be moved away from said disc-shaped elements to disengage in association with another mechanism, important too, for the present invention, through which it is effected the connection of the starter to the shaft of the internal combustion engine and the release of the starter therefrom.

Figures 1 and 2 represent a starter according to the present invention.

As shown in figure 2, the casing 1 of an internal combustion engine is firmly secured to a disc-shaped element or body 2 in which a disc-shaped element or body 3, coaxial with the first one, is encased.

More particularly the disc-shaped body 2 is constituted by a box-shaped element formed by a base 4 integral with the casing 1 of the internal combustion engine. From the edge of said base 4 there projects a cover 5 so as to define between said cover 5 and said base 4 a closed space. The base 4 and the cover 5 are connected to each other by at least a pair of bolts 6 which extend through the closed space cited above. Said bolts 6 constitute shafts on which reels 7 and 8 are freely rotatable.

As previously said, the disc-shaped body 3 is encased in the disc-shaped body 2.

The disc-shaped body 3 comprises a set of three circular plates 9, 10 and 11 coaxial with one another and equally spaced from one another.

The circular plates 9, 10 and 11 are connected with one another by pins 12 and 13 which constitute the shafts of reels 14, 15, 16 and 17 which are freely rotatable on the above said pins 12 and 13. The two disc-shaped bodies 2 and 3 are connected to each other by strips of elastomeric material and, therefore, of elastically deformable material. More particularly, a strip 18 of elastically deformable material is secured at one of its

ends to the reel 7 connected to the disc-shaped body 2, whilst the other end of the strip 18 is secured to the reel 15 connected to the disc-shaped body 3. A second strip 19 of elastomeric material has one of its ends secured to the reel 8 connected to the disc-shaped body 2, whilst the other end of the strip itself is secured to the reel 17 connected to the disc-shaped body 3.

As previously said, the disc-shaped bodies 2 and 3 are coaxial with each other and the second is encased in the first one.

In correspondence of the axis of the two disc-shaped bodies 2, 3 there is a shaft 20 which to the effect of rotation with the disc-shaped body 3 is connected thereto which, however, is free to move along its own axis. To this end, the shaft 20 is formed by two coaxial cylinders 21 and 22. The cylinder 21 is the outermost one and encases the cylinder 22, the inner surface of the cylinder 21 being in contact with the outer surface of the cylinder 22.

Moreover, the cylinder 22 is hollow so as to be able to engage with a not represented key to move said cylinder 22 longitudinally with respect to the cylinder 21.

The connection between cylinder 21 and cylinder 22 is made thanks to the presence of longitudinal grooves 23 obtained in the inner surface of the cylinder 21 encasing protuberances 24 projecting from the outer surface of the cylinder 22, which assure a solidarity between the said cylinders 21, 22 to the effect of common rotation and of independence between the said cylinders 21, 22 with respect to longitudinal movements along their common axis.

The disc-shaped body 3 is rigidly connected to the cylinder 21 with means known to a technician of the field, for example fixed joints and the like, whilst the cylinder 22 at its end faced towards the shaft 25" of the engine carries an end clutch

crown 25 the teeth of which lie on a plane face of the crown and precisely on the face directed towards the outside of the starter so as to be able to engage the teeth of an end clutch crown 25' connected to the shaft 25" of an engine.

The end clutches 25 and 25' are formed in such a manner that during engagement of these clutches 25 and 25' rotation of clutch 25 is transmitted to rotation of clutch 25' only in one sense of rotation, whilst in the other sense of rotation the clutches 25 and 25' are independent. Therefore, clutches 25 and 25' form themselves a one-way clutch.

Between the end clutch 25 integral with the cylinder 22 and the disc-shaped body 3 there is a spring 26. More particularly, one end of the spring 26 leans against an extension defined by the end clutch 25 whilst the other end of the spring 26 leans against the circular plate 11 of the disc-shaped body 3.

As previously said, one of the essential elements of a mechanical starter for engines according to the present invention is a mechanism which permits the use and the release of the starter with the shaft 25" of the internal combustion engine.

Said mechanism comprises a circumferential slot 27 obtained in the cylinder 22, in which there is a through opening 27' constituting a part of the shaft 20 of the starter and a pawl 28 constituted by an L-shaped lever 29 sliding in a guide 30 present in the cover 5. One end of the L-shaped lever 29 being capable of being received in the slot 27 and in the through opening 27' and moved away from this latter in opposition to the action of a spring 31, while the other end of the L-shaped lever 29 is provided with a gripping handle.

The other essential element of a mechanical starter according to the invention is the device for loading the same and said mechanism is represented in figure 1 and in enlarged scale in figure 3.

As shown in said figures, a lever 33 projecting from the cover 5 is encased within a casing 32, said lever 33 oscillating in opposition to a flat spring 34 around a point 35 placed in correspondence of one end of the lever 33. In fact, in correspondence of point 35 there is a pivot the ends of which are firmly bound to the walls of the casing 32.

A lever 36 is hinged to the casing 32, said lever 36 having at one end a driving handle 37 and at the other end a cam 38 able to act against the free end of the lever 33.

Between the ends of the lever 33 there is a rotatable shaft 39 which is integral with a gear wheel 40 and a wheel 41 having saw teeth, said wheels 40, 41 being integral with one another. Associated to the wheel 41 having saw teeth there is a pawl 42 pivoted on the same pivot 35 to which the lever 33 is pivoted, but which is freely rotatable in respect of said pivot 35, and a spring 43 connects the pawl 42 at one of its ends with said lever 33.

The driving mechanism provides further the presence (see figure 2) of a crown gear 44 connected to the disc-shaped body 3 and more particularly connected to the plate 9 of said disc-shaped body 3.

The operation of a mechanical starter according to the present invention is the following and will be described with reference to figures 2 and 3.

Figure 2 represents the starter in unloaded condition, i.e. with the strips 18 and 19 of elastomeric material not under tension and in this condition the pawl 28 has the free end of its own L-shaped lever 29 inserted in the slot 27 present in the shaft 20. In this way the end clutch 25 does not coact with the end clutch 25' connected to the shaft 25" of the engine or to a fly wheel to be connected to the shaft of the engine.

Consequently the starter for engines according to the present invention is not connected to the shaft 25" of the internal combustion engine.

If at that time it is acted on the driving handle placed at the end 37 of the lever 36 (figure 3) the loading mechanism of the starter is drawn near the pair of disc-shaped bodies 2 and 3, overcoming the resistence of the flat spring 34 which would tend to maintain the above cited mechanism far from the pair of disc-shaped bodies 2, 3.

By drawing near the driving mechanism, the gear wheel 40 of the mechanism itself couples with the crown gear 44 secured to the disc-shaped body 3.

At that time the rotatable shaft 39 is actuated through a crank 45 (figure 1).

Setting in action the crank 45, the gear wheel 40 is rotated and on its turn it rotates the crown gear 44 and consequently the disc-shaped body 3.

By means of the rotation of the disc-shaped body 3, which takes place with respect to the disc-shaped body 2, which disc-shaped body 2 is fixed by being connected to the engine body, the strips 18 and 19 of elastomeric material are placed under tension and consequently these latter store energy.

The rotation of the disc-shaped body 3 which takes place by dragging along with it in rotation the shaft 20 continues as far as the through opening 27' present on the shaft 20 faces the free end of the L-shaped lever 29 of the pawl 28.

At this moment, under the action of the spring 31 associated to the pawl 28 the free end of the L-shaped lever 29 of the pawl 28 is inserted into the through opening 27' present on the shaft 20 preventing the rotation from continuing and

blocking the disc-shaped body 3 with respect to the disc-shaped body 2.

In order to set in motion the engine by supplying the energy stored in the starter, first it is provided to act on the handle 37 of the lever 36 so as to release the end of the lever 33 in order to permit the driving mechanism of the starter from moving away from this latter.

When the above operation has been carried out, it is sufficient to act on the pawl 28 so as to release the end of the L-shaped lever 29 being inserted in the through opening 27' obtained in the shaft 20.

By setting in motion the pawl 28 there are the following two movements:

1. The shaft 20 slides along its own axis so as to have the end clutches 25' and 25 meshing with each other, said end clutches 25' and 25 belonging respectively to the shaft 25" of the engine and the shaft 20 of the starter;

2. The shaft rotates and under the rotation it is released the disc-shaped body 3 which is able to transmit, for example, through the flat flanks of the teeth of the end clutch 25 acting on the flat flanks of the teeth of the end clutch 25', the energy stored in the strips 18 and 19 of elastomeric material to the shaft 25" of the engine so as to cause the ignition. Subsequently, according to the above example, the rotation of the shaft 20 acting through the inclined flanks of the teeth of the clutch 25' on the inclined flanks of the teeth of the clutch 25 moves away the clutch 25 and during said separation the pawl 28 inserts its end into the slot 27 of the shaft 20 blocking it.

From the above description it is understood that by means of a mechanical starter according to the present invention the aimed purposes are achieved.

In fact there are avoided the risks for the users since during the loading operation of the starter this latter is not connected to the shaft of the internal combustion engine and, therefore,there are avoided as much as possible kicks by this latter. Moreover, the providing of a mechanism capable of being drawn near or moved away from the starter for its loading increases the safety degree because if the loading mechanism is not moved away from the starter, it is not possible to effect the actuation of the starter thanks to the presence of the wheel 41 having saw teeth and to the pawl 42 engaged with this latter.

The useful life of the starter according to the present invention is extended since by means of said starter it is prevented any possibility from overloading the elements through which the energy is stored and further thanks to the fact that the loading mechanism of the engine can be moved away from the starter at the moment of supplying energy stored in this latter, there are avoided in the most absolute way unbalances in the masses under rotation of the starter. This means reduction of the vibrations both in the starter and in the internal combustion engine associated to this latter and therefore reduction of the risks of unserviceability for both, but mainly for the starter. At last it is possible to apply a starter for internal combustion engine according to the present invention also on already existing engines, whose starting is of the mechanical type since it is possible to apply said starter with an easy substitution of the starting mechanism present in said engines using the same securing means provided for them.

Although a particular embodiment of the invention has been illustrated and described, it is understood that the invention includes in its scope any other alternative embodiment accessible to a technician of this field.

CLAIMS:

1. Mechanical starter for internal combustion engines, the starter comprising elastically deformable means for storing and delivering energy, characterized by the fact of comprising at least a pair of disc-shaped elements (2,3) coaxial to and rotatable in respect of each other, at least an elastically deformable body (18) connected with one of its own ends to one of said disc-shaped elements of the pair, and with the other end connected to the other disc-shaped element of the pair, means capable of being drawn near or moved away from one of the disc-shaped bodies to permit relative rotation of one disc-shaped element with respect to the other so as to deform the elastically deformable body, and means (25,25') for transferring energy from the elastically deformable body to the shaft (25") of the internal combustion engine.

2. Mechanical starter according to claim 1, characterized by the fact that the means capable of being drawn near or moved away from one of the disc-shaped bodies to permit relative rotation of one disc-shaped element with respect to the other, comprise a crown gear (44) integral with a disc-shaped element (9), a lever (33) pivoting in opposition to a spring (34) around one of its own ends at a fixed point (35), a cam (38) acting on the other end of the lever and a gear wheel (40) the axis of rotation of which is placed in an intermediate position to the lever, a crank (45) releasably associable to the gear wheel being provided to cause its rotation, and means being provided for obliging the gear wheel to rotate in a single sense.

3. Mechanical starter according to claim 2, characterized by the fact that the means for obliging the gear wheel (40) to rotate in a single sense comprise a pawl (42) pivoting in opposition to a spring (43) and acting on a wheel (41) having saw teeth and being coaxial to and integral with the gear wheel.

4. Mechanical starter according to claim 1, characterized by the fact that the means for transferring energy from the elastically deformable body (18) to the shaft (25") of the internal combustion engine comprise a pair of end clutch crowns (25,25'), each crown having the toothing arranged on one flat face of the crown, a first (25') end clutch crown of the pair being fixed to the shaft (25") of the engine and the second (25) end clutch crown of the pair being integral in rotation with one (3) of the disc-shaped elements and sliding along the axis of this latter in opposition to a spring (26), means being provided for blocking and releasing to each other the said end clutch crowns.

5. Mechanical starter according to claim 4, characterized by the fact that the means for blocking and releasing to each other the end clutch crowns (25,25') comprise a circumferential slot (27) provided with a through opening (27') present in a shaft (20) integral with one (25) of the end clutch crowns and a pawl (28) movable in opposition to a spring (31) having one end capable of being encased in the circumferential slot and in the through opening provided in said slot, said pawl being borne by the outermost disc-shaped element (2).

Fig. 1

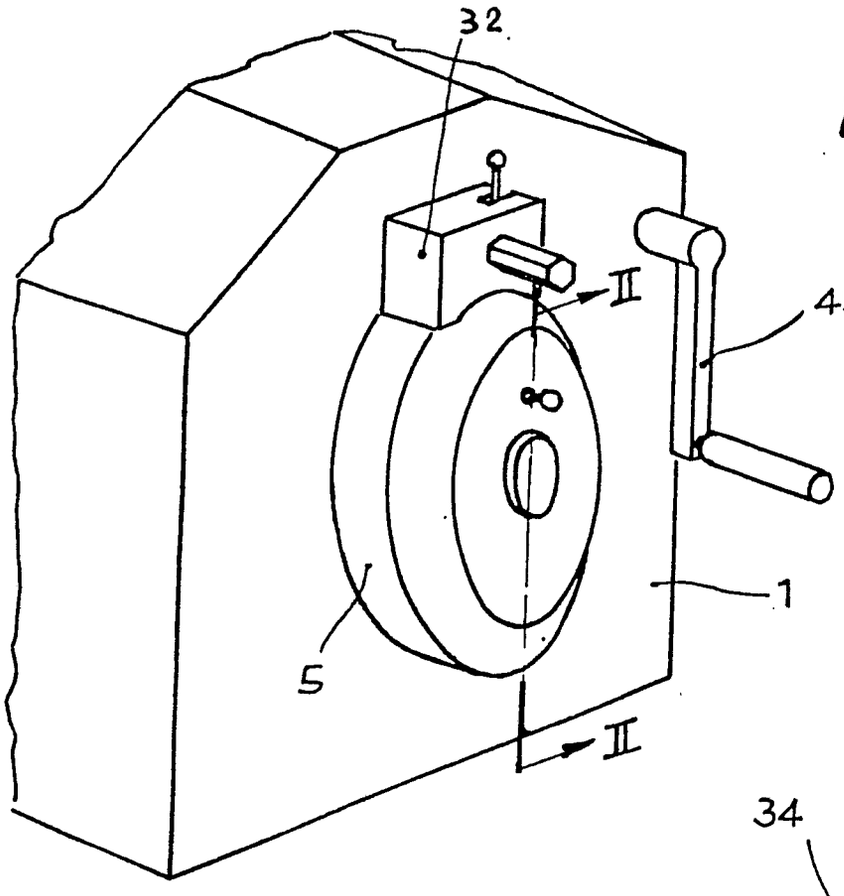
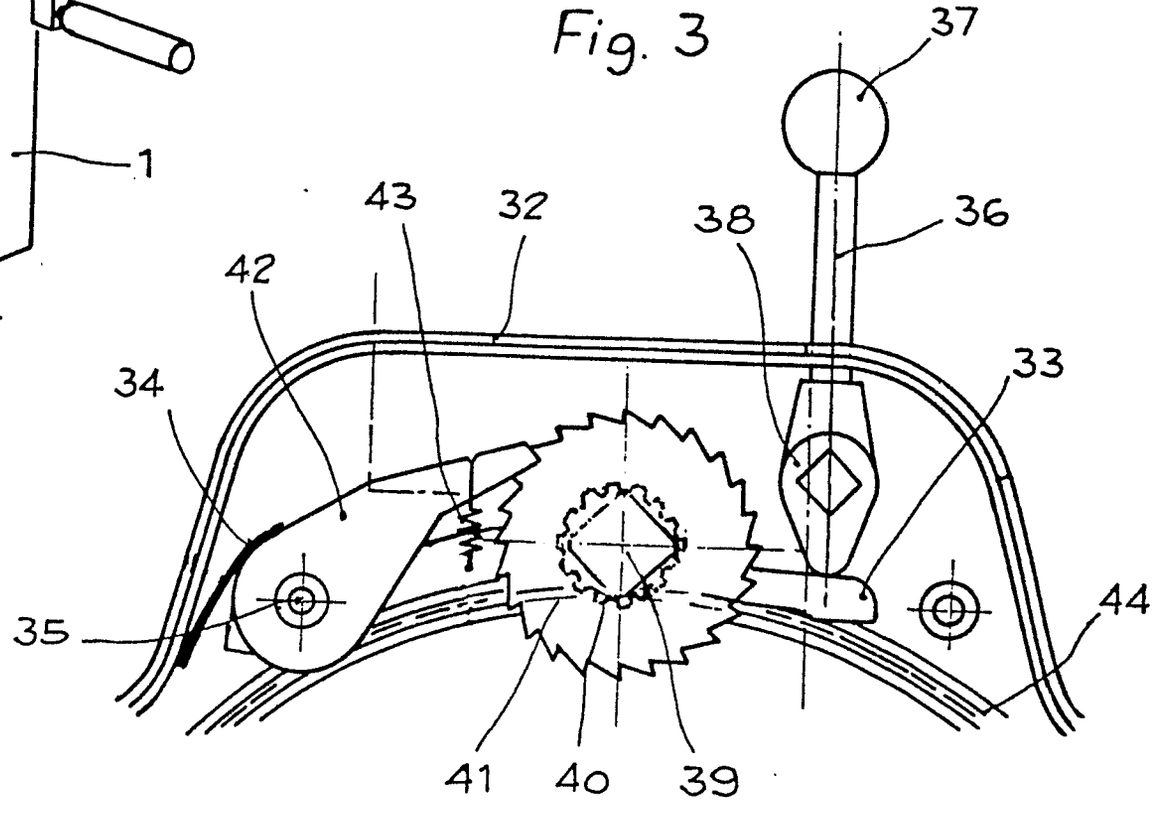


Fig. 3



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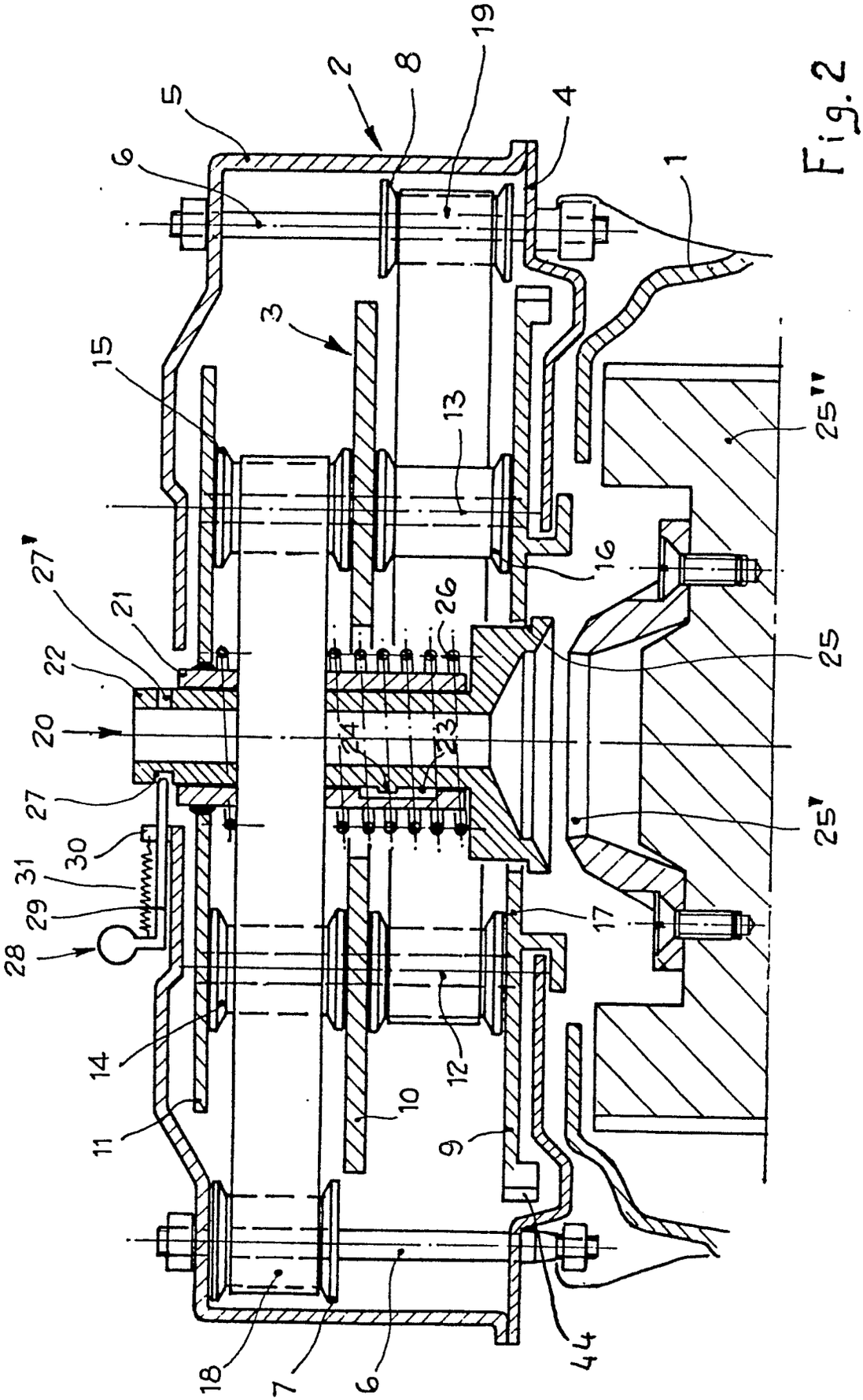
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Fig. 2

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EUROPEAN SEARCH REPORT

0087772
Application number

EP 83 10 1833

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. ³)
X	FR-A- 602 649 (GERARD) * Page 1, line 52 - page 2, line 56; figure 3; page 2, line 95 - page 3, line 32; figures 2,4; page 3, lines 65-74 *	1-4	F 02 N 5/02
X	DE-C- 638 291 (HUMBOLDT - DEUTSCHMOTOREN) * Page 1, line 52 - page 2, line 24; figures 1,2 *	1-3	
A	US-A-2 314 546 (MAULE) * Page 2, right-hand column, line 52 - page 3, left-hand column, line 10; figure 2 *	3	
A	US-A-2 744 586 (BLANKENBURG) * Column 2, line 68 - column 3, line 3; figure 1 *	5	TECHNICAL FIELDS SEARCHED (Int. Cl. ³) F 02 N
A	CH-A- 595 556 (NICOLET) * Column 2, lines 19-30; figure 1 *	5	
P,X	GB-A-2 095 758 (PIRELLI) * Page 1, line 122 - page 2, line 22; figure 1 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	31-05-1983	BIJN E.A.

CATEGORY OF CITED DOCUMENTS

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