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(54) Mechanism to select the slow running condition and find the pick in weaving looms

(57) The invention concerns a mechanism to select the slow running condition and find the pick in weaving looms, of the type comprising a double gear clutch (I_1, I_2) wherein a driven gear (2), fixed to a shaft (4) transmitting the motion to a weave machine (A), is apt to alternately or simultaneously mesh with a main gearwheel (1), transmitting the motion from and to the main shaft (P) of the loom, and with a slow running gear (14) receiving the motion from an auxiliary motor (m). According to the invention, both the main gearwheel (1) and the slow running gear (14) are formed of a single body and are apt to perform an axial translation, and at least the meshing between said driven gear (2) and said slow running gear (14) takes place in the manner of a spur gearing.

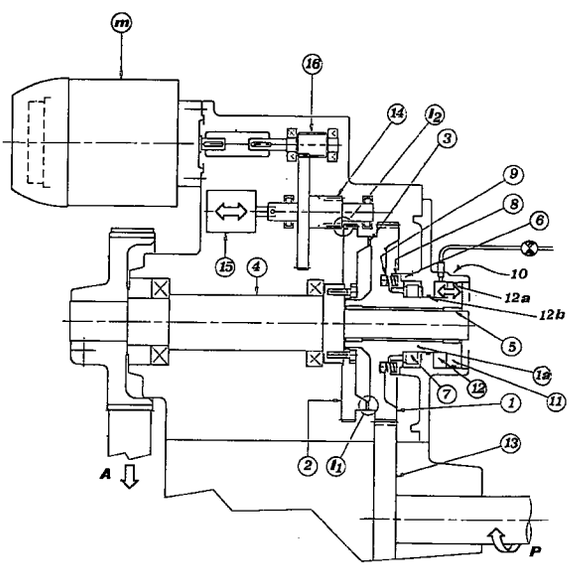


Fig.2

EP 0 882 824 A1

Description

The present invention concerns a mechanism to connect the main shaft of a loom with the loom weave machine and with the slow running control of said loom. In particular it concerns a so-called mechanism to select the slow running condition and find the pick in looms.

As known, the main shaft of a loom controls also the weave machine (dobby, jacquard or cam machine) working with said loom. In the event that, for any reason (for instance, braking of a warp yarn, faulty weft yarn insertion, and so on) it may be required to stop the working of the loom, it is indispensable to subsequently be able to carry out some loom picks in slow running conditions, eventually going in reverse, so as to locate the fault, or inconvenience, and then start again in steady running conditions without leaving defects in the fabric.

To work in slow running conditions, the loom is equipped with an auxiliary motor which acts, through an appropriate kinematic chain with high reduction ratio, on the shaft of the weave machine.

It is however necessary for the auxiliary motor to be able to act only in slow running conditions and to then be excluded during the steady running conditions of the loom. A slow running clutch is provided for the purpose, to connect the auxiliary motor with the weave machine only when the slow running conditions are set.

In most cases, the stopping, maintenance and restarting of the loom require the motion of the weave machine to be independent from that of the main shaft of the loom: for example, when a faulty weft insertion occurs, it should be possible to cause the weave machine to perform an appropriate motion, keeping the main shaft idle, so as to open the shed and pull out the faulty weft yarn, without a new weft yarn being inserted by the weft insertion device controlled by the main shaft of the loom.

To make the two movements independent, the main shaft of the loom and the shaft of the weave machine are connected through a main coupling clutch. Said clutch should not only determine or exclude the connection, but should also guarantee for the connection to be univocally determined, namely for the phase angle between the two shafts to be always the same, so that the loom cycle may be constantly repeated to answer the requirements of the fabric pattern. According to known technique this is obtained in different ways, one of the most common ways being to adopt a pin, fixed onto one of the two portions of the clutch and engaging into a seat therefor formed into the other portion of the clutch. The step wherein - with the loom in slow running conditions - the pin is moved up to being brought in correspondence of its seat, is called "pick finding" step, and this is how it will be indicated hereinafter.

It can be seen from the above that, in modern looms, it is necessary to equip the drive mechanism with two clutches - one to connect the main shaft of the loom with the shaft of the weave machine, and the other one to connect the auxiliary motor with the weave machine - with three fundamental operating conditions (shown in figs. 1A, 1B and 1C of the accompanying drawings):

- Steady running conditions, with the main clutch I_1 engaged and the slow running clutch I_2 disengaged (fig. 1A).
- Slow running conditions of the whole loom, with both clutches I_1 and I_2 engaged (fig. 1B).
- Slow running conditions of the weave machine A and main loom shaft P in idle conditions (for example, pick finding step), with the main clutch I_1 disengaged and the slow running clutch I_2 engaged (fig. 1C).

Mechanisms of this type are known in technique, and have different and more or less complicated structures.

One of such mechanisms - mostly in demand on the market - is that disclosed in EP-B1-322.928, in the name of BARUFFALDI S.p.A.. In this patent, the double clutch substantially consists of two plane bevel gears (i.e. bevel gears developing on a plane) mounted as a sandwich and moved, so as to mesh, axially one against the other, according to appropriate working schemes. The main loom shaft and the shaft of the weave machine are coaxial and face each other with one of their ends. On the end of the main loom shaft there is fixed a rotor carrying, by way of a flat spring, a first plate having a plane bevel toothing. Said first plate is apt to axially translate in respect of its rotor, under the opposing action of a combination of flat and thrust springs and of an electromagnet fixed onto an external box, which develops a magnetic field through the rotor, such as to attract the toothed plate. The thrust springs are apt to press the first toothed plate against a second rotor with plane bevel toothing, fixed at the opposite end of the shaft of the weave machine, thus ensuring the engagement of the main clutch. A pin coupling system is moreover provided between the second rotor and the first translatable plate, said system allowing an univocal mesh between the plane bevel toothings of the plate and of the second rotor. On the rear surface of the second rotor there is provided a second translatable plate with plane bevel toothing, apt to mesh - again under the opposing action of springs and of an electromagnet - with a plane bevel gear, coaxial to the two rotors but idle in respect thereof. This last gear comprises, over its circumference, a toothing apt to mesh with a worm screw operated by an auxiliary motor. Hence, the meshing between the second plate and the plane bevel gear represents the slow running clutch.

This solution, though widely spread, involves however a series of inconveniences.

To start with, the two rotors and the translatable

plates by meshing through plane bevel toothings, cannot provide any reduction ratio; this task is hence fully entrusted to another kinematic chain, separate from the clutch system. This arrangement, besides requiring a higher number of components, forces to adopt kinematic mechanisms with a high reduction ratio, such as worm and pinion gears, having a low efficiency.

Secondly, the plane bevel gears are rather critical in transmitting a torque, as the teeth profiles impart on the gear an axial thrust, which is inclined to disengage the clutch when they undergo a tangential stress deriving from the application of a torque; consequently, the gears should be kept pressed one against the other with a strong axial force imparted by preloaded springs. Thus, the higher the torque meant to he applied, the stronger will need to be the axial compressive stress being imparted on the gears of the clutch. This inevitably introduces design limits.

Moreover, the flat springs - used, both to allow the translation of the toothed plate in respect of the corresponding rotor, and to provide a certain coupling thrust - form a very delicate element of the mechanism. Without taking into account the fact that they introduce the presence of a critical elasticity in the clutch, which is apt to create problems of vibrations and unsteadiness in the coupling.

In addition, the use of translatable plates interposed between the rotors, requires to adopt electromagnetic actuators apt to act thereon, thanks to the magnetic field, even through the thickness of the actual rotating gears. However, the use of electromagnets does not allow to perform translation strokes exceeding 1÷2 mm, and this no doubt represents a considerable drawback, as it makes it indispensable to adopt gears with a plane bevel toothing which, besides involving the already cited drawback, are more costly than the common spur gears.

Finally, the worm gear used to transmit the motion of the auxiliary motor, has a very low efficiency and thus requires the use of a powerful auxiliary motor. Besides, also this gear is a costly component.

The object of the present invention is to overcome said drawbacks. In particular, it is meant to supply a mechanism allowing to determine and exclude the connection between the main shaft of the loom and the shaft of the weave machine, and between the shaft of the weave machine and an auxiliary slow running motor, by means of a double gear clutch which is simple and economic, which may be operated both by electromagnetic means and by hydraulic or pneumatic means, and in which the use of gearings with plane bevel toothings is reduced to a minimum (concerning this last aspect it should be noted that, in spite of the drawbacks and costs involved, plane bevel toothings are still considered at present an unreplaceable solution in this field of technique).

Said object is reached by means of a mechanism to select the slow running condition and find the pick in weaving looms - of the type comprising a double gear clutch wherein a driven gear, fixed to a shaft transmitting the motion to a weave machine, is apt to alternately or simultaneously mesh with a main gearwheel, transmitting the motion from and to the main shaft of the loom, and with a slow running gear receiving the motion from an auxiliary motor - in which, both the main gearwheel and the slow running gear are formed of a single body and are apt to perform an axial translation, and in which, at least the meshing between said driven gear and said slow running gear takes place in the manner of a spur gearing.

Further characteristics and advantages of the mechanism according to the present invention will anyhow be more evident from the following detailed description of some preferred embodiments thereof, given by way of example and illustrated on the accompanying drawings, in which:

Figs. 1A, 1B and 1C are diagrammatic views showing the different possibilities of operation of the mechanism to select the slow running condition and find the pick in looms (already indicated heretofore);
Fig. 2 is a cross section view of a preferred embodiment of the invention, with the loom in steady running conditions;
Fig. 3 is a view similar to fig. 2, with the loom in slow running conditions;
Fig. 4 is a view similar to fig. 2, showing the pick finding step;
Fig. 5 is a view similar to fig. 2, of another embodiment of the invention; and
Fig. 6 is a view similar to fig. 2, of a further embodiment of the present invention.

As already said with reference to figs. 1A to 1C, the mechanism of the present invention substantially comprises two gear clutches: a first main clutch I_1, which connects the main shaft P of the loom with the shaft of the weave machine A; and a second slow running clutch I_2, which connects an auxiliary motor m to the shaft of the weave machine A.

According to the invention and as clearly shown on the drawings, the main clutch I_1 and the slow running clutch I_2 are positioned offset one in respect of the other, and in respect of the main loom shaft P, according to a structure which could be defined "cantilevered", for reasons which will appear evident hereinafter.

As shown in fig. 2, the clutch I_1 consists of two gearwheels 1 and 2, apt to mesh through plane bevel toothings 3, and mounted coaxial onto a same shaft 4.

According to the invention, the outer gearwheel 1 - or main gearwheel - is formed of a single body, apt to perform an axial translation. It is in fact mounted on the shaft 4 by way of needle bearings 5 and onto a case 6 by way of a radial roller bearing 7, having an axial slack, so as to allow the gearwheel 1 to freely perform an axial translation.

Preferably, also the inner gearwheel 2 - or driven gear - is formed of a single body.

The thrust required to cause the meshing between the two gearwheels 1, 2, with plane bevel toothing, is imparted by springs 8 acting between the main gearwheel 1, through an axial needle bearing 9, and the case 6.

An actuator acts on the outer gearwheel 1, in opposition to the springs 8, to disengage the clutch I_1 by parting the main gearwheel 1 from the driven gear 2 (fig. 4). According to a preferred embodiment of the invention, said actuator is a hydraulic actuator 10: the gearwheel 1 comprises a hub 1a extending so as to form, at one end thereof, a piston 11 into a pressure chamber 12, oil under pressure being fed into said chamber. Sliding gaskets 12a and 12b are provided to ensure the seal.

According to another embodiment of the present invention (fig. 5), said actuator is an electromagnetic actuator 50, the magnets acting directly onto the outer gearwheel 1 in opposition to the springs 8.

The gearwheels 1 and 2 also comprise, over their circumference, a conventional spur gearing apt to mesh, respectively, with a spur gear 13 fixed to the main loom shaft P, and with a slow running gear 14.

The toothing provided on the spur gear 13 is sufficiently long to be in constant mesh with the main gearwheel 1, even when this latter translates into the position of disengagement from the driven gear 2 (fig. 4): this prevents from missing the correct phase angle between the main shaft P and the main gearwheel 1 of the clutch I_1 . Furthermore, the phase angle between the gearwheel 1 and the driven gear 2 is univocally determined, for example, by a conventional pin coupling (not shown).

The clutch I_2 is instead formed by meshing of the spur gear 2 with the slow running gear 14. According to the invention, said gear 14 is a spur gear, formed of a single body apt to perform an axial translation by way of a second actuator 15. This solution - though taking up more space in a transversal sense, and requiring a wider motion of translation than needed to mesh similar gearwheels with a plane bevel toothing - provides several advantages. It is in fact positively more efficient, it does not require the presence of thrust means to keep the gears in constant mesh, and it also allows to obtain a gearing-down directly in the clutch, which cannot be obtained between two gearwheels with plane bevel toothing. Finally, it involves less costs.

The slow running gear 14 is caused to rotate by the auxiliary motor m through a driving gear 16 - having a sufficiently long toothing to keep in constant mesh with the gear 14 through all its positions of axial translation - and eventually by a reduction gear 17.

Preferably moreover, the auxiliary motor m, or the kinematic chain connected thereto, should be provided with a brake (not shown) apt to oppose the torque applied by the weave machine A. In fact, the load of the weave machine is variable in time and, in particular cases (jacquard, negative dobby), due to the presence of return springs, an acceleration torque is applied on the auxiliary motor, which torque may be troublesome in the pick finding step. Thus the presence of a brake apt to slow down the rotation speed of the driven gear 2, proves to be advantageous.

The combination of the described components, in the three typical working conditions, is as follows:

- In steady running conditions (fig. 2), the motion is transmitted by the main shaft P to the main gearwheel 1 and from this latter - by way of the driven gear 2 and the shaft 4 - to the weave machine A.
- In slow running conditions of the whole loom (fig. 3), the motion is transmitted by the auxiliary motor m, through the slow running gear 14, on one side - by way of the driven gear 2, the main gearwheel 1 and the spur gear 13 - to the main shaft P of the loom and on the other side - by way of the driven gear 2 and the shaft 4 - to the weave machine A.
- In the pick finding step (fig. 4), the motion imparted to the driven gear 2 by the auxiliary motor m, is no longer transmitted to the main shaft P - in that the main gearwheel 1 is parted from the driven gear 2 - but is merely transmitted to the weave machine A, up to reaching the correct phase angle between the gearwheels 1 and 2 (insertion of the coupling pin into its seat), whereby the steady running conditions of the loom can be reset.

Preferably, the auxiliary motor m is a variable-speed motor. This allows to work at a minimum speed in critical slow running conditions (for example, during insertion of the coupling pin into its seat), and at a higher speed in other slow running conditions, thereby reducing even further the overall dead times of the loom.

The speed variation of the auxiliary motor m can be obtained, for example, by varying the frequency of the supply current.

According to a further embodiment of the invention, shown in fig. 6, also the meshing in the clutch I_1 takes place in the manner of a spur gearing, being obtained - for example - between an outer spur toothing 61, formed on the gearwheel 1, and an inner spur toothing 62, formed on the gearwheel 2, said toothings engaging frontally. In this case, it is no longer necessary to use thrust springs 8, and the axial translation of the gearwheel 1 can be obtained through an actuator 63 with double-acting hydraulic piston.

The present invention is thus apt to fully accomplish the proposed objects, providing a series of advantages in respect of prior art.

In fact, the cantilevered structure of the mechanism according to the invention allows to adopt spur gears which, besides being component parts of the clutches I_1 and I_2 (as the gearwheels 1 and 2, and the slow running gear 14), also form part of the kinematic chain to reduce the gear ratio, thereby obtaining a real economy of com-

ponents of the mechanism, as well as an appreciable structural simplicity. Moreover, it is consequently no longer indispensable to obtain the whole reduction ratio on a single gear pair (for example, worm and pinion gears), to the full advantage of driving efficiency.

The gearwheels 1 and 2 are in a single body - i.e. having no translatable plates with plane bevel toothings, as in EP-B1-322.928 - which allows to eliminate delicate components, as the actual plate and the flat springs; this also leads to more freedom in the choice of the actuators, which no longer need to be electromagnetic, to act through the thickness of the gearwheels, but which can be of a different type (hydraulic, pneumatic, with linear motor, and so on), with undeniable advantages as far as forces and shifting possibilities.

Furthermore, the meshing between two spur gears no longer requires the presence of delicate thrust means.

The use of a hydraulic actuator 10 allows the main gearwheel 1 to perform an axial stroke which is positively longer than that allowed by an electromagnetic actuator: this helps, not only to determine or exclude the engagement of the clutch I_1, but also to obtain the disengagement of the gearwheel 1 from the spur gear 13. The advantages thus provided are the possibility to disengage the gears 1 and 13, find a new phase angle between them, and subsequently reset the mesh, by simply increasing, beyond a desired disengagement value, the normal stroke imparted by the actuator 10 onto the gearwheel 1: this finally allows to change the phase angle between the main shaft P and the weave machine A when requiring to change the type of fabric weave, while keeping the same mesh between the gears 1 and 2 during the normal loom maintenance operations.

The adjustment of the new phase angle, once the gears 1 and 13 have been disengaged, can be manually operated for instance by acting on a control wheel with rating notches, visible to the operator, or it can be obtained by electronic systems, for example by comparing the signal issued by two control devices - such as conventional encoders - fixed, respectively, to the main shaft P of the loom and to the shaft 4 transmitting the motion to the weave machine A, such devices being apt to supply a reading of the phase angle between said shafts P and 4. The electronic type of adjustment is preferable, as it allows to create an electronic file wherein, to each woven article, there is associated a respective phase angle.

It is anyhow understood that the invention is not limited to the particular embodiments described, which merely represent non-limiting examples of its scope, but that many variants can be introduced, all within reach of a person skilled in the art, without thereby departing from the protection field of the present invention.

In particular, the wide possibility of choice for what concerns the actuators of the mechanism, also foresees - according to an even further embodiment of the invention - the use of a fork actuator, of the type commonly known as gearshift fork in motorvehicles. This solution, though more bulky, would eliminate all problems deriving from the use of sliding gaskets required to ensure a seal for the hydraulic fluid in the pressure chamber 12.

Claims

1. Mechanism to select the slow running condition and find the pick in weaving looms, of the type comprising a double gear clutch (I_1, I_2) wherein a driven gear (2), fixed to a shaft (4) transmitting the motion to a weave machine (A), is apt to alternately or simultaneously mesh with a main gearwheel (1), transmitting the motion from and to the main shaft (P) of the loom, and with a slow running gear (14) receiving the motion from an auxiliary motor (m), characterized in that, both the main gearwheel (1) and the slow running gear (14) are formed of a single body and are apt to perform an axial translation, and in that, at least the meshing between said driven gear (2) and said slow running gear (14) takes place in the manner of a spur gearing.

2. Mechanism as in claim 1), wherein also the driven gear (2) is formed of a single body.

3. Mechanism as in claim 1) or 2), wherein also the meshing between said driven gear (2) and said main gearwheel (1) takes place in the manner of a spur gearing.

4. Mechanism as in claim 1), 2) or 3), wherein said main gearwheel (1) comprises a further spur gearing; through which it meshes with a gear (13) fixed to the main shaft (P) of the loom.

5. Mechanism as in any one of the previous claims, wherein the hub (1a) of said main gearwheel (1) comprises, at one end thereof, piston means (11) of a hydraulic actuator (10) for the translation of the main gearwheel (1).

6. Mechanism as in claim 5), wherein the hydraulic actuator (10) acts in opposition to thrust springs (8), acting between the main gearwheel (1) and a case (6) of the mechanism.

7. Mechanism as in claim 5), wherein the hydraulic actuator (10) is a double-acting actuator.

8. Mechanism as in any one of claims 1) to 4), wherein the main gearwheel (1) translates under the action of an electromagnetic actuator (50).

9. Mechanism as in any one of the previous claims, wherein the translatable slow running gear (14) meshes with a spur driving gear (16), sufficiently

long to keep in constant mesh the teeth of the two gears (14, 16) through all the positions taken up by the slow running gear (14).

10. Mechanism as in claim 4), wherein the meshing between said main gearwheel (1) and said gear (13) extends over a length which is shorter than the maximum stroke of the main translatable gearwheel (1).

11. Mechanism as in claim 10), wherein two encoders are provided, fixed respectively to the main shaft (P) of the loom and to said shaft (4) transmitting the motion to the weave machine (A), said encoders being apt to supply a reading of the phase displacement angle between said shafts (P, 4).

12. Mechanism as in any one of the previous claims, wherein a brake is also provided to act on the auxiliary motor (m), or on a kinematic chain connected thereto.

13. Mechanism as in any one of the previous claims, wherein the auxiliary motor (m) is a variable-speed motor.

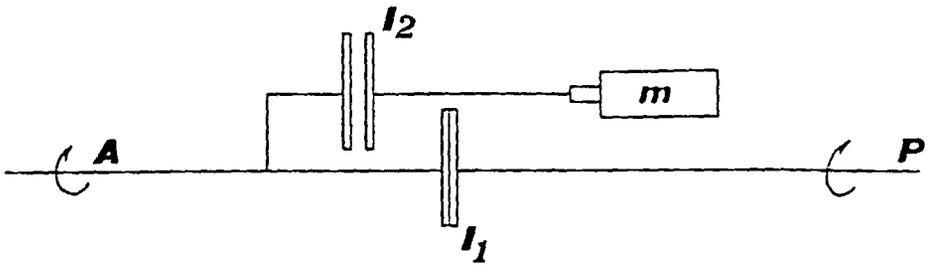


Fig.1A

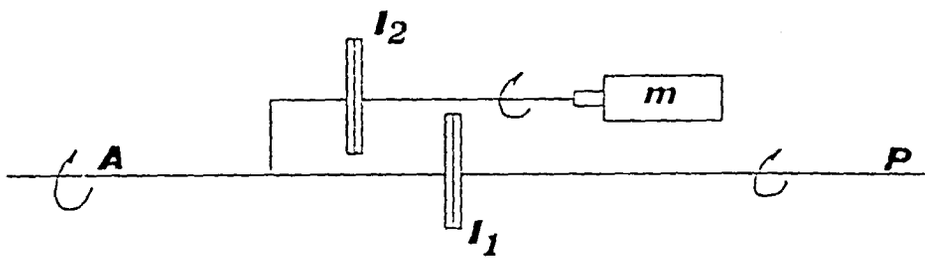


Fig.1B

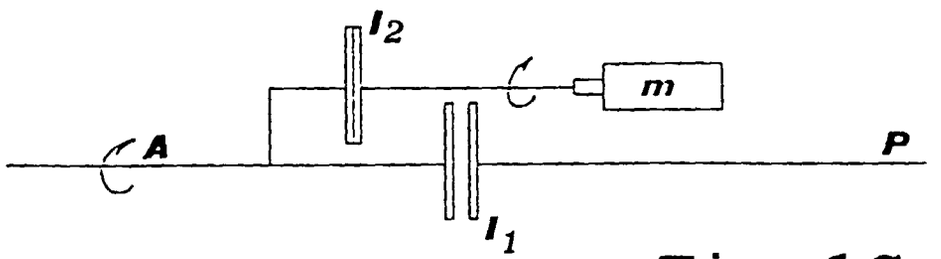


Fig.1C

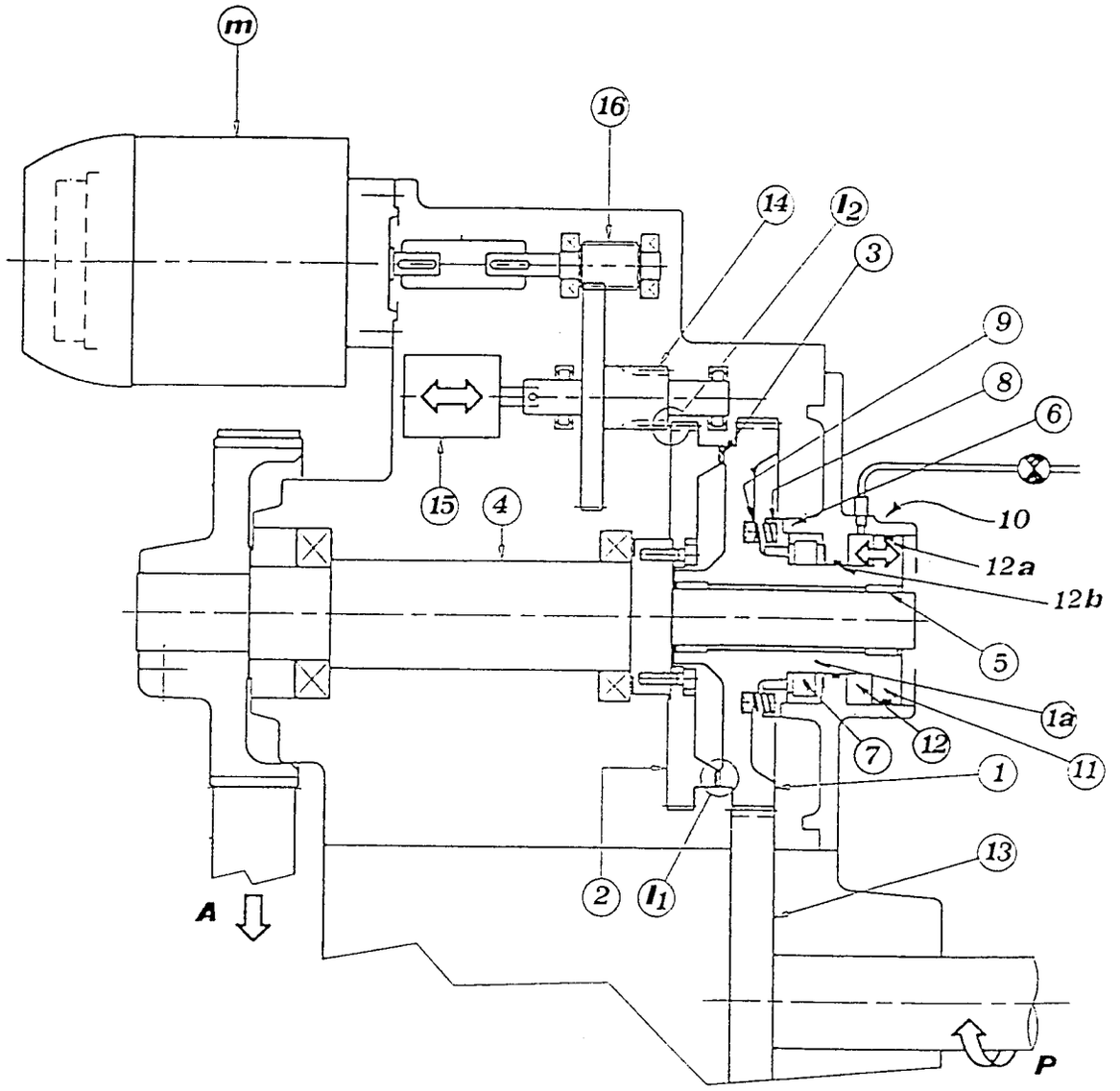


Fig.2

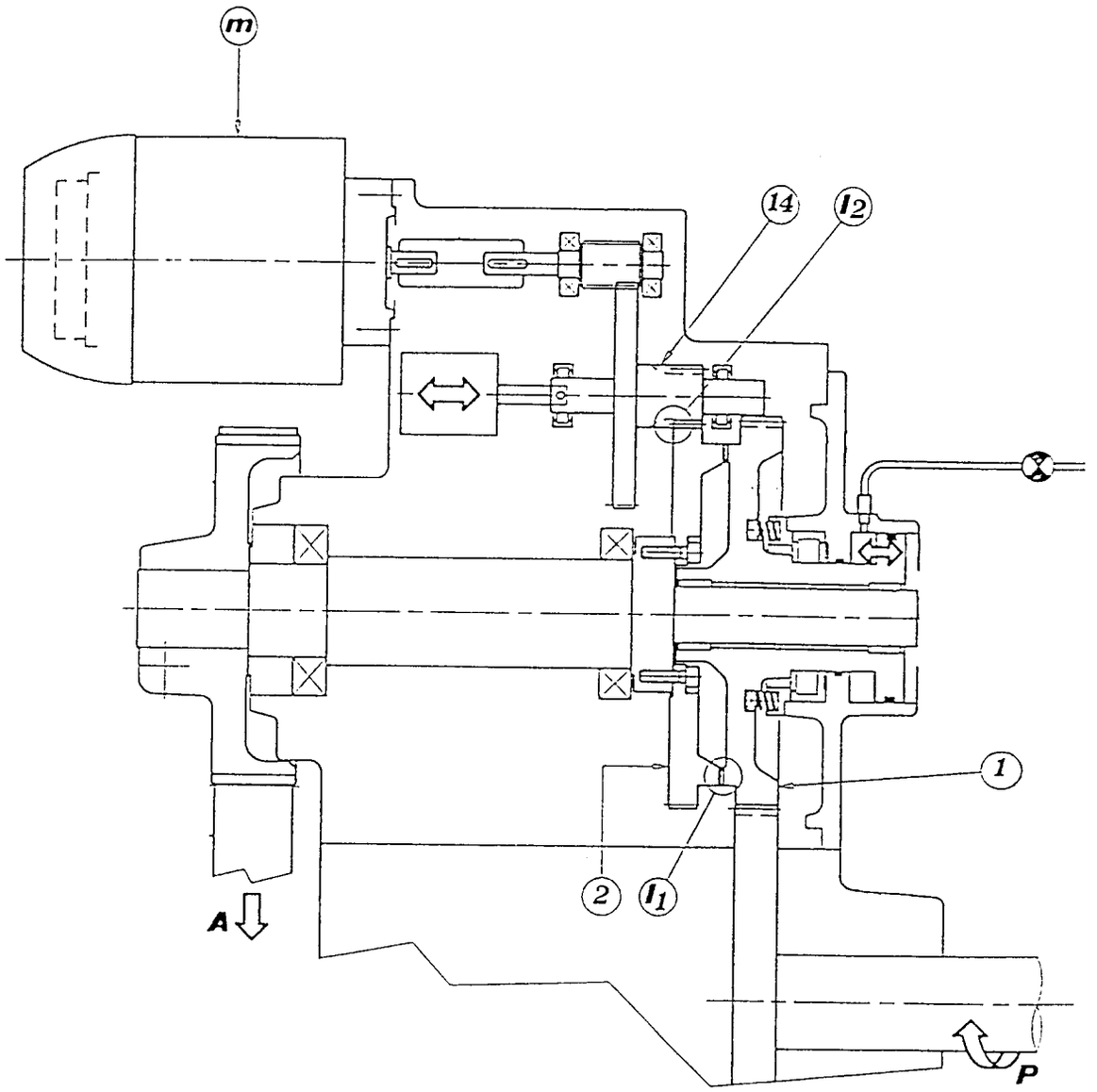


Fig.3

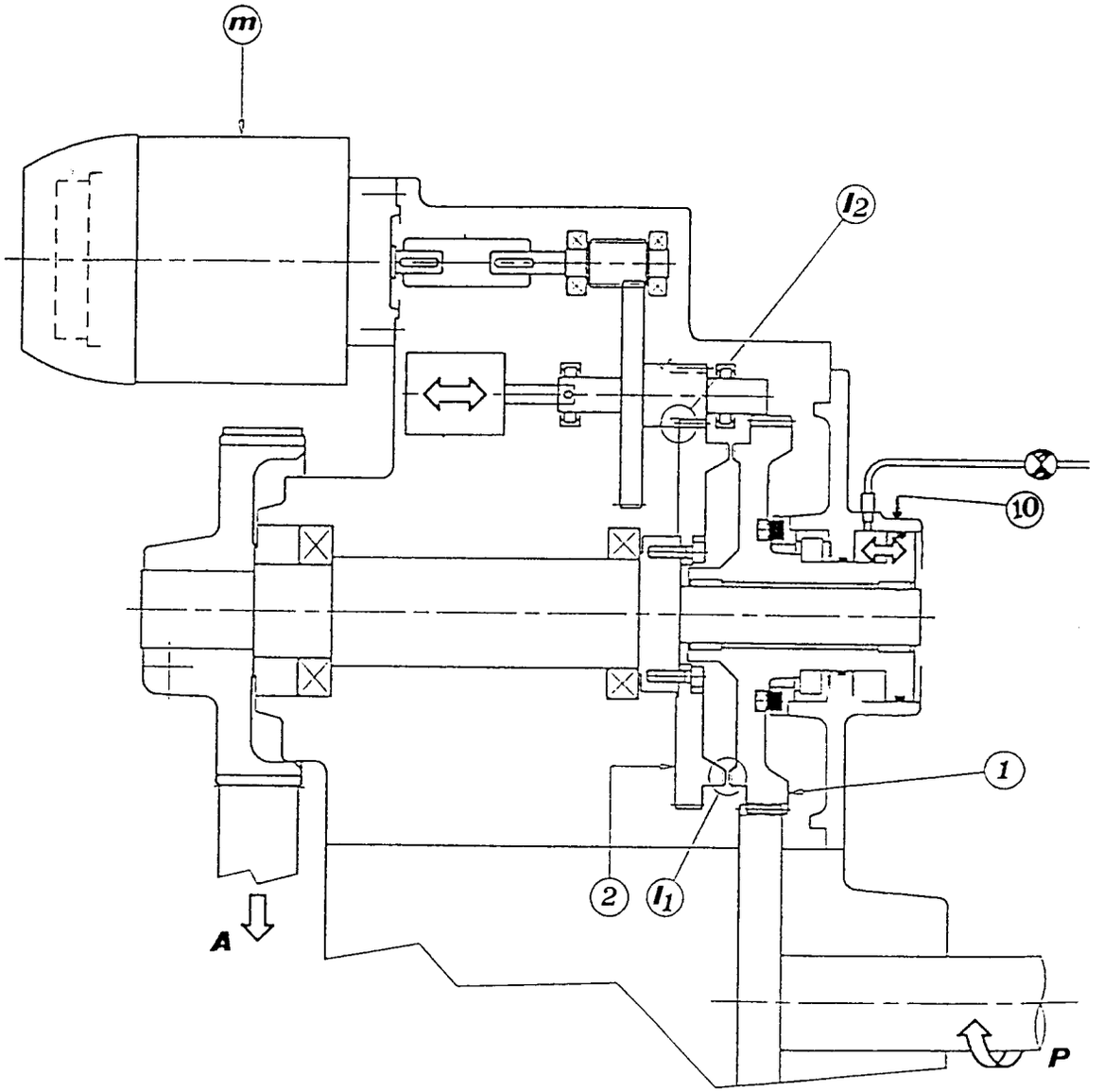


Fig. 4

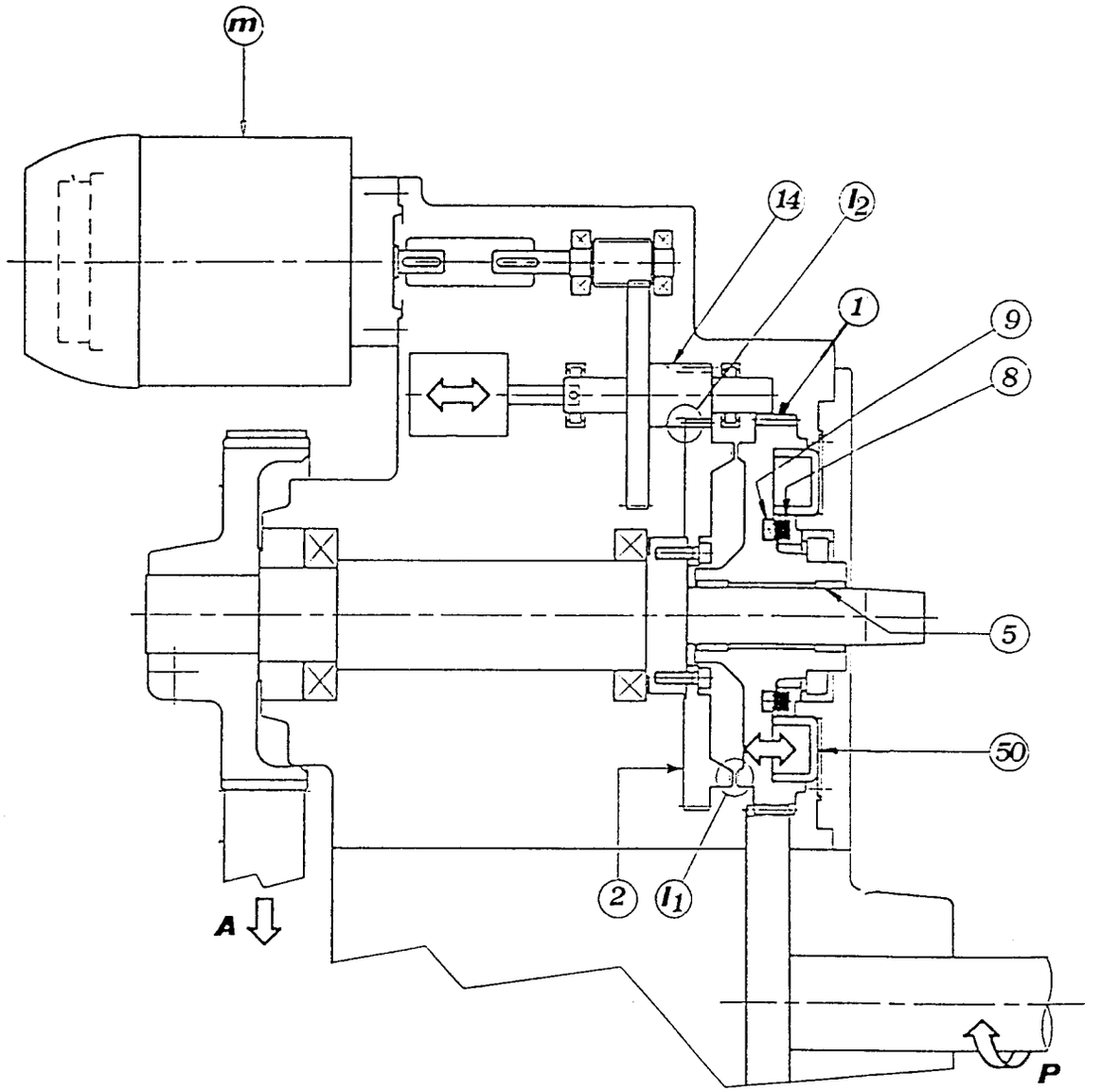


Fig.5

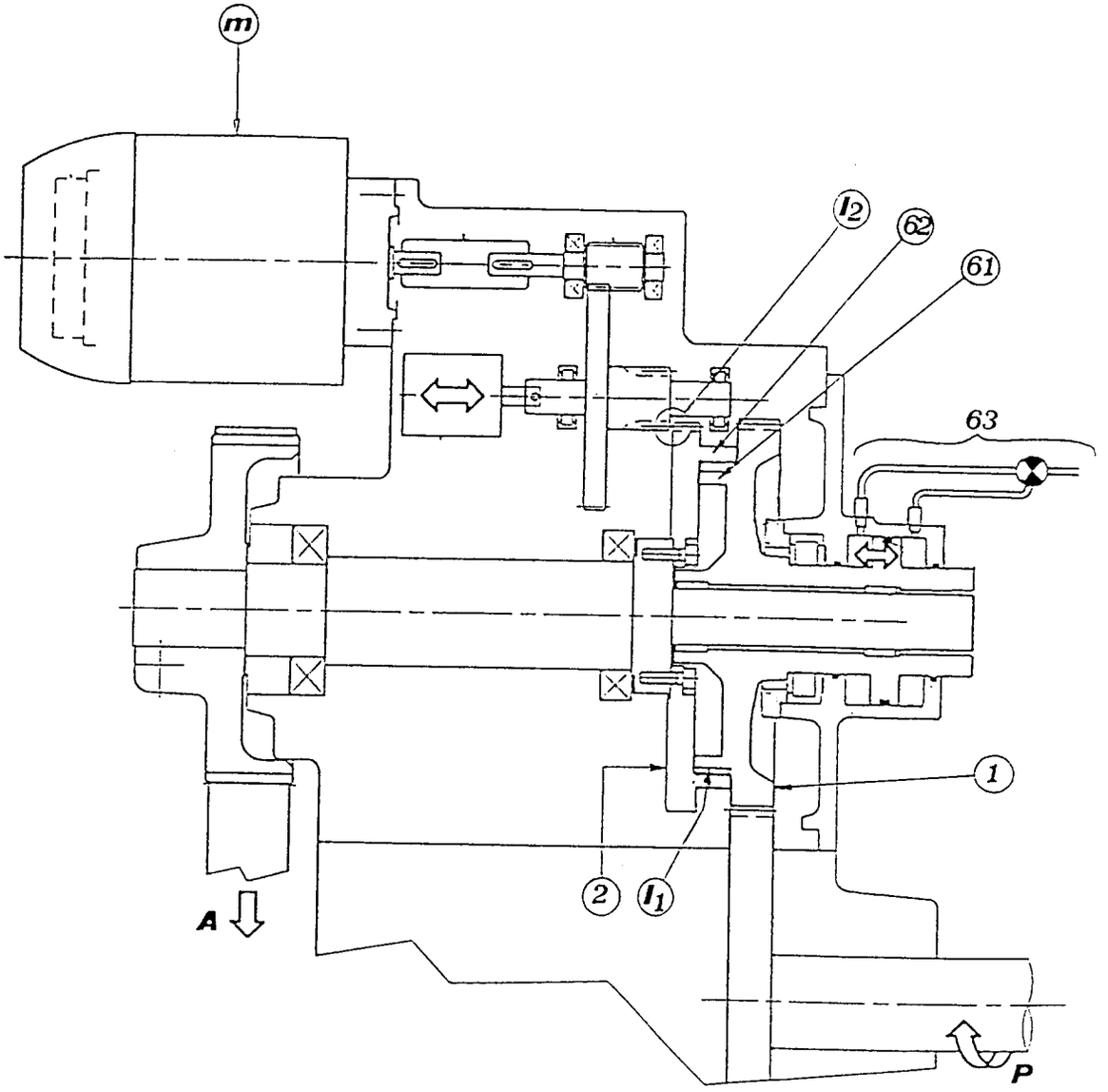


Fig.6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 11 0018

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)
A	EP 0 161 012 A (PICANOL) 13 November 1985 * the whole document *	1,8,9	D03D51/00
A,D	EP 0 322 928 A (BARUFFALDI) 5 July 1989 * the whole document *	1,8,9	
A	FR 2 137 554 A (NUOVO PIGNONE) 29 December 1972		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

D03D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	1 October 1998	Boutelegier, C

CATEGORY OF CITED DOCUMENTS

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