



(11) **EP 2 341 170 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**06.07.2011 Bulletin 2011/27**

(51) Int Cl.:  
**D03D 51/02 (2006.01)**

(21) Application number: **10197114.1**

(22) Date of filing: **28.12.2010**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA ME**

(71) Applicant: **Promatech S.p.A.**  
**24020 Colzate (Bergamo) (IT)**

(72) Inventor: **Casarotto, Giuseppe**  
**24122 Bergamo (IT)**

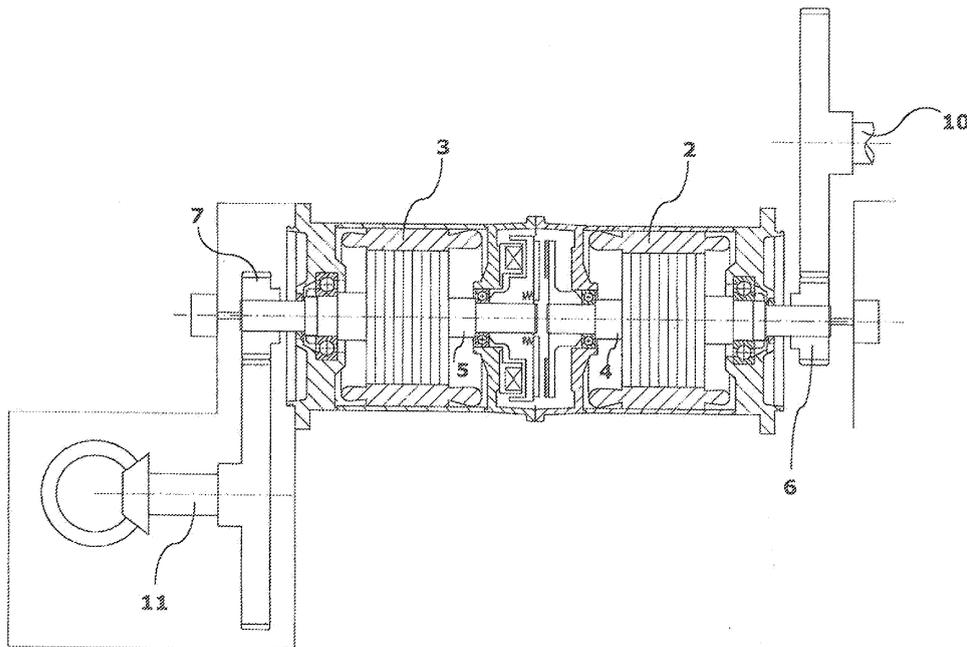
(74) Representative: **Faggioni, Marco et al**  
**Fumero Studio Consulenza Brevetti Snc**  
**Pettenkoferstrasse 20-22**  
**80336 München (DE)**

(30) Priority: **30.12.2009 IT MI20092337**

(54) **Drive unit for weaving looms with a high degree of use flexibility, provided with safety controlling device for possible critical phase displacements of the moving mechanical members and weaving process using such unit**

(57) Drive unit (1) for weaving looms, of the type comprising a first electric motor (2) driving the moving members of the loom (T) which cause the insertion and beating of the weft, a second electric motor (3) driving the weaving machine (A) which causes the opening/closing movement of the warp yarns for shed forming and an electric-axis control system to maintain the synchronisation

and/or the desired degree of phase displacement between said moving members of the loom (T) and said weaving machine (A). Said first and second motor (2, 3) are mounted coaxially and are both provided with a second power takeoff, said second power takeoffs being adjacent and mutually connected through an electromagnetic connection, disengageable by energising the electromagnet.



**Fig. 6a**

**EP 2 341 170 A1**

## Description

### FIELD OF THE INVENTION

**[0001]** The present invention refers to a drive unit for weaving looms, and in particular to a unit of this type which allows a high degree of use flexibility of the loom from a weaving point of view and, simultaneously, which prevents possible failures of the moving mechanical members of the loom through a safety controlling device apt to prevent that any phase displacements of such members exceed preset critical values.

**[0002]** The invention also concerns a weaving process which uses such drive unit.

### STATE OF THE PRIOR ART

**[0003]** In weaving looms it is well-known to use electric motors for driving loom movements.

**[0004]** The traditional solution provides the use of a main motor, to which all the moving members of the loom are connected through suitable kinematic mechanical connections, and in particular the main movements of the sley with reed, of the weaving machine and, in gripper looms, of the grippers for weft introduction into the shed. The main motor is normally kept in constant rotation and hence a clutch assembly and a flywheel are essential components of such solution to allow start and stop transient conditions, respectively, as well as a satisfactory operation evenness.

**[0005]** In this respect, as a matter of fact it must firstly be remembered that the above-said movements of the moving members of the loom are all of an alternative type with cyclically and highly varying resistant torque paths. If on the loom side (sley and grippers) the dynamic behaviour for each certain loom height is virtually repetitive cycle by cycle, on the side of the weaving machine the dynamic behaviour is instead strongly influenced by the number of the heald frames, by their travel and especially by the movement sequence determined by the weaving pattern. In case of a Jacquard-type weaving machine, the extreme pattern variability is complemented by the potential energy of the return springs. Hence the strong need to regularize the circular motion of the motor by the use of adequate flywheel masses.

**[0006]** Still in the traditional solution, a secondary electric motor was furthermore provided for actuating the sole weaving machine when disconnected from the drive of the main motor, the so-called "slow run", for the purpose of performing the backward search of the shed after the insertion of a wrong weft.

**[0007]** An advanced type of this solution is schematically illustrated in the enclosed fig. 1, wherein the references have the following meanings:

M = main electric motor for actuating loom T and weaving machine A, through cinematic chains along which clutch assemblies are arranged;

V = flywheel of the main motor;

F = clutch of the main motor, to allow the coupling between motor M already at running conditions and the halted loom T and weaving machine;

B = front brake with brake lining, to keep halted the moving members of loom T and of weaving machine A when clutch F is disengaged;

T = loom (reed and grippers) ;

S = secondary motor actuating the slow-run and backward movement of weaving machine A, for the search of the shed where wrong weft insertion occurred;

F<sub>S</sub> = secondary motor clutch, to allow the coupling of weaving machine A alternatively to main motor M or to secondary motor S;

I<sub>T</sub> = toothed joint with single-position engagement, for the phase coupling between loom T and weaving machine A;

I<sub>S</sub> = toothed joint with multiple-position engagement, for the coupling between armature machine A and secondary motor S;

A = weaving machine.

**[0008]** Compared to this initial state of the art in the motorisation of weaving looms, the continuous developments in electric motors and in the control opportunities of the same have furthermore allowed the development of other types of solutions, which will be briefly illustrated in the following.

**[0009]** A first one of these innovative solutions concerns the simplification of the drive unit due to the removal of the clutch, of the flywheel and of the secondary motor. As a matter of fact the functions performed by these members in this solution are all played by main motor M. As a matter of fact said motor can be drive at reduced speed and in both rotation directions to perform the simultaneous slow run of loom T and of weaving machine A, or that of sole weaving machine A. Engagement systems are hence present which allow the disengagement from motor M of sole loom T, despite maintaining the movement of weaving machine A. Also the functions of the clutch and of the flywheel are performed by main motor M, the electric supply power of which is variable so as to accomplish sufficiently quick start and stop transient conditions and as to compensate - electrically/electronically rather than mechanically - the fluctuation of the overall resistant moment of the weaving machine and of the loom within each cycle.

**[0010]** Solutions of this type are schematically shown in figs. 2 and 3. In the diagram of fig. 2 the disconnection of motor M from loom T is achieved through a clutch F, possibly combined with a double front toothed joint, wherein a first joint IM is a rotary running joint, preferably with multiple connection positions spaced apart by a constant pitch (for example 4-5°) while second joint I is a halting joint to keep halted the moving members of loom T when clutch F is disengaged. The moving disc of clutch F has an axial play designed so that, during the clutch

detachment/attachment operation, a phase is entered in which said moving disc is meshed both with running joint IM and with halting joint I. Thereby it is possible to keep the loom members steadily in the position in which they have been stopped. In the diagram of fig. 3 the disconnection of motor M from loom T is instead achieved by means of an axially sliding gear G (fig. 3). A solution of the first type is disclosed in EP-1158081 and EP-1245707 in the name of the same Applicant, while a solution of the second type is disclosed in WO98/31856 (PICANOL) or EP-1600542 (SMIT).

**[0011]** A second more recent innovation, schematically shown in fig. 4, provides instead the full duplication of the motorization so as to obtain independent controls for weaving machine A and for loom T by means of respective motors MA and M. Weaving machine A and loom T are hence fully independent from a mechanical point of view and their synchronism is guaranteed by means of an electric/electronic control system managed through a suitable software, commonly known as "electric-axis" and schematically shown in the drawing by block E. A solution of this operating mode of a loom drive is disclosed for example in EP-1312709 in the name of the same Applicant, in EP-1775361 (SMIT), in US-7114527 and WO-2006/039912 (both in the name of Dornier).

**[0012]** This last solution is the one which - from a weaving point of view - compared to the other preceding solutions illustrated above which are characterised by a constant and absolute synchronism between the movements of the different loom members, and which hence offer an opportunity for mutual phasing of the same only with a halted loom - has a much higher degree of use flexibility consisting in the opportunity of adjusting the mutual phasing of said members (reed and possibly grippers on the one hand, and weaving machine with relative heald frames on the other one) also during loom processing and even within a same weft insertion cycle and/or between groups of subsequent cycles. This opportunity proves particularly useful both during the transient start and stop phases, and during the shed search phases with a halted loom, and during running conditions, where the opportunity to adjust shed opening and closing, possibly also depending on the individual weft inserted, can allow the processing of items which in conventional looms are instead difficult or problematic to weave. Moreover, this solution has a greater mechanical construction simplicity, in particular as concerns the motion transmission members which are highly simplified.

**[0013]** In the light of these potential interesting advantages, which have spurred great expectations by the weavers' market, the solution set forth above with two independent motors, however, has some undeniable and not negligible drawbacks which in fact have so far limited the application thereof to the sole pneumatic looms and to non-high-quality items.

**[0014]** A first one of such drawbacks is linked to the fact that, in running condition, the independence of the two drive units no longer allows to partly compensate

with one another the cyclical oscillations of the torque between weaving machine and loom. The regularisation of the movement of both the drive units must hence be obtained exclusively through the management of the flow of electric energy for the supply of the electric-axis connected motors, which normally causes an oversizing of the motor assemblies, with a resulting greater installed and also actually consumed power.

**[0015]** A second and more serious drawback is connected to the risk of collision of the weft transfer members (tapes and grippers) with the warp yarns driven by the motion, of the weaving machine, following significant losses of angular synchronism due to malfunctioning, such as for example failure of the electronic systems (drive, software, encoder etc.), or to sudden and unexpected increases/decreases of the varying, resistant fraction forces of the waving machine or of the loom. Another risk situation - as concerns the maintenance of synchronism conditions between the weaving machine and the loom - furthermore arises in case of sudden lack of power. Moreover, beyond these malfunctioning issues, also during the regular operation of the loom there are risks of imprecision in the synchronism of the two deriving systems, especially in some critical angular positions. An electric-axis system, in the light of continuous torque variations, hence does not constantly guarantee a connection rigidity equal to the one offered by conventional mechanical systems.

**[0016]** In all the cases examined above, when the loss of synchronism originates an interference between moving mechanical members, in addition to the possible damages to the machine and to the fabric being woven determined by a possible collision, another serious problem to be overcome also arises, related to the safety of the operators in charge of monitoring the machines, who may be involved in the consequences of such collision. These safety problems would impose the adoption at least of moving protection shields which would increase the cost of the machine and to remarkably decrease the practicality of use thereof.

#### PROBLEM AND SOLUTION

**[0017]** The problem at the basis of the present invention is hence that of proposing a drive unit for weaving looms which, despite capturing all the weaving advantages of the solution with independent motors described above, overcomes the limitations thereof and the drawbacks indicated above and hence offers high condition of safety both for the dedicated staff and for the integrity of the moving members of the loom.

**[0018]** This object is achieved by a drive unit for weaving looms having the features defined in claim 1. Other preferred features of the invention are defined in the dependent claims,

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0019]** Further features and advantages of the invention are in any case more evident from the following detailed description of a preferred embodiment of the drive unit of the invention, given purely as a non-limiting example and shown in the attached drawings, wherein:

fig. 1 (known art) is a diagram which represents a drive unit for weaving looms according to a classic solution with flywheel, clutch and auxiliary drive with independent motor with clutch and toothed joint for the shed search movement of the weaving machine; fig. 2 (known art) is a diagram which shows a drive unit for weaving looms according to a single-motor solution with electronic control, with front teeth joint for the engagement/disengagement between loom and weaving machine;

fig. 3 (known art) is a diagram which shows a drive unit for weaving looms according to a solution similar to that of the preceding drawing, where the engagement/disengagement is obtained by the axial displacement of a gear;

fig. 4 (known art) is a diagram which shows a drive unit for weaving looms according to a solution with two independent motors for the separate drive of the loom and of the weaving machine, said motors being electric-axis connected;

fig. 5 is an axial section view of a drive unit according to a first embodiment of the present invention;

fig. 6a is a view of the drive unit of fig. 5 positioned on a loom, during the operation of the unit in electric-axis;

fig. 6b is a view similar to fig. 6a, during the operation of the unit in mechanical-axis; and

fig. 7 is an axial section view of a drive unit according to a second embodiment of the invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0020]** A first embodiment of drive unit 1 according to the present invention (fig. 5) consists of a pair of motors 2 and 3 made mutually integral in the fixed outer case, so that the rotors of said motors are coaxial. Said coaxial rotors are mounted on respective shafts 4 and 5 which carry on the outer end of unit 1 driving pinions 6 and 7, which represent the outer power takeoffs for driving a loom T and a weaving machine A, respectively.

**[0021]** According to the fundamental feature of the invention, both motors 2 and 3 furthermore have a second power takeoff, through which they can be made mutually integral to rotation. In this first embodiment, said second power takeoffs are arranged in correspondence of the opposite inner ends of shafts 4 and 5, each of which carries - as inner power takeoff of unit 1 - one of the two cooperating portions 8 and 9 of a front electromagnetic spring joint. The construction of the joint is preferably of

the passive-joint type, i.e. wherein the coupling position of the joint is determined by said springs in the absence of electric excitation and vice versa. When the electromagnet of joint 8, 9 is energised, the two shafts 4 and 5 are hence mutually free and the two motors 2 and 3 have an operation fully independent from a mechanical point of view. On the contrary, when the electromagnet of joint 8, 9 is not energised, a rigid connection to rotation of the two shafts 4 and 5 occurs and the two motors 2 and 3 rotate in perfect sync. The joint 8, 9 may also advantageously be of the so-called "viscous-operation" type, i.e. such that, when it is in the energised disengagement position, it allows only a limited degree of bilateral sliding of the two portions of the joint with respect to the synchronous coupling position and the resistance of such viscous sliding may be remotely managed, by the electronic control system of the loom, for example so as to make it progressively larger as the position of synchronous coupling is abandoned and one of the two safety-limit positions is approached, in correspondence of which the coupling between the two shafts 4 and 5 becomes perfectly rigid.

**[0022]** The drive unit according to the present invention can hence - depending on the different operation requirement connected to the various work phases of the loom and/or to the type of woven item, and depending on the position of joint 8, 9 - act as a pair of independent motors or as a single motor.

**[0023]** The solution of the present invention hence allows to have on the one hand maximum flexibility of use of the two motors, making them mutually (fully or partly) free from a mechanical point of view by exciting joint 8, 9, as illustrated in fig. 6a, and adjusting the controlled phase displacement thereof through electronic means well-known per se (electric-axis). On the other hand, the same drive unit allows to obtain the maximum level of safety, since the disexcitation of joint 8, 9 is capable of bringing back immediately motors 2 and 3 in rigid mechanical-axis connection, as illustrated in fig. 6b, whenever this is necessary or useful.

**[0024]** In particular this mechanical-axis connection between the two motors can for example be activated, for safety purpose, when the phase displacement between the two motors exceeds a predefined safety limit value or - and this in a fully automatic way, i.e. without the need of an active control - when electric energy supply fails due to failures or power cut-off, thus removing any possibility of failures of the moving members of the loom or of the warp yarns and hence the drawbacks and the costs connected with the repair thereof and the loss of efficiency due to the resulting time of machine downtime.

**[0025]** The mechanical-axis connection can of course also be used in normal weaving conditions, in running conditions, whenever there is no longer the need to have controlled varying phase displacements between loom T and weaving machine A.

**[0026]** Due to the construction described above, the drive unit of the present invention has an extremely com-

pact configuration and can hence be advantageously installed on the edge of the loom in a "strategic" position existing between the main shaft 10 of loom T and the main shaft 11 of weaving machine A (figs. 6A and 6B) which is normally devoid of other members, thus obtaining a very "neat" loom design and a dramatic bulk reduction over the kinematic motion transmission chains between loom and weaving machine found in known-type looms, which kinematic chains are as a matter of fact fully replaced by the only two coaxial shafts 4 and 5 of drive unit 1.

[0027] In a second embodiment of the invention, illustrated in fig. 7, while the design of motor 2 is identical to the one described above, the one of motor 3 provides that the second power takeoff of said motor is arranged on an extension of shaft 5 beyond pinion 7, and hence on the same side of motor 3 where the first power take off is already arranged, consisting indeed of pinion 7, instead of opposite parts as in the first embodiment. Due to this design of motor 3, and as appears evidently from the drawings, it is possible to obtain an even more compact design of the drive unit 1 of the present invention.

[0028] The design of the drive unit of the present invention finally allows to use motors 2 and 3 consisting of fully identical assemblies, mounted in a coaxial position on the two sides of electromagnetic joint 8, 9. This arrangement allows remarkable advantages both from the point of view of the manufacturing costs of drive unit 1, and from the point of view of the maintenance and storage costs of the required spare parts.

[0029] As is evident from what has been stated above, in addition to the above-recalled advantages in terms of safety and bulk, the drive unit of the present invention is of course capable of achieving all the advantages of flexibility in the weaving operations typical of the systems with electric-axis direct motorisation.

[0030] In particular it allows:

- an independent movement of loom T and of weaving machine A, when motors 2 and 3 are electric-axis connected (fig. 6a), during slow run for shed search;
- an independent movement of loom T and of weaving machine A, when motors 2 and 3 are electric-axis connected (fig. 6a), during the transient phases of start and stop of the loom with controlled and varying phase-displacement;
- to use an electro-magnetic clutch 8, 9 which, in an energised condition of the electromagnet, is either fully or partly free (this last so-called viscous joint), in order to be able to control in different ways the phase displacement between the two motors 2 and 3;
- a synchronous movement of loom T and of weaving machine A, when motors 2 and 3 are mechanical-axis connected (fig. 6b), during the running phase;
- once the start phase according to the electric-axis has been completed, and in conditions of accomplished electric synchronism, to mechanically con-

strain the rotation (Fig.6b) of shafts 4 and 5 in conditions wherein the relative speed thereof is null or near null;

- to use the maximum available energy of two motors for the acceleration and deceleration phases, and to subsequently only partially use drive unit 1 by using a single motor for the running operation, after the passage to mechanical-axis of motors 2 and 3 has occurred, while the unused motor acts as additional flywheel mass;
- to obtain a controlled angular phase displacement during the arc of the turn (cycle) for weaving requirements;
- a good regularisation of the loom system reducing to a minimum the additional inertial masses due to the exchange of mechanical energy (resistant torque/driving torque) which travels through joint 8, 9 between the two axes 4 and 5.

[0031] The drive unit of the present invention has been described with reference to a preferred embodiment of the same, but it must be clear that the scope of protection of the invention is not limited to such embodiment, but extends to all the possible variants and improvements of the same which are within the reach of a person skilled in the field and fall within the definitions of the invention provided in the attached claims.

### 30 Claims

1. Drive unit (1) for weaving looms, of the type comprising a first electric motor (2) driving the moving members of the weaving loom (T) which cause the introduction and the beating of the weft, a second electric motor (3) driving the weaving machine (A) which causes the opening/closing movement of the warp yarns for shed forming and an electric-axis control system for maintaining the synchronisation and/or the desired degree of phase displacement between said moving members of the weaving loom (T) and said weaving machine (A), **characterised in that** each of said first and second motor (2, 3) has a second power takeoff and said second power takeoffs are mutually connected in rotation by means of a disengageable mechanical connection.
2. Drive unit as claimed in claim 1), wherein the second power takeoff of at least one of said first and second motor (2, 3) is axially opposite to the one used for driving the moving members of the weaving loom (T) and of the weaving machine (A), respectively.
3. Drive unit as claimed in claims 1) or 2), wherein the shafts (4, 5) of said first and second motor (2, 3) are coaxial, said second power takeoffs are adjacent and said mechanical connection consists of a front electromagnetic spring joint, the two portions of which

(8, 9) are integral with the opposite ends of the shafts (4, 5) of said motors, respectively.

4. Drive unit as claimed in claim 3), wherein said electromagnetic spring joint is in an engaged position when the electromagnet driving the same is not energized.
5. Drive unit as claimed in claim 4), wherein said electromagnetic spring joint, in an energised position, allows a viscous sliding of the two portions of the joint within preset limits.
6. Drive unit as claimed in claim 5), wherein said electromagnetic joint is driven, both in the engaged/disengaged position and in the adjustment of the value of the viscous sliding resistance, by the electronic system controlling the weaving loom.
7. Drive unit as claimed in claim 5), wherein the resistance of said viscous sliding of the electromagnetic joint progressively increases from the synchronous coupling position towards either one of the two safety limit positions, in correspondence of which the joint becomes a rigid joint.
8. Drive unit as claimed in any one of the preceding claims wherein said first and second motor (2, 3) and said disengageable mechanical connection (8, 9) are housed in a single case.
9. Drive unit as claimed in any one of the preceding claims wherein the drives of said first and second motor (2, 3) consist of pinions (6, 7) meshed directly with the toothed wheel actuating the moving members of the weaving loom (T) and with the toothed wheel actuating the weaving machine (A), respectively
10. Drive unit as claimed in any one of the preceding claims wherein said first and second motor (2, 3) are identical and are mounted in the drive unit in a coaxial position, on both sides of said electromagnetic spring joint (8, 9).
11. Weaving process in a weaving loom equipped with a drive unit as claimed in any one of claims 1) to 10), **characterised in that**
  - a. in transient conditions, i.e. weaving loom start and stop, the mechanical connection between the shafts (4, 5) of the motors (2, 3) is kept disengaged and the two motors are kept in synch, with the desired degree of variable phase displacement, by an electric-axis control system; and
  - b. in running conditions, the mechanical connection between the shafts (4, 5) of the motors (2,

3) is kept:

- i. engaged, and the two motors are kept in synch by a mechanical-axis, or alternatively
  - ii. disengaged, and the two motors are kept in synch, with the desired degree of variable phase displacement, by an electric-axis control system.
12. Weaving process as claimed in claim 11), wherein the mechanical-axis connection in the disengagement position is only partly free and allows a viscous sliding of the two portions (8, 9) of the joint within preset limits.
  13. Weaving process as in claim 12), wherein the resistance value of said viscous sliding is remotely adjusted by means of the electronic system controlling the weaving loom.
  14. Weaving process as claimed in claim 13), wherein said resistance value of the viscous sliding progressively increases from the synchronous coupling position towards either one of the two safety-limit positions, in correspondence of which the joint becomes a rigid joint.
  15. Weaving process as claimed in any one of claims 11) to 14), wherein in running condition one of said electric motors (2, 3) is not active or is only partly active and wherein the non-active or only partly active motor is driven into rotation by the active motor which it is connected to, acting as an additional fly-wheel mass of the drive unit (1).

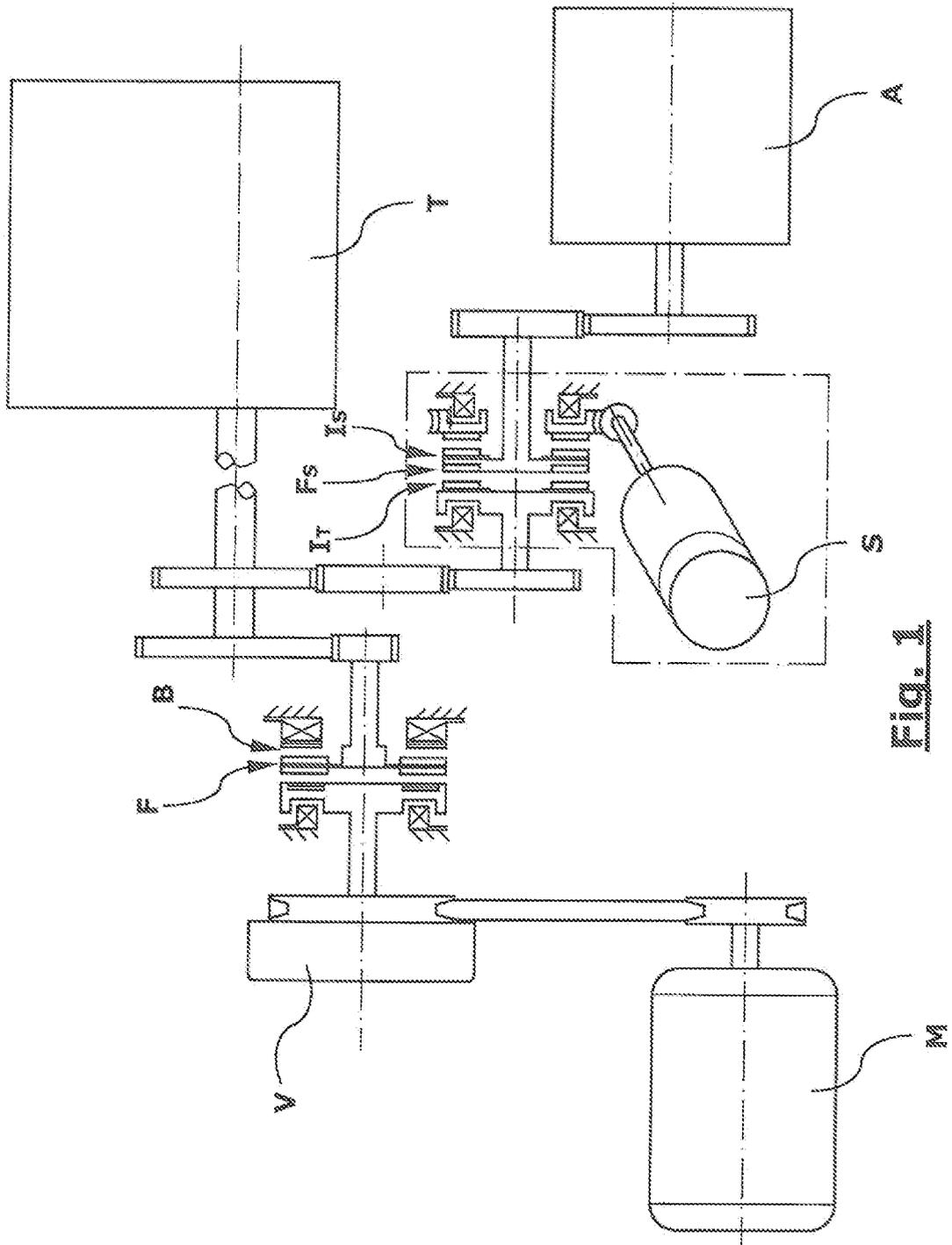


Fig. 1

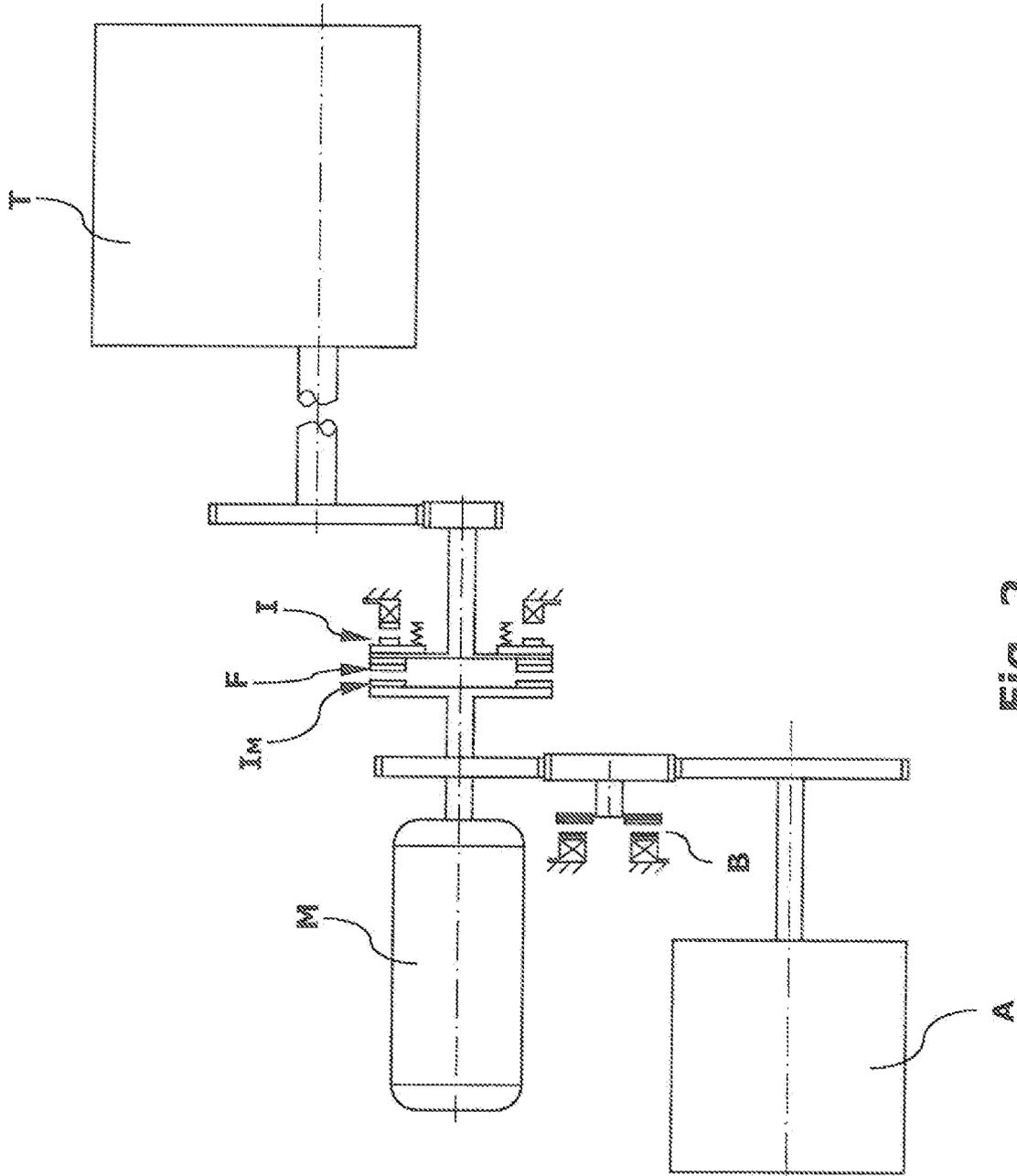


Fig. 2

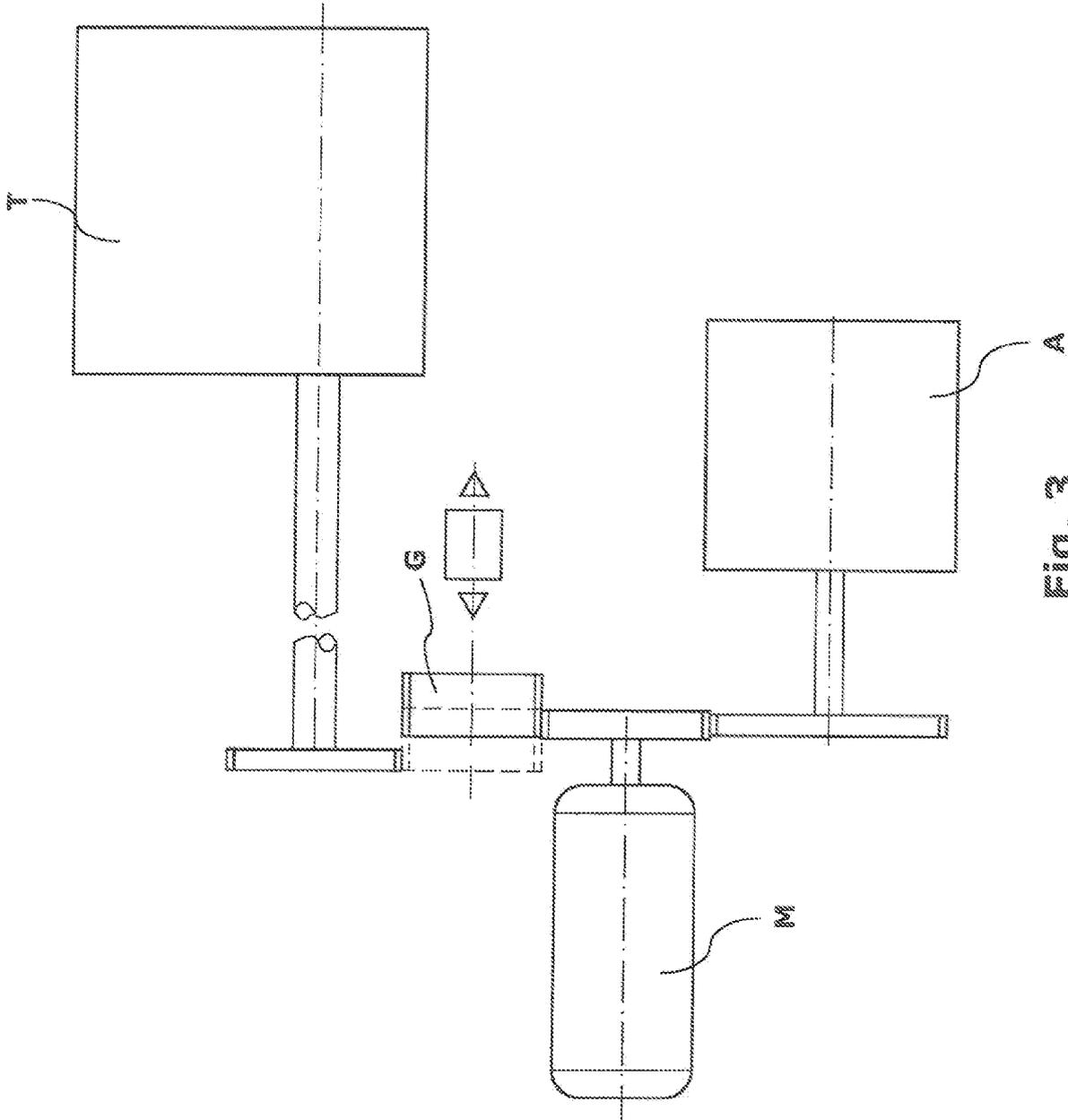


Fig. 3

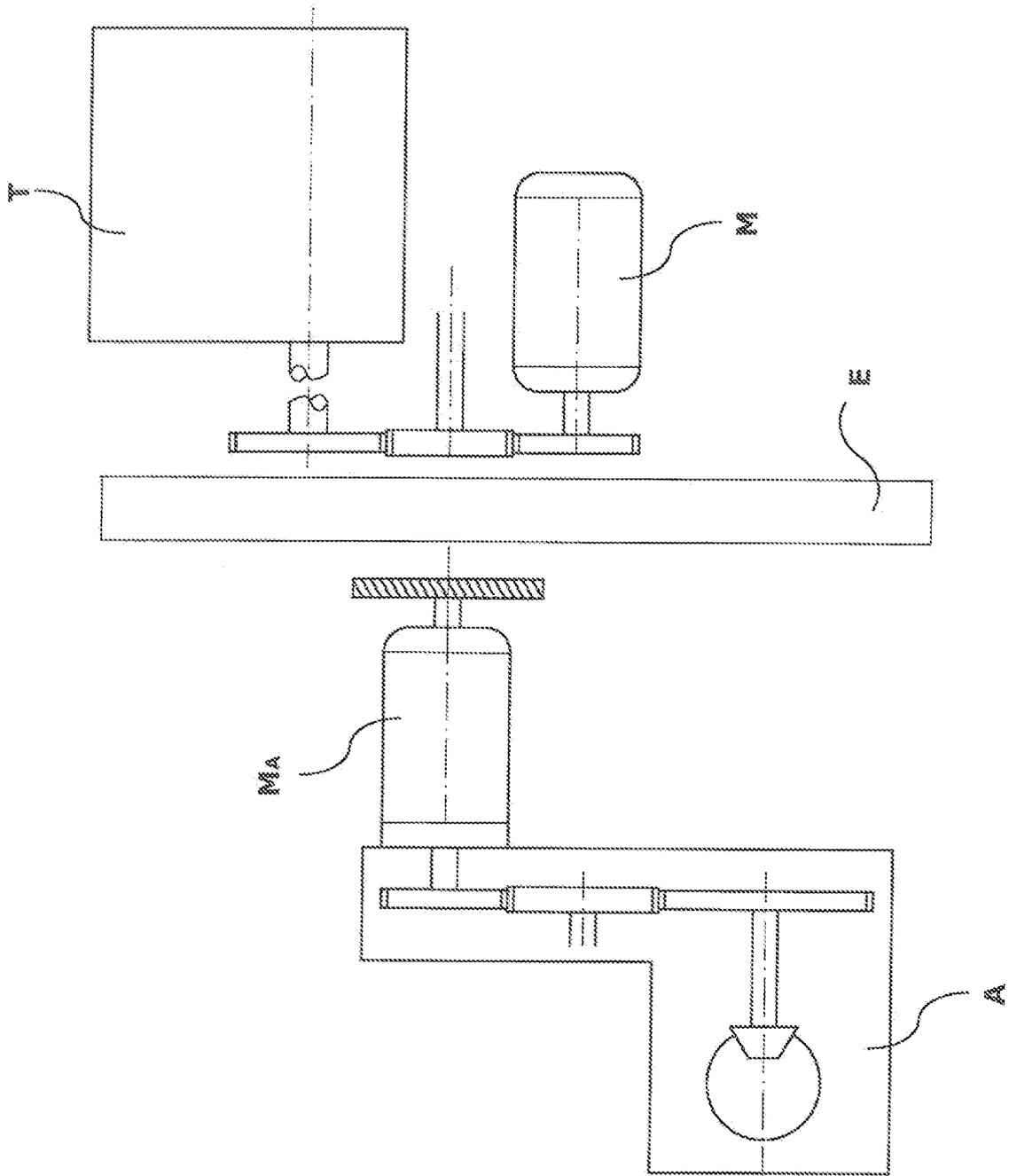
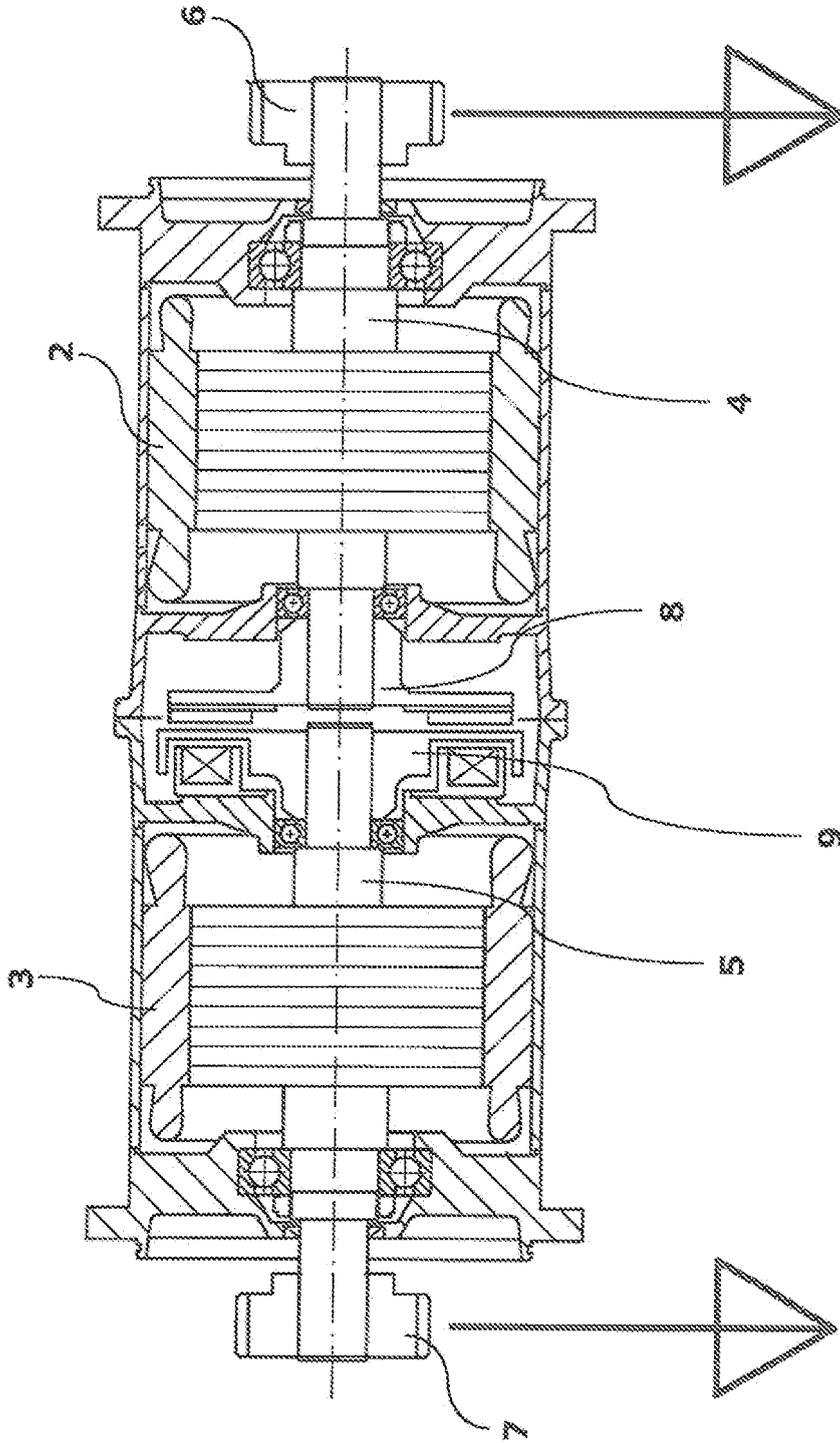


Fig. 4



**Fig. 5**

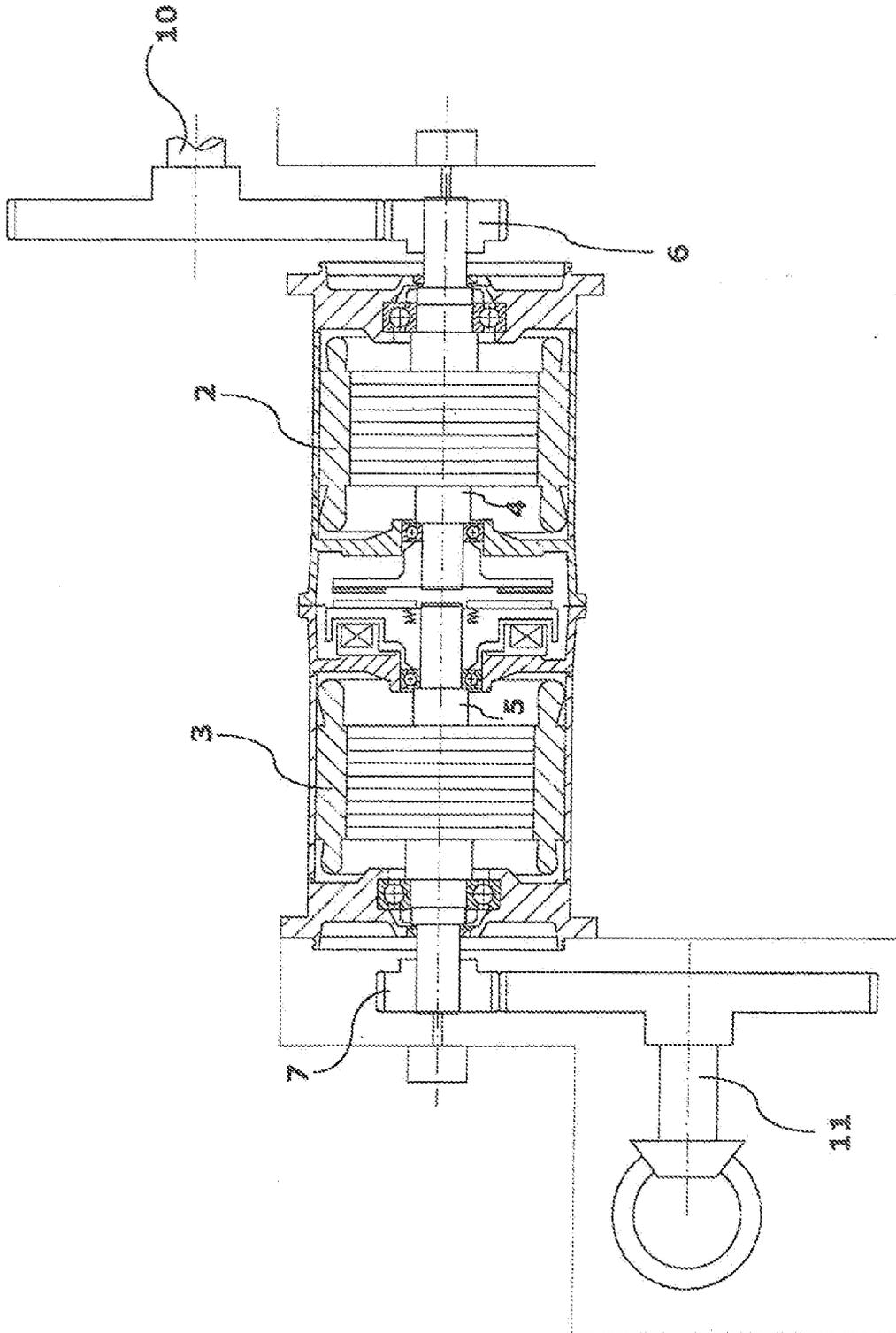


Fig. 6a

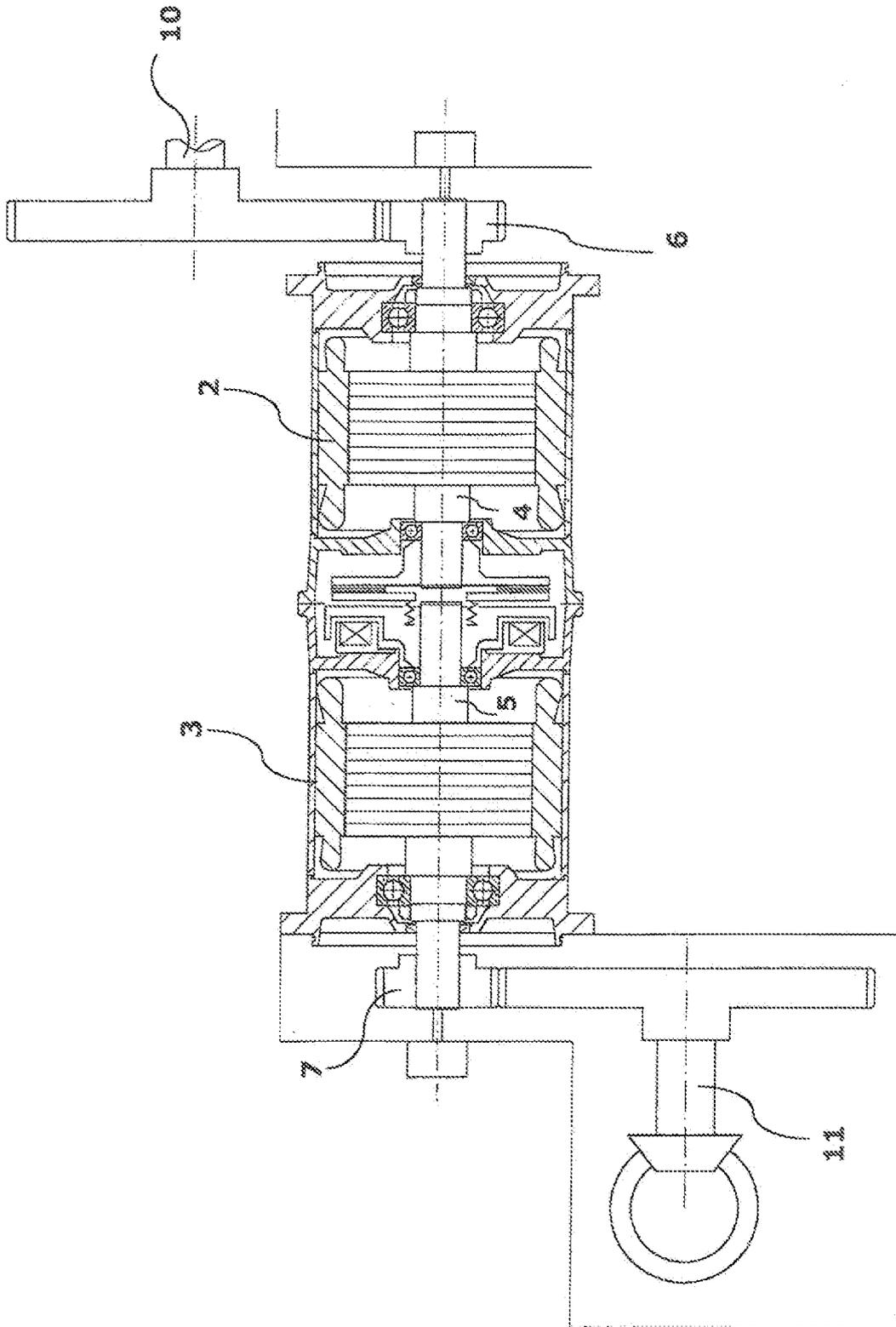


Fig. 6b

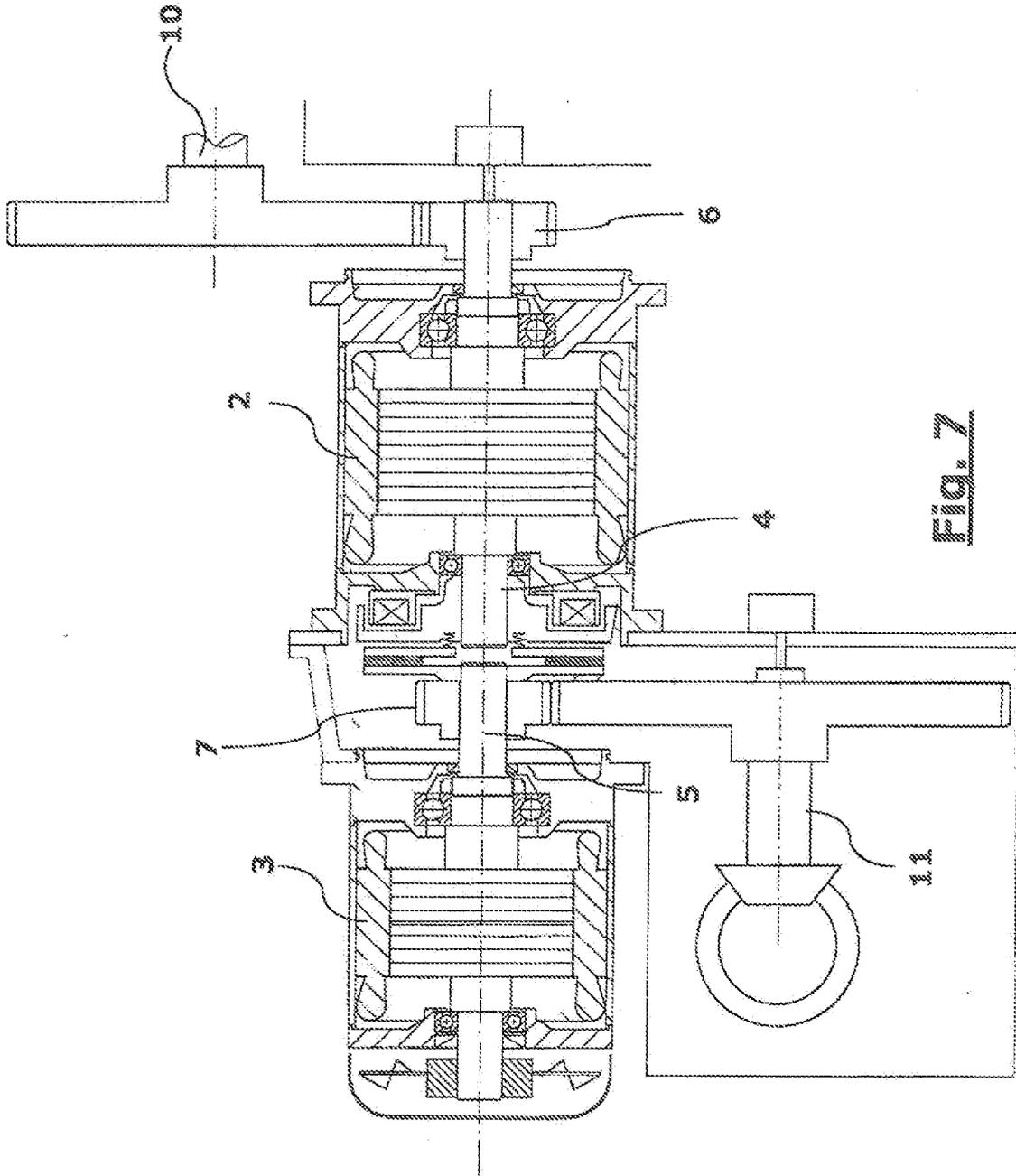


Fig. 7



## EUROPEAN SEARCH REPORT

 Application Number  
 EP 10 19 7114

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 1 312 709 A1 (PROMATECH SPA [IT]) 21 May 2003 (2003-05-21) * paragraphs [0019], [0020]; claim 1; figure 1 *	1-15	INV. D03D51/02
A	US 6 247 503 B1 (SHAW HENRY [FR] ET AL) 19 June 2001 (2001-06-19) * column 3, line 5 - column 8, line 49; figures 1-10 *	1-15	
A	EP 1 191 137 A2 (BARUFFALDI SPA [IT]) 27 March 2002 (2002-03-27) * paragraphs [0014] - [0028]; figure 1 *	1-15	
A	US 4 875 565 A (DEPOLI ERMINIO [IT]) 24 October 1989 (1989-10-24) * columns 3-6; figure 1 *	1-15	
A	DE 102 25 037 A1 (DORNIER GMBH LINDAUER [DE]) 24 December 2003 (2003-12-24) * paragraphs [0007] - [0027]; figure 1 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			D03D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		3 March 2011	Iamandi, Daniela
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

2

EPO FORM 1503 03.02 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 10 19 7114

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

03-03-2011

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 1312709	A1	21-05-2003	AT 365242 T	15-07-2007
			AU 2002349034 A1	10-06-2003
			CN 1589344 A	02-03-2005
			DE 60129026 T2	21-02-2008
			WO 03044254 A1	30-05-2003
			ES 2288921 T3	01-02-2008
			KR 20050044527 A	12-05-2005
			TW 284159 B	21-07-2007
			US 2005016611 A1	27-01-2005
-----				
US 6247503	B1	19-06-2001	AU 6208798 A	07-08-1998
			BE 1010849 A3	02-02-1999
			CN 1243555 A	02-02-2000
			DE 59806111 D1	05-12-2002
			WO 9831856 A1	23-07-1998
			EP 0953073 A1	03-11-1999
			ES 2260351 T3	01-11-2006
			ES 2184231 T3	01-04-2003
			HK 1025136 A1	11-10-2002
			JP 4231555 B2	04-03-2009
			JP 2001508141 T	19-06-2001
			TR 9901644 T2	21-05-2001
-----				
EP 1191137	A2	27-03-2002	AT 345412 T	15-12-2006
			CN 1346908 A	01-05-2002
			CZ 20013444 A3	15-05-2002
			DE 60124478 T2	21-06-2007
			IT MI20002089 A1	26-03-2002
			JP 4261094 B2	30-04-2009
			JP 2002173853 A	21-06-2002
-----				
US 4875565	A	24-10-1989	DE 3878876 D1	08-04-1993
			DE 3878876 T2	17-06-1993
			EP 0322928 A1	05-07-1989
			IT 1223621 B	29-09-1990
-----				
DE 10225037	A1	24-12-2003	NONE	
-----				

## EP 2 341 170 A1

### REFERENCES CITED IN THE DESCRIPTION

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

#### Patent documents cited in the description

- EP 1158081 A [0010]
- EP 1245707 A [0010]
- WO 9831856 A [0010]
- EP 1600542 A [0010]
- EP 1312709 A [0011]
- EP 1775361 A [0011]
- US 7114527 B [0011]
- WO 2006039912 A, Dornier [0011]