(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 319 596 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
18.06.2003 Bulletin 2003/25

(51) Int Cl.[7]: **B65B 11/02**

(21) Application number: **02102756.0**

(22) Date of filing: **13.12.2002**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SI SK TR
Designated Extension States:
AL LT LV MK RO

(30) Priority: **13.12.2001 IT MI20012648**

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(54) Mechanically-controlled dispenser for wrapping machines and wrapping machine obtained with such a device

(57) A dispenser of stretchable plastic material film and a wrapping machines equipped with such a dispenser are described. The dispenser comprises a bobbin (2) of plastic film, a pre-stretching unit (P1,P2) driven by driving means and a movable controlling roller (B) apt to control said driving means on the basis of the tension applied thereon by the plastic material film, said movable controlling roller being mechanically connected to a friction slipping clutch (10-12) apt to transfer a torque from said driving means to the pre-stretching unit, the torque transferred by said slipping clutch being proportional to the pressure applied thereon through said movable controlling roller.

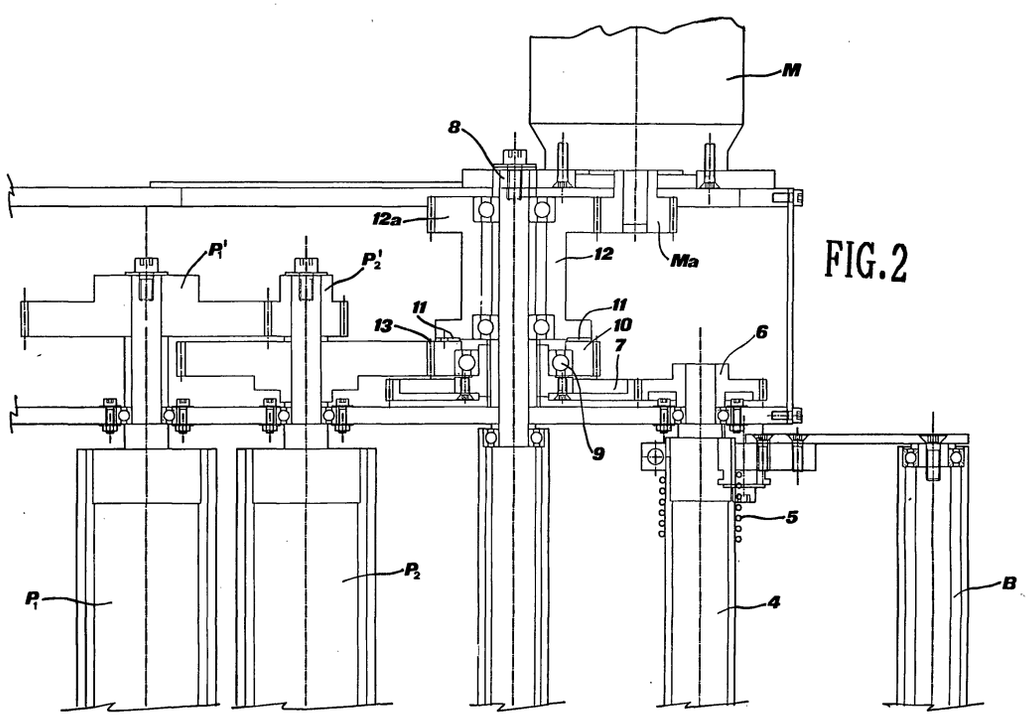

FIG.2

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Description

[0001] The present invention relates to a dispensing system for a wrapping machine, wherein the amount of film dispensed is mechanically controlled.

[0002] As known, wrapping machines are machines that are apt to package a load by wrapping it in a plastic film. The wrapping of the load in the film may occur in different ways, for example with a fixed film bobbin and a rotating load, or with a fixed load and a rotating bobbin; in the latter case, the bobbin may be mounted onto a rotating boom arrangement or onto a circular ring.

[0003] It is also known that most wrapping machines use very stretchable (up to 200%-300%) film, which, for maximum yield, is pre-stretched by a pre-stretching unit before being applied onto the load. The simplest pre-stretching units comprise rollers onto which the film passes, which are broken in order to obtain the stretching of the film by means of the tension applied while applying the film onto the load: however, this system has some drawbacks that make it little effective, although very economical.

[0004] More effective devices provide that the film passes between a pair of rollers, the downstream one of which has a higher peripheral speed, so as to obtain a uniform pre-stretching, adjustable as desired.

[0005] The best results are obtained with a driving and controlling device for these rollers, which establishes the film dispensing speed depending on the system requirements in a given instant.

[0006] The most widespread solution on the market provides to adopt an electrical motor to drive one of the two rollers - the two rollers being connected to each other, for instance, by a pair of gears - and a dancing arm arranged between the pre-stretching unit and the load to be wrapped, through which the tension in the film may be detected and hence the electrical motor speed may be controlled. The dancing arm is usually connected to a load cell, or to another position transducer, which generates a signal that is proportional to the film tension and is then sent to a control unit of the driving motor.

[0007] This way, when the film tension increases, i.e. when the wrapping operation requires a larger quantity of film, the control unit makes the driving motor accelerate and vice versa. However, these driving motor acceleration/deceleration phases must typically (with a rectangular plan section load) occur 8 times per turn, and therefore require a very prompt reaction from the system. The electronic control unit, no matter how advanced and expensive, experiences set up problems in order to prevent the system inertial moments and delays from dispensing a quantity of film differing from the actual requirements.

[0008] Unfortunately, this type of problems is inherent in electronic control systems, where, in addition, the reaction times of an electrical motor may not exceed certain thresholds, unless in exchange for high costs and power consumption.

[0009] Furthermore, whenever the pre-stretching unit and the respective driving and controlling device are mounted on a rotating support (for example in wrapping machines with a rotating boom or provided with a ring track), it is necessary to provide wiping electrical contacts in order both to supply the driving motor and to manage the controlling device. However, these wiping contacts are often responsible for drawbacks and maintenance charges.

[0010] The object of the present invention is to solve the above-listed drawbacks. In particular, it is meant to provide a film dispenser for a wrapping machine wherein the speed change of the pre-stretching unit may be achieved in a completely mechanical way, without the intervention of an electronic control unit; furthermore, according to another aspect, it is meant to provide a film dispenser wherein wiping contacts may be completely eliminated, and a wrapping machine comprising such a device.

[0011] Such objects are obtained with a device as described in its essential features in the appended claim 1.

[0012] Further features and advantages of the device according to the invention will become more evident from the following detailed description of preferred embodiments thereof, given by way of example and illustrated in the appended drawings, wherein:

[0013] fig. 1 is a sectional view of a first embodiment of the device according to the invention;

[0014] fig. 2 is an enlarged view of a detail of fig. 1;

[0015] fig. 3 is a schematic plan view of a ring wrapping machine provided with a device according to a second embodiment of the invention;

[0016] fig. 4 is an enlarged view of the device according to the invention shown in fig. 3;

[0017] fig. 5 is a sectional view taken along line V-V of fig. 4;

[0018] fig. 6 is a sectional view taken along the hatched line VI-VI of fig. 4; and

[0019] fig. 6A is an enlarged view of a detail of fig. 6.

[0020] As shown in fig. 1, a dispenser is comprised, in a *per se* known manner, of a support plate 1 onto which a stretchable film bobbin 2, a pair of pre-stretching rollers P_1 and P_2 and a movable roller B are mounted.

[0021] In the example shown, the movable roller B is mounted oscillating, by means of a pair of arms 3a and 3b, onto a rotating shaft 4 provided with elastic return means 5. The latter balance the oscillation of the movable roller B against the tension applied thereto by the stretchable film (not shown in fig. 1), which extends, passing thereon, from the bobbin 2 and the pre-stretching rollers P_1 and P_2, to the load CA to be wrapped (fig. 3).

[0022] Rolls P_1 and P_2 are connected to each other, for example through a pair of gears P_1' and P_2' that set a gear ratio such that the downstream gear P_2 rotates faster than the upstream gear P_1, achieving the desired pre-stretching of the film.

[0023] According to a first embodiment of the inven-

tion (fig. 2), the rotating shaft 4 carries, at one end thereof, a first geared wheel 6 engaging a second geared wheel 7 splined onto a supporting shaft 8 by means of a helical engagement. In other words, a screw coupling is provided between the hub of the second gear 7 and the supporting shaft 8, which transforms the rotation of gear 7 into a translation thereof along the longitudinal axis of the shaft 8.

[0024] A lower half-clutch 10 - onto which a friction slipping element 11 is attached - is mounted onto the second gear 7 through a suitable ring bearing 9. The friction slipping element is in the form of a circular rim.

[0025] Opposed to the lower half-clutch 10, there is an upper half-clutch 12, axially fixed but rotatively mounted onto the shaft 8 by means of bearings. The surface of the upper half-clutch 12 opposed to the slipping element 11 also has an analogous friction slipping element or is itself made of a friction slipping material.

[0026] The material with which the friction slipping element 11 is made is apt to transfer a torque between the two half-clutches 10 and 12 in a progressive way as the compressive force between said half-clutches varies. From this point of view, this material is quite different from the one employed for the traditional automotive clutches, which is apt to properly work in static condition only when high compressive force is applied between the two portions of the clutch. The friction slipping material may be, for example, Iglidur® marketed by Igus GmbH.

[0027] The half-clutch 12 is further connected with an electrical motor M, for example through an engagement of gears 12a and Ma.

[0028] The lower half-clutch 10 is connected to the pre-stretching unit instead, preferably with the downstream roller P_2, through a gear engagement 13.

[0029] Although the transmission to the pre-stretching unit may also be realised with the upstream roller P_1, this would not be as much effective, because the operation would be affected by potential oscillations in the degree of film pre-stretching.

[0030] When the device is in use, the motor M is excited and made to rotate at a constant speed. Accordingly, the upper half-clutch 12 is made to rotate at a constant speed.

[0031] When no film is required, i.e. when no tension is applied to the movable roller B, the translatable gear 7 is in its totally lowered position (in the view of fig. 2) and therefore the two half-clutches 10 and 12 are kept spaced apart and no torque is transferred from the motor M to the lower half-clutch 10.

[0032] When film is drawn by the system, a tension is applied to the movable roller B, the shaft 4 is thus rotated by a certain angle depending on the ratio between film tension and elastic force of the return means 5. The rotation of the shaft 4 results in a rotation of the wheel 6 and of the translatable wheel 7, therefore in a translation of the lower half-clutch 10 along the longitudinal axis of the shaft 8. This way, the two engaging half-clutches 10 and 12 are brought closer to each other and the friction slipping element 11 begins to work, transferring a torque that is proportional to the displacement of the movable roller B or, in other words, proportional to the tension applied onto the roller B by the film. In this condition, the motor M transfers its motion to the pre-stretching unit P_1 and P_2, actively dispensing stretchable film.

[0033] As may be guessed, this arrangement represents a self-controlled dispensing system; in fact, the more film the system requires - which corresponds to an increase in the film tension - the more the movable B is biased, which results in more pressure on the slipping contact 11 and in a higher torque being transferred from the motor M to the pre-stretching unit, therefore in an increased dispensing of film; vice versa, when the system requires less film, the tension loosens, therefore the movable roller B returns towards its rest position, thus a lower pressure is applied between the two engaging half-clutches 10 and 12, with a subsequent transfer of a lower torque and a decrease in the dispensing of the film.

[0034] Through a proper adjustment of the gear ratio and of the elastic modulus of the return means and through a suitable choice of the friction slipping element 11 material - which is within the reach of an expert in the field, once having acquired the teachings offered herewith - it is possible to obtain a progressive and regular operation of the device.

[0035] The constant rotation speed of the motor M is advantageously set like the speed required in order to dispense the maximum film quantity that the system is envisaged to require.

[0036] It is worth stressing that the engagement of the slipping rims does not occur in the same way as a common clutch, which is by nature apt to work, in a steady state, either in a disengaged or in a completely engaged way. In this case, instead, the progressiveness of a "slipping" engagement is exploited, i.e. an engagement between two surfaces apt to properly work while slipping, transferring a more or less high torque, depending on the pressure applied. If it were not so, the control evenness and progressiveness would be lost, resulting in an irregular and halting behaviour of the dispenser.

[0037] Advantageously, in order to obtain the best outcome from the slipping clutch, i.e. to obtain a prompt reaction and to prevent jams, the rotation direction of the translatable wheel 7, which brings the two half-clutches 10 and 12 close to each other, is opposed to the rotation direction of the half-clutch 12. This prevents the natural tendency of the engagement to become tighter and thus favours a prompt release and an immediate decrease of film dispensing as soon as the film tension onto the movable roller B is released.

[0038] As may be guessed, the above described controlling device, being completely mechanical, ensures a proportional, direct and virtually instant reaction, which does not cause instability in the control cycle, as may occur with the prior art.

[0039] The embodiment shown so far may be applied onto a wrapping machine wherein the support plate 1 is mounted onto a rotating boom or onto a ring track, or also in a fixed position with a rotating load.

[0040] Another embodiment of the invention, typically applicable onto a ring track wrapping machine, is shown in figs. 3-6.

[0041] In fig. 3 a typical annular structure A is schematically shown, which is vertically translatable on two columns of a wrapping machine, onto which a supporting plate 100 is movably mounted.

[0042] The plate 100 is translatably mounted onto tracks of the annular structure A by means of a series of rolling wheels R_1, R_2, R_3 and is fixed onto a rotating driving rim T, lying onto bearings Ci circumferentially placed on the annular structure A.

[0043] The driving rim T and the plate 100 are made to rotate through a driving belt CT driven by a motor MT (fig. 5), fixedly placed outside the annular structure A.

[0044] On the plate 100 there are substantially the same elements described above. A stretchable film P is extended from a bobbin 102 to a pre-stretching unit P_{10} and P_{20}, then around an intermediate roller 104a, and finally onto a movable roller B_{10}.

[0045] The movable roller B_{10} is connected, through arms 103, to a rotating shaft 104, which also supports the intermediate roller 104a, integral with a first driving wheel 106. The rotation of the shaft 104 is opposed by elastic return means 105.

[0046] The gear wheel 106 is connected, through a chain 106a, to a translatable gear wheel 107, mounted through a helical engagement onto a supporting hollow stand 107a, wherein a transmission shaft 108 is coaxially rotatably mounted. The translatable gear 107 carries a lower half-clutch 110 apt to engage another upper half-clutch 112 through a friction slipping rim 111.

[0047] The upper half-clutch 112 is splined onto the transmission shaft 108, integral with the downstream roller P_{20} of the pre-stretching unit.

[0048] According to the present embodiment, the lower half-clutch 110 has the shape of a bush, on the outer surface of which a groove 110a is provided.

[0049] A second driving belt D - winding as much as possible, with the assistance of a belt tightener, around said bush 110 and then adhering to a track D1 integral with the annualar structure A - is apt to be engaged into groove 110a (figs. 4 and 5).

[0050] When the supporting plate 100 is made to rotate by the motor MT around the annular structure A, the second driving belt D, which is static relative to the track D1, makes the bush 110 rotate.

[0051] Thus, the movement of the supporting plate 100 causes the rotation of the bush 110, which is the driving member of the dispenser, similar to the function of the motor M in the first embodiment illustrated.

[0052] This allows to avoid the use of a driving motor mounted on the supporting plate 100, with all the advantages deriving from not having to supply electrical power to a moving device.

[0053] Apart from this specific feature, the operation is otherwise identical to the one described above. Through a suitable choice of the transmission ratio between the annular track D1 and the rotating bush 110, it is ensured that the device is apt to dispense the maximum quantity of film required by the system, depending on the peripheral rotation speed of the device on the annular structure A.

[0054] This second embodiment also achieves the second object set in the premises, i.e. that of totally avoiding the use of any sliding contacts in order to transfer electrical power from outside the wrapping machine to the rotating dispenser.

[0055] It is however intended that the invention is not limited to the specific embodiments illustrated above, which are only non-limiting examples of the scope of the invention, but many alternatives are possible, all within the reach of an expert in the field, without thereby departing from the scope of the invention.

[0056] It is for instance clear that the kinematic mechanism which causes the engaging half-clutches to get closer to each other, depending on the movable roller displacement, may have different shapes. Besides, it is not necessary that the movable roller be supported oscillatorily, as it may also be translatable. Furthermore, the movable roller may be equally substituted by other devices, the displacement of which depends on the stretchable film tension.

[0057] Accordingly, the outer driving system, illustrated in figs. 4-6, it is to be considered purely illustrative, as it is possible to adopt many different solutions to make the dispenser rotate on the carrying ring structure.

[0058] Finally, the driving belt apt to drive the bush of the slipping clutch may be substituted by similar elements, as long as the movement of the device around the annular structure is exploited in order to drive the dispenser.

Claims

1. Dispenser of stretchable plastic material film in wrapping machines, of the type comprising a bobbin of plastic film, a pre-stretching unit driven by driving means and a movable controlling roller apt to control said driving means on the basis of the tension applied thereon by the plastic material film, **characterised in that** said movable controlling roller is mechanically connected to a friction slipping clutch apt to transfer a torque from said driving means to the pre-stretching unit, the torque transferred by said slipping clutch being proportional to the pressure applied thereon through said movable controlling roller.

2. Dispenser as in claim 1), wherein said slipping clutch comprises a first half-clutch and a second

half-clutch, which may be brought close to each other, between which an element of a material apt to work in a slipping condition is inserted.

3. Dispenser as in claim 2), wherein the first half-clutch is constantly rotating by means of said driving means, while the second half-clutch is connected to said pre-stretching unit.

4. Dispenser as in claim 3), wherein said first half-clutch is fixed in translation and rotating onto a supporting shaft, while the second half-clutch is rotatably mounted onto a translatable wheel coaxially mounted by a helical coupling onto said supporting shaft, said translatable wheel being made to rotate by the displacement of said movable controlling roller.

5. Dispenser as in claim 3), wherein said first half-clutch is rotating onto a translatable wheel mounted, by means of a helical coupling, onto a supporting shaft, while said half-clutch is mounted fixed in translation, the displacement of said movable controlling roller causing the rotation/translation of said translatable wheel.

6. Dispenser as in any one of the preceding claims, wherein said dispenser is movably mounted onto an annular structure of a wrapping machine and said driving means comprise a transmission element interposed between an annular track of said ring structure and said second half-clutch.

7. Dispenser as in claim 6), wherein said transmission element is a transmission belt that is wrapped around said track and around a bush that is integral with said second half-clutch.

8. Dispenser as in any one of the preceding claims, wherein the two engaging half-clutches are brought closer to each other, each one according to a rotation direction opposed to that of the other.

9. Dispenser as in any one of the preceding claims, wherein the torque transferred is applied to the roller downstream of said pre-stretching unit.

10. Wrapping machine comprising a dispenser as in any one of the preceding claims.

FIG.1

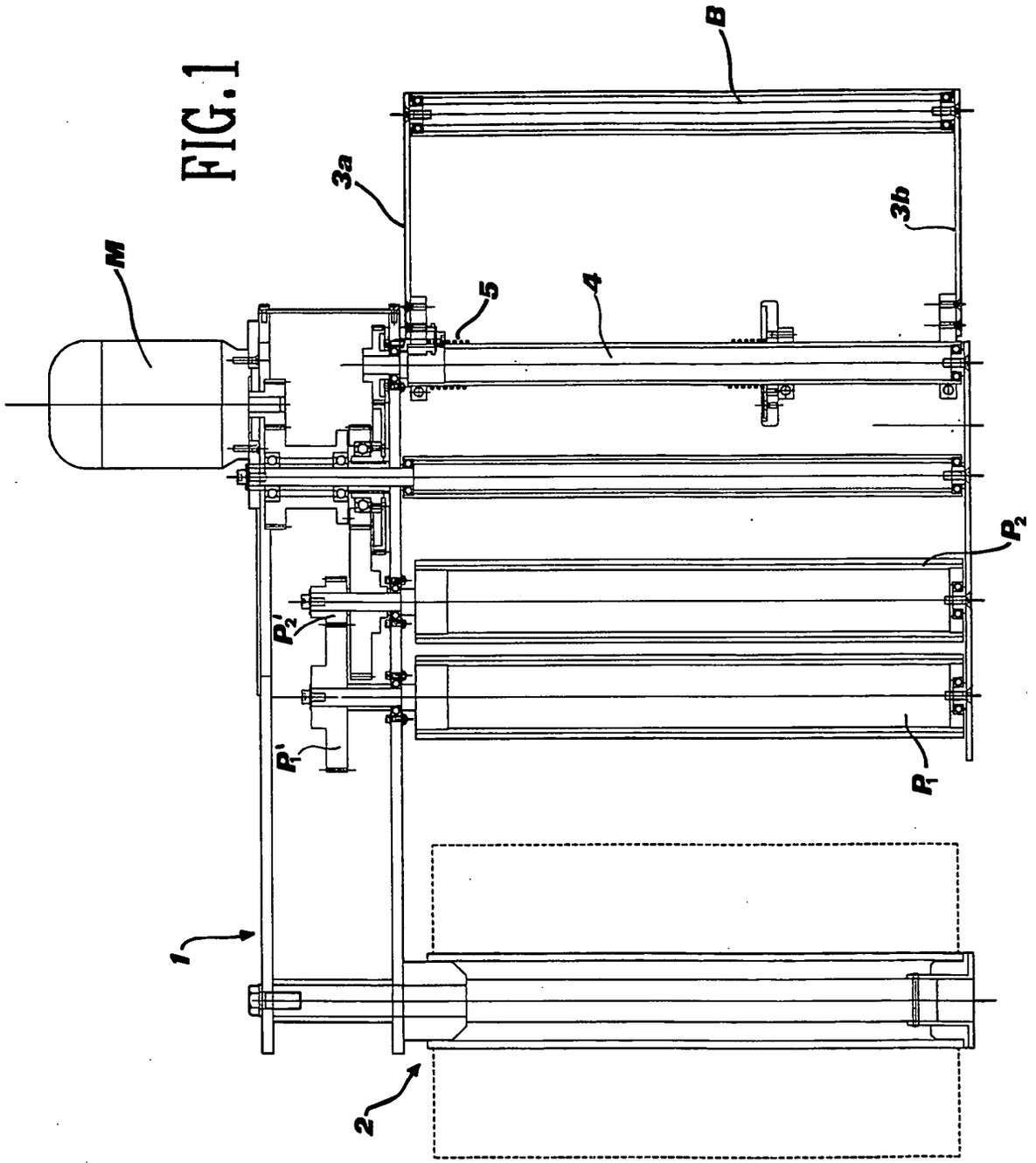
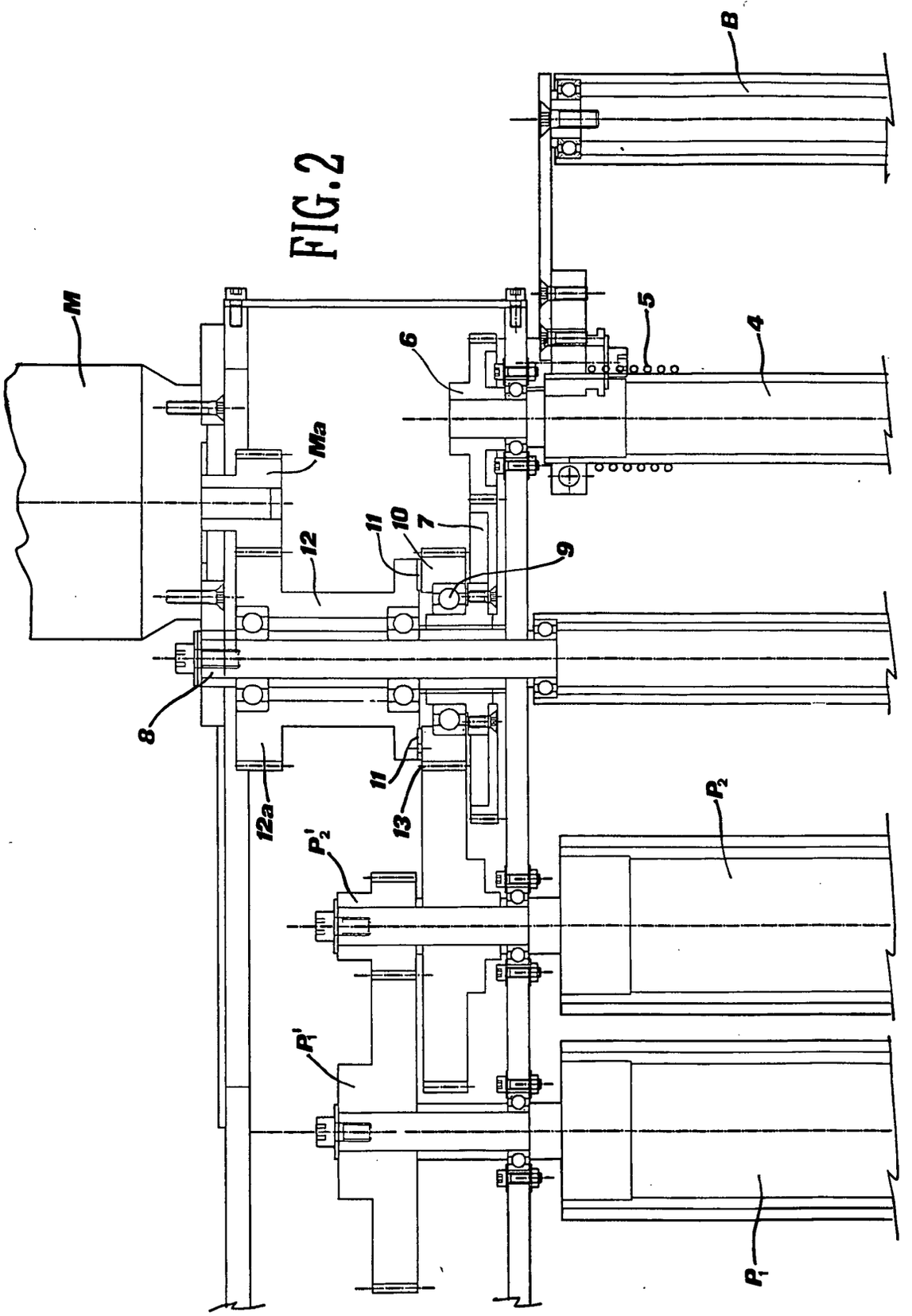


FIG.2



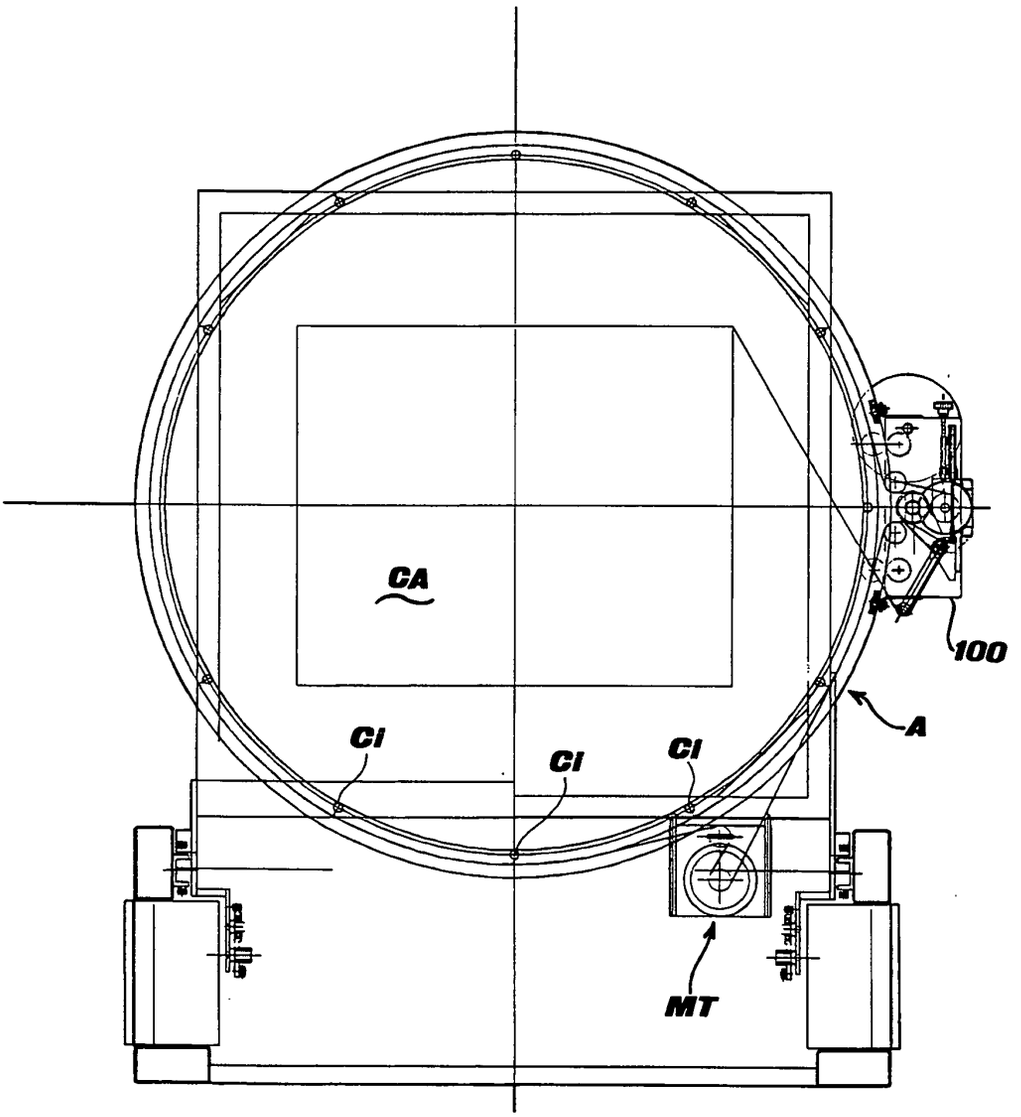


FIG.3

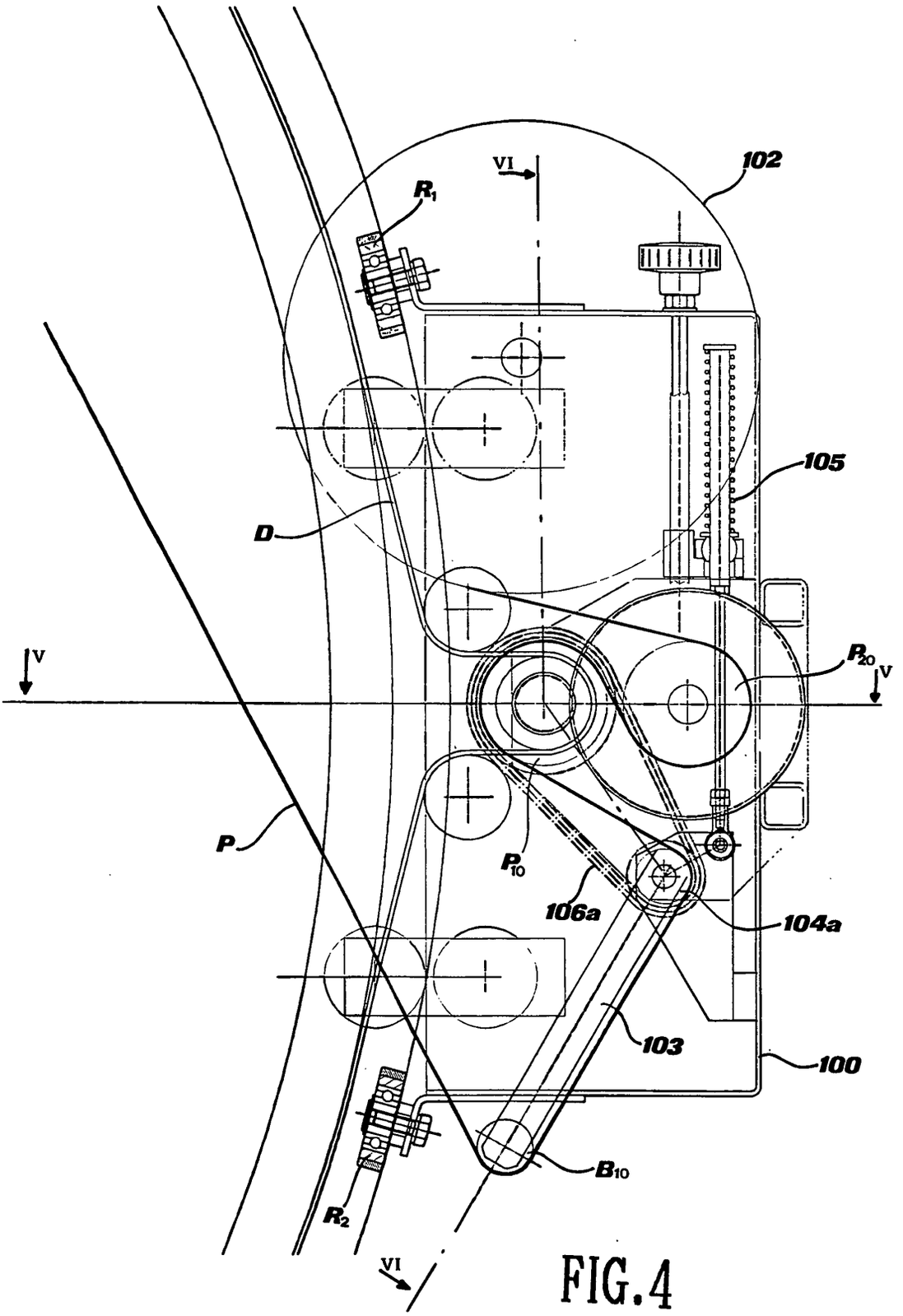


FIG.4

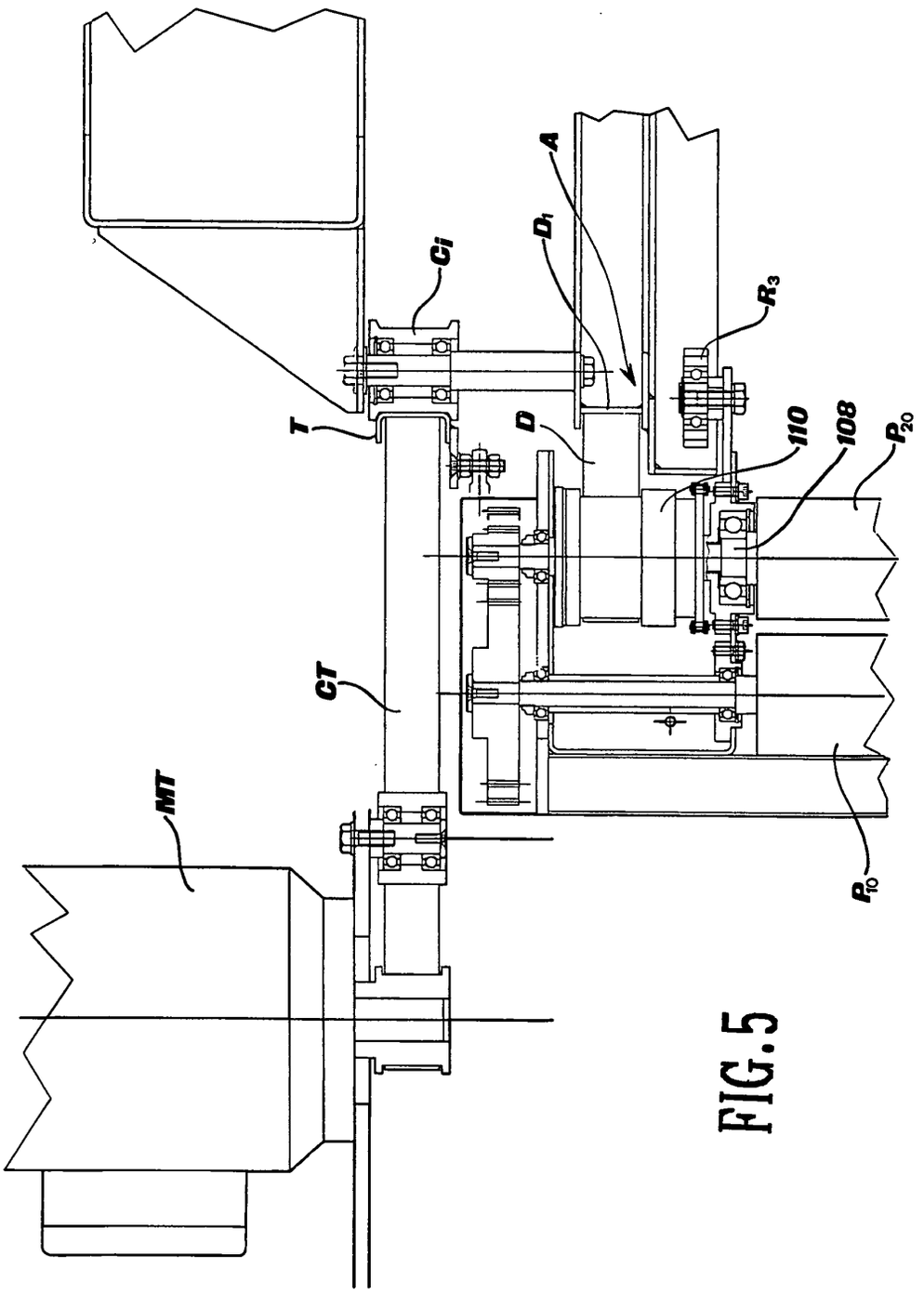


FIG.5

FIG.6

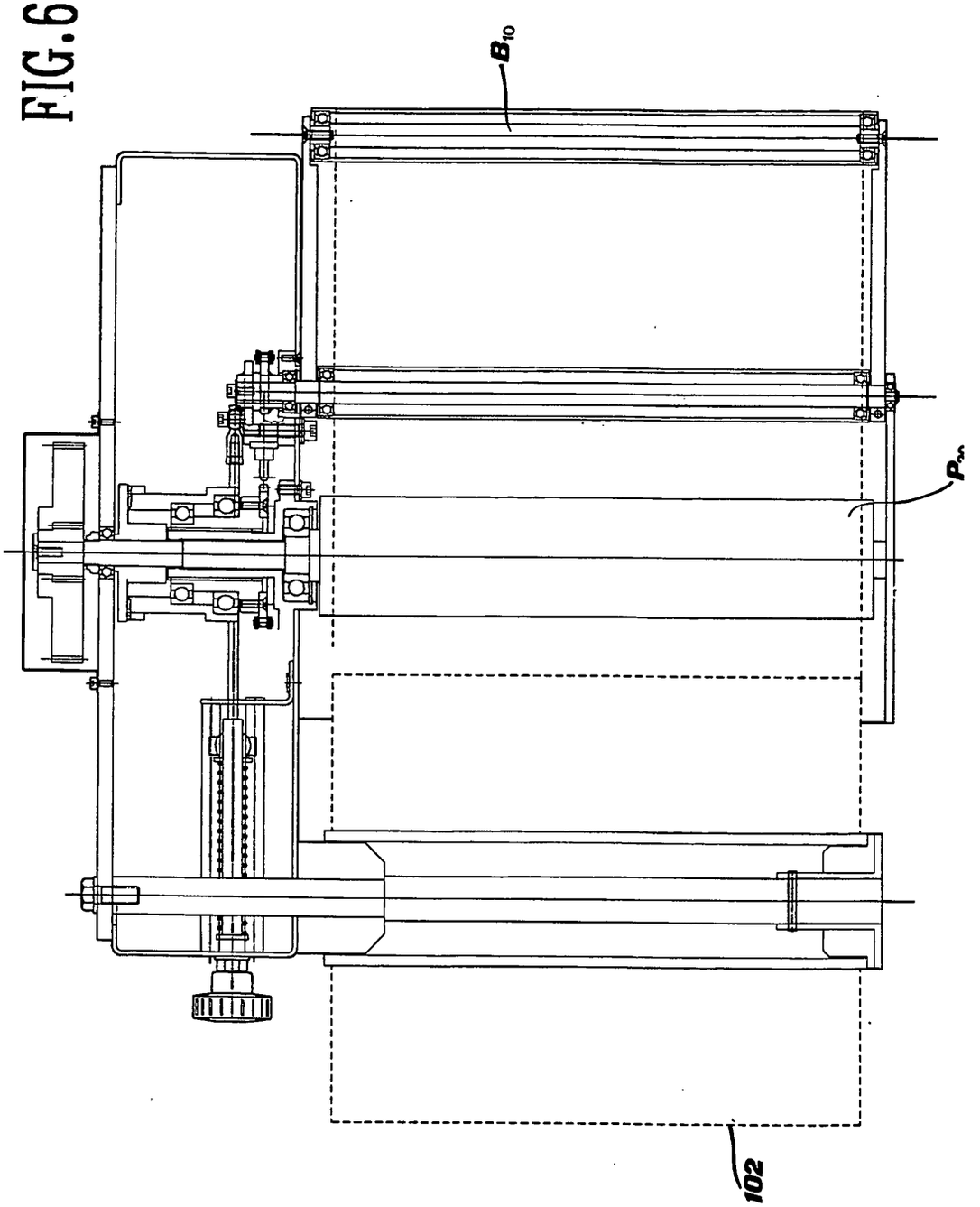


FIG.6A