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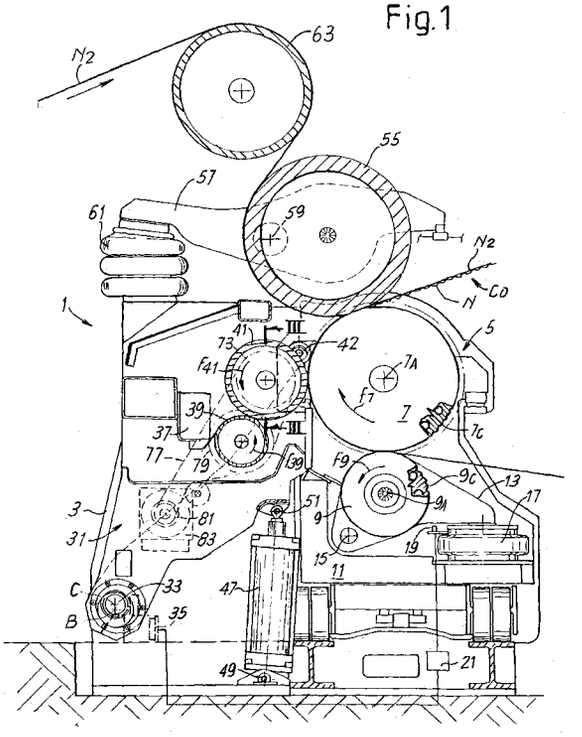
(54) Device for controlling the distance between gluing- and corrugating rollers in a corrugating machine

(57) The machine for the production of corrugated cardboard comprises:

- a first corrugating roller (7);
- a second corrugating roller (9) co-operating with the first corrugating roller for corrugating a sheet of web-like material (N), which passes between said first corrugating roller and said second corrugating roller, which are provided with projections that mesh together;
- a gluing assembly (31) with a gluing cylinder (41), which co-operates with the first corrugating roller for applying a glue on the crests of said web-like material; and
- adjustment means for adjusting the position of the gluing cylinder with respect to the first corrugating roller.

The adjustment means comprise a detector for detecting a parameter indicating a variation in the speed of rotation of the gluing cylinder. The position of the gluing cylinder (41) is adjusted according to said variation in speed.

Fig.1



EP 1 362 690 A1

Description

Technical field

[0001] The present invention relates to a machine for the production of corrugated cardboard and, more in particular, to an improvement of the control system for controlling the distance between the gluing cylinder and the main corrugating roller, over which is run the web-like material, which it is to receive the glue delivered by the gluing cylinder on the crests formed by the two corrugating rollers.

State of the art

[0002] Plants for the production of corrugated cardboard comprise a series of machines or workstations, among which one or more machines, referred to in the art as "single facers", which comprise a pair of corrugating rollers that cooperate with one another, each of which presents ribs and grooves that mesh together, whilst a web-like material, namely a sheet or web of paper or cardboard, passes through the gap between the two rollers, so that said web-like material undergoes corrugation.

[0003] The web-like corrugated material remains adherent to the first corrugating roller and passes in front of a gluing cylinder, which applies an adhesive on the crests of the corrugations formed on the web-like material itself. Downstream of the gluing area, on the crests of the corrugated material, moistened with glue, there is applied a second smooth web-like material, for instance, a sheet of paper or cardboard, which forms the so-called "cover" of the corrugated cardboard. A second cover is then applied on the opposite face of the corrugated web-like material in a machine set downstream.

[0004] One of the critical aspects of single facers consists in controlling the relative position between the first corrugating roller, over which the web-like material that is to undergo corrugation is run, and the gluing cylinder. In fact, the distance between the surface of the gluing cylinder and the surface to be glued must be controlled in such a way as to guarantee a uniform application of the glue on all the crests and on all the transverse length of the web-like material, i.e., on all the length of each crest. Normally, the surface of the gluing cylinder does not touch the material; instead, a very small distance is left between them, of the order of magnitude of the thickness of the film of glue which coats the active surface of the gluing cylinder.

[0005] The control of the relative position between the corrugating roller (or, more precisely, between the corrugated paper material lying on the roller itself) and the gluing cylinder is a critical aspect of the production cycle of corrugated cardboard, in so far as it is upon the correct control of this parameter that the quality of gluing between the corrugated sheet of cardboard and the smooth sheet of cardboard, i.e., the so-called cover, depends. An other than accurate control entails a non-uniform distribution of adhesive and hence the risk that the two sheets, the smooth one and the corrugated one, will remain not accurately glued to one another.

[0006] During operation of the machine, variations in the operating conditions occur, which can affect proper gluing. In particular, the set comprising the first corrugating roller and the second corrugating roller can be replaced at every order change, when the shape and size of the corrugation on the cardboard varies from one order to the next. Insertion into the machine of a so-called "cartridge", i.e., of the set of the two corrugating rollers, entails the need for an adjustment of the position of the gluing cylinder with respect to the first corrugating roller.

[0007] Another factor that must be taken into account for achieving proper gluing is the possible fluctuation in the thickness of the web-like paper material fed into the machine. This thickness may vary, for example, when the reel from which the material is fed towards the single facer is replaced. Even very small variations in the thickness of the paper may lead to substantial variations in the application of the glue on the web-like material.

[0008] Furthermore, during operation of the machine, there occurs a gradual heating of the corrugating rollers, which are brought up to temperature by means of a suitable heating system, for instance by steam, which is made to circulate in chambers adjacent to the surface of the corrugating rollers. This heating process brings about an expansion of the corrugating rollers. Any increase in diameter of the first corrugating roller, with which the gluing cylinder co-operates, must be matched by an adjustment in the position of the gluing cylinder in order to maintain optimal conditions of application of the glue. The diameter may vary as a result of temperature fluctuations during operation.

[0009] Not the least important factor that renders the control of the distance between the gluing cylinder and the corrugating roller critical is the wear, especially of the corrugating roller, and hence its gradual reduction in diameter.

[0010] Various systems have thus been devised for carrying out an accurate control of the relative position between the corrugating roller and the gluing cylinder, i. e., for controlling the so-called "glue gap".

[0011] In EP-B-0601528, a single-facer machine of the above-mentioned type is described, in which a special sensor continuously detects the relative distance between the gluing cylinder and the first corrugating roller. The gluing assembly of which the gluing cylinder forms part is provided with a contrast, which co-operates with a fixed part of the frame of the machine. The contrast can be lengthened or shortened by means of a special actuator, in such a way as to modify the effective distance between the gluing cylinder and the corrugating roller and to maintain this distance constantly equal to a desired value. The system is particularly complex and does not guarantee a sufficient reliability in the po-

sitioning between the gluing cylinder and the corrugating roller. In particular, the sensor is set in a critical area of the machine and is subject to high thermal stresses, as well as being affected by the vibrations of the device. Furthermore, the system does not take into account the wear of the corrugating roller and any differential thermal expansion due to the fact that the roller itself is subject to different temperatures in the various areas thereof.

[0012] In EP-A-0870598 it is suggested not to maintain a fixed distance between the web-like corrugated material (and hence the corrugating roller) and the gluing cylinder. Instead, the machine described in this prior document envisages that the gluing cylinder be pressed against the crests of the paper sheet or corrugated cardboard run over the first corrugating roller, hence eliminating the distance between the cardboard and the gluing cylinder. This solution, on the one hand, simplifies control of the position of the gluing cylinder, but, on the other, does not provide a satisfactory gluing quality. In fact, on account of the force of contact between crests of the corrugated cardboard and the gluing cylinder, the glue tends to be pushed away from the tops of the crests and to be distributed over the sides of the crests, where it does not contribute to the subsequent gluing of the cover. In addition, the forced contact between the gluing cylinder and the corrugating roller leads to the generation of major vibrations and a high wear of the machine members.

[0013] In EP-A-1086805 the relative position between the gluing cylinder and the corrugating roller is controlled by pressing the end supports of the gluing cylinder against the end supports of the corrugating roller and by measuring the force of contact. Moreover provided is a mechanism which makes it possible to increase or reduce the distance between these supports until a desired contact force is achieved. Corresponding to this is a very precise relative position between the active surface of the gluing cylinder and the web-like corrugated paper material that is run over the corrugating roller. This system proves very complex on account of the need to have available a plurality of actuators. A particularly critical and complex aspect is the mechanism for adjusting the distance between the end supports of the gluing cylinder and those of the corrugating roller.

[0014] In EP-B-0786329 there are described single facers with systems for controlling the distance between the gluing cylinder and the corrugating roller, said systems being based upon detection of an operating parameter. This parameter may be vibration, noise, the torque applied to the gluing cylinder, or the force of reaction between the gluing cylinder and the corrugating roller. The measurements thus made are all affected by error, in so far as, whatever the parameter considered, it is influenced not only by the distance between the gluing cylinder and the corrugating roller, but also by external factors which have nothing to do with said distance. The control is, therefore, far from accurate and is rendered complex by the need to use particularly delicate sensors.

Objects and summary of the invention

[0015] An object of the present invention is to provide a machine for the production of corrugated cardboard, or so-called "single facer", in which it is possible to control, in a reliable and simple way, the position of the cylinder with respect to the corrugating roller with which the cylinder co-operates.

[0016] An object of the present invention is also to provide a method for controlling the operating condition of the gluing cylinder with respect to the corrugating roller.

[0017] The above and further objects and advantages are achieved basically with a single facer comprising:

- a first corrugating roller;
- a second corrugating roller co-operating with the first corrugating roller for corrugating a sheet of web-like material, which passes between said first corrugating roller and said second corrugating roller, which are provided with projections and grooves that mesh together;
- a gluing assembly with a gluing cylinder which co-operates with the first corrugating roller for applying a glue on the crests of said web-like material; and
- adjustment means for adjusting the position of the gluing cylinder with respect to the first corrugating roller;

characterized in that the adjustment means comprise a detector for detecting a parameter indicating a variation in the speed of rotation of the gluing cylinder, the position of the gluing cylinder being regulated according to said variation in speed.

[0018] The parameter measured may be directly the speed or else, for example, a modification in the relative angular position between the gluing cylinder and a member for transmitting motion to said gluing cylinder, for example a wheel, such as a gear wheel or a pulley.

[0019] In practice, the gluing assembly is mounted in such a way that it can move with respect to the first corrugating roller, the position of the gluing assembly being modified according to the variation in speed of the gluing cylinder.

[0020] According to a practical embodiment, the gluing cylinder is driven in rotation with a peripheral speed lower than the peripheral speed of the sheet of web-like material run over the first corrugating roller, for example, 0.5%-10% lower, and preferably 1%-5% lower. In this way, when the gluing cylinder approaches the corrugating roller excessively, or, more exactly, when it approaches the corrugated web-like material lying on the corrugating roller, the web-like material applies a force of friction and hence an effect of drawing on the gluing cylinder, which is added to the drawing performed by the motor of the machine. This brings about a variation in

speed, i.e., an increase in the angular velocity of the gluing cylinder. The speed increase may be used directly as a parameter for controlling the distance between the gluing cylinder and the corrugating roller. For this purpose, an angular encoder may, for example, be used. Alternatively, it is possible to use, as controlling parameter, the variation in the angular position between the gluing cylinder and the corresponding transmission of motion thereto, which results from the angular acceleration. For this purpose, it is possible to envisage, for instance, that the gluing cylinder may assume, with respect to the mechanical transmission that drives it in rotation, a staggered angular position. The staggering is detected, for example, by a load cell or some other sensor appropriately set between a support of the gluing cylinder and the axis thereof.

[0021] In order to render the system accurate and sensitive, it is advantageously possible to envisage that the acceleration due to the frictional force applied on the gluing cylinder will be limited to the cylinder itself, and that it will not be transmitted also to the mechanical members for transmission of motion from the machine motor to the cylinder. For this purpose, there may be provided a suitable device, for instance a free-wheel mechanism, between a drive wheel co-axial to the gluing cylinder and the cylinder itself. Said free wheel enables just the cylinder to accelerate, without also the pulley or wheel for transmitting motion being accelerated. In this way, the system proves particularly sensitive and accurate.

[0022] According to the present invention, there is also provided a method for controlling the distance between a gluing cylinder and a first corrugating roller in a machine for producing corrugated cardboard, which comprises said gluing cylinder, said first corrugating roller and a second corrugating roller 9, which co-operates with said first corrugating roller to corrugate a sheet of web-like material, upon which said gluing cylinder applies a glue, said method being characterized by detecting a parameter indicating a variation in the velocity of the gluing cylinder and by adjusting the distance between said first corrugating roller and said gluing cylinder according to said variation in velocity.

[0023] Further advantageous features and embodiments of the machine and of the method according to the invention are specified in the attached claims and will be described with reference to a non-limiting example of embodiment.

Brief description of the drawings

[0024] A better understanding of the invention will be obtained from the ensuing description and from the attached drawing, which shows a practical non-limiting example of embodiment of the invention. In the attached drawing:

- Figures 1 and 2 illustrate two side views of the machine according to the present invention in two different configurations of the gluing assembly; and
- Figure 3 is a longitudinal cross section of the gluing cylinder.

Detailed description of a preferred embodiment of the invention

[0025] Figure 1 illustrates the machine with the gluing assembly in the working position, with the gluing cylinder in contact with the web-like material run over the first corrugating roller, whilst Figure 2 illustrates the same machine with the gluing assembly in the opened condition, i.e., with the machine prearranged so as to enable replacement of the set or cartridge of corrugating rollers, for instance, when there is a change of production order.

[0026] The machine, designated as a whole by 1, has a load-bearing structure 3, on which an assembly 5 is fitted, the said assembly comprising a first corrugating roller 7 and a second corrugating roller 9. The two corrugating rollers 7 and 9 are mounted on a unit or cartridge 11, which can be inserted into and removed from the machine for replacement of the corrugating rollers themselves with others having a different configuration, of the ribs that have the function of corrugating the web-like material that is fed into the machine.

[0027] The corrugating roller 7 has a plurality of ribs or undulations 7C on its own cylindrical surface, with which corresponding undulations or ribs 9C of the second corrugating roller 9 mesh. Through the gap defined between the two rollers 7 and 9, where the ribs 7C and 9C mesh into one another, a web-like material N is made to pass, for example a sheet of paper or cardboard, which undergoes corrugation between the two rollers 7 and 9, said web-like material N remaining adherent, at output from the gap between the said rollers, to the first corrugating roller 7, for instance, by means of a suction system or a pressurized-air system of a type in itself known. The first corrugating roller 7 turns about an axis 7A in the direction indicated by the arrow f7, the axis 7A being substantially fixed with respect to the unit 11, which supports the rollers 7 and 9. Instead, the second corrugating roller 9 is supported by a pair of arms 13, which are hinged about an axis of oscillation 15, parallel to the axis 7A of the first corrugating roller 7 and to the axis 9A, about which the second corrugating roller 9 turns in the direction indicated by the arrow f9. The second corrugating roller 9 is forced against the first corrugating roller 7 by means of a pair of actuators (a pair of so called torpresses, in the example illustrated), designated by 17, which act upon the two end arms 13 that support the axis 9A of the corrugating roller 9. The position of the arms 13, and hence of the second corrugating roller 9 with respect to the unit 11, and hence with respect to the structure 3 of the machine 1, is detected by means of a sensor designated by 19, said sensor being interfaced with a control unit 21, for the purposes specified hereinafter. Said sensor could be omitted in

certain embodiments of the machine and in certain implementations of the control method. The corrugating roller 9 may be made with a diameter that is even much smaller (as compared to the one represented in the figure) than the diameter of the corrugating roller 7. This reduces the number of ribs 7C, 9C meshing together in the area of co-operation between the two corrugating rollers, and consequently facilitates the formation of the corrugation on the web-like material N, as is known to persons skilled in the art. In order to overcome the excessive flexibility of the corrugating roller 9 when this has a particularly small diameter, it may be envisaged that it is supported in an intermediate position between the arms 13 by one or more supporting belts carried by the unit 11, which are appropriately run over the bottom portion of the corrugating roller 9.

[0028] Constrained to the structure 3 of the machine is a gluing assembly, designated as a whole by 31. The gluing assembly 31 is hinged about an axis of oscillation B parallel to the axes 7A and 9A of the corrugating rollers 7 and 9. The geometrical axis of oscillation B is parallel to a second axis C of an eccentric cam 33. The angular position of the eccentric cam 33 may be modified by means of an actuator, for instance a stepper motor reducer 35. The rotation of the eccentric cam 33 about the axis C brings about a modification in the position of the geometrical axis B of oscillation of the gluing assembly 31 for the purposes described hereinafter.

[0029] The gluing assembly 31 carries a glue tank 37, from which the glue is taken by means of a transferor cylinder 39, which turns in the direction indicated by the arrow f39. The transferor cylinder 39 is tangential to a gluing cylinder 41, which turns in the direction indicated by the arrow f41, in the same direction as the transferor cylinder 39 and in contact with the latter. In this way, the glue is transferred from the tank 37 onto the cylindrical surface of the gluing cylinder 41, and therefrom to the crests of the web-like material N, which is run over the first corrugating roller 7 and previously deformed in the gap between the corrugating roller 7 and the corrugating roller 9.

[0030] The working position of the gluing assembly 31 is defined by the position of the axis B and by a pair of eccentric pins 42 carried by the unit 11.

[0031] Whenever a unit 11 is inserted into the machine, the eccentric pins 42 carried by the unit 11 are adjusted to adjust the position of the gluing assembly 31 in such a way that the axis of the gluing cylinder 41 is perfectly parallel to the axis 7A of rotation of the first corrugating roller 7. This adjustment operation is normally carried out just once, when a set of corrugating rollers 7, 9 carried by the unit 11 are inserted into the machine.

[0032] Oscillation of the gluing assembly 31 about the axis B is controlled by means of a cylinder-piston actuator 47, which is hinged in 49 to the fixed structure 3 of the machine and in 51 to the gluing assembly 31. The positions of working and opening of the gluing assembly 31 are shown in Figures 1 and 2, as mentioned above. In the position illustrated in Figure 2, the gluing assembly 31 has been moved away from the corrugating roller 7 to enable replacement of the unit 11, which carries the corrugating rollers 7 and 9.

[0033] Along the development of the corrugating roller 7, downstream of the gluing area defined by the position of the gluing cylinder 41, there is provided a pressure roller 55 supported by a pair of arms 56, which are hinged in 59 to the fixed structure 3 and which are forced by actuators 61 so that they press the pressure roller 55 against the corrugating roller 7. Run over the pressure roller 55 is a second continuous web-like material, for example, a sheet of paper material designated by N2, said material being guided by a cylinder 63. The web-like material N2 is applied by pressure exerted by the roller 55 onto the crests of the web-like material N previously provided with glue by means of the gluing cylinder 41. The second web-like material N2 constitutes the so-called "cover" of the corrugated cardboard produced by the machine. The corrugated cardboard, designated by CO, is thus made up of the corrugated web-like material N glued onto the smooth web-like material N2. In a way of itself known, this material is then sent on to a further machine for application of a second smooth sheet on the opposite face, and is then possibly combined with other sheets of corrugated cardboard.

[0034] As shown, in particular, in the longitudinal sections of the gluing cylinder 41, illustrated in Figure 3, the gluing cylinder 41 is supported on the gluing assembly 31 by means of a pair of bearings 71. Mounted at one end of the gluing cylinder 41 is a pulley 73, with interposition of a free-wheel mechanism 75. Run over the pulley 73 is a toothed belt 77, which is then run over a further pulley 79, fitted on the axis of the transferor cylinder 39 and run over a motor-driven pulley 81, which receives motion from a motor 83. The latter then drives in rotation the transferor cylinder 39 and the gluing cylinder 41 by means of the belt 77.

[0035] The peripheral speed of the gluing cylinder 41 applied by the motor 83 is chosen in such a way as to be slightly lower than the peripheral speed of the first corrugating roller 7, and, more precisely, slightly lower than the peripheral speed of the most radially external points (i.e., the crests) of the corrugated web-like material N, which passes between the rollers 7 and 9 and is run over the corrugating roller 7. Characteristically, the difference in peripheral speed may be in the range of 0.5% to 10%, and preferably between 1% and 5%.

[0036] With an arrangement of this type it is possible to control and adjust the position of the gluing cylinder 41 with respect to the corrugating roller 7, using as control parameter the speed of rotation of the gluing cylinder 41 in the way described hereinafter. This speed is detected by means of an encoder 91 (see Figure 3) mounted on the gluing assembly 31 co-axially with respect to the gluing cylinder 41.

[0037] The device so far described operates as fol-

lows. Once the unit 11 is inserted into the machine, the gluing assembly 31 is brought into the working position (see Figure 1), retracting the actuator 47 until the gluing assembly is brought right up against the eccentric cams 42. By adjusting the angular position of the eccentric cams 42, the axis of the gluing assembly 41 is brought up parallel with the axis of the corrugating roller 7. The eccentric cam 33 is brought into an angular position such as to bring the gluing cylinder 41 to the maximum distance from the corrugating roller 7.

[0038] In the above configuration, the distance between the active cylindrical surface of the gluing cylinder 41 and the web-like material N run over the corrugating roller 7 is certainly greater than the optimal distance for obtaining perfect gluing. In order to adjust this distance to the appropriate value, after starting up feeding of the web-like material N through the machine, the actuator 35, which turns the eccentric cam 33, is activated, so bringing the axis of oscillation B closer to the vertical plane containing the axis 7A of the corrugating roller 7, whilst the machine is brought up to the operating speed, with the gluing cylinder 41 that turns at a slightly lower speed than that of the web-like material run over the first corrugating roller 7. When the gluing cylinder 41 approaches the corrugated web-like material resting on the ribs of the first corrugating roller 7, the force of friction that is generated between the web-like material and the gluing cylinder 41 tends to bring about an angular acceleration of the latter, since the web-like material advances at a speed higher than the peripheral speed of the gluing cylinder 41. The web-like material N starts to exert on the gluing cylinder 41 a frictional force and hence an effect of drawing even prior to contact between the web-like material itself and the active surface of the cylinder on account of the presence of the film of glue on the cylinder itself.

[0039] Since the gluing cylinder 41 is connected to the transmission with interposition of the free wheel 75, the effect of this frictional force will be to cause an effective angular acceleration of the gluing cylinder 41. This angular acceleration is detected by the encoder 91 interfaced to the control unit 21. The distance between the gluing cylinder 41 and the corrugating roller 7 is fixed by arresting rotation of the eccentric cam 33 when the gluing cylinder 41 has reached a certain over-speed with respect to the speed at which it would be driven in rotation by the motor 83, or else, and preferably, the eccentric cam 33 is caused to rotate again in the opposite direction as soon as the encoder 91 detects an angular acceleration of the cylinder 41 until this angular acceleration ceases, an event which corresponds to a distance being reached between the active cylindrical surface of the gluing cylinder 41 and the web-like material N run over the corrugating roller 7 such as not to cause application of a force of friction sufficient for drawing the gluing cylinder 41 into a condition of over-speed.

[0040] To obtain proper operation, it may be necessary, or in any case expedient, to provide, on the axis of the gluing cylinder 41, a braking device (not illustrated), appropriately calibrated to prevent the cylinder 41 from being brought up to an excessive speed of rotation as a result of the frictional force applied by the web-like material N that is run over the corrugating roller 7.

[0041] Since, during operation, there may be variations in the diameter of the corrugating roller 7 on account of its being heated and/or variations in the thickness of the web-like material N that is fed in, the unit 21, which is interfaced with the encoder 91 and with the actuator 35, is always able to detect any possible acceleration of the gluing cylinder 41 that is due to the reduction in the distance between the cylinder 41 itself and the corrugated web-like material N. When this situation arises, the actuator 35, which moves the gluing assembly 31 and hence the gluing cylinder 41 away from the corrugating roller 7 by the necessary amount, is activated. The adjustment is extremely accurate thanks to the distance of the axis of oscillation B from the resting point defined by the eccentric contrasts 42.

[0042] The unit 21 can be programmed in such a way as to cause a periodic gradual approach, by means of rotation of the eccentric cam 33, of the gluing cylinder 41 in the direction of the corrugating roller 7 to verify that there have not been any increments in the distance between the gluing cylinder 41 and the corrugated web-like material N, which may be due, for example, to a reduction in the thickness of the web-like material N and/or to a reduction in the diameter of the corrugating roller 7. The unit 21 will periodically cause an approach and then a gradual recession of the gluing cylinder 41 once again on the basis of the signal sent to the encoder 91 to determine the final position that the gluing cylinder 41 must assume with respect to the corrugating roller 7.

[0043] According to a different mode of operation, the control of the distance between the gluing cylinder 41 and the corrugating roller 7, when the first adjustment of the position of the gluing assembly 31 has been carried out via rotation of the eccentric cam 33, the maintenance of the distance between the corrugated web-like material N and the active surface of the gluing cylinder 41 can be entrusted to the sensor 19. In fact, the position of the arms 13, and hence of the second corrugating roller 9 with respect to the axis of rotation 7A of the first corrugating roller 7, depends upon the diameter of the corrugating roller 7 itself, upon the diameter of the corrugating roller 9, and upon the thickness of the web-like material N passing between the two corrugating rollers. If the variation in diameter of the corrugating roller 9 during operation is assumed as being negligible, for the reasons clarified hereinafter, the position read by the sensor 19 is a function of the variation in diameter of the corrugating roller 7 and of the variation in the thickness of the web-like material N. This variation is the one that affects the distance between the crests of the corrugation of the web-like material N and the active surface of the gluing cylinder 41. Consequently, the actuator 35, which modifies the position of the axis of oscillation B,

and hence of the gluing assembly 31, with respect to the corrugating roller 7 can be interlocked to the signal detected by the sensor 19 through a control made by the control unit 21.

[0044] An approach of the arm 13 to the sensor 19 indicates an increase in the thickness of the web-like material N and/or an increase in the diameter of the corrugating roller 7, and hence there derives therefrom the need to rotate the eccentric cam 33 by means of the actuator 35 to move the gluing cylinder 41 away from the axis of rotation 7A of the corrugating roller 7. An increase in the distance read by the sensor 19 indicates, instead, a reduction in the thickness of the web-like material and/or a reduction in the diameter of the corrugating roller 7, and hence the consequent need to reduce the distance between the gluing cylinder 41 and the axis 7A of rotation of the corrugating roller 7.

[0045] With the signal coming from the sensor 19, it is therefore possible to obtain a continuous control of the distance between the gluing cylinder 41 and the corrugating roller 7, without having to carry out periodic approach and recession of the gluing assembly 31 in order to detect the difference in speed on the gluing cylinder 41, as described previously, and limiting this operation just to the initial stage of adjustment, when starting up the machine.

[0046] The variation in the diameter of the corrugating roller 7, of which account is not taken in the adjustment described above by means of the signal of the sensor 19, is neglected in that the smaller diameter of this roller leads to a smaller variation in its dimensions due to the fluctuation in temperature. In addition, the variation in diameter of the corrugating rollers is mainly due to a variation in the thermal flow removed from the web-like material N during operation of the machine. In fact, if the machine increases its speed, the web-like material that is passing through it per unit time increases, and consequently also the heat removed by thermal conduction between the corrugating roller and the web-like material increases. Since the arc of contact between the web-like material N and the second corrugating roller 9 is very small and negligible as compared to the extensive arc of contact of the web-like material N with the top corrugating roller 7, this variation in the thermal flow removed from the web-like material N as a function of the variation in the operating conditions of the machine is negligible. Consequently, the dimensional variation of the corrugating roller 9 with respect to the dimensional variation of the corrugating roller 7 is negligible.

[0047] It is understood that the drawing only shows an example of embodiment provided purely as a practical demonstration of the invention, which may vary in its embodiments and arrangements, without thereby departing from the scope of the inventive idea underlying the invention itself. The possible presence of reference numbers in the attached claims has the purpose of facilitating reading thereof with reference to the description and to the table of drawings, and in no way limits the sphere of protection represented by the claims.

Claims

1. A machine for the production of corrugated cardboard, comprising:

   - a first corrugating roller (7);
   - a second corrugating roller (9) co-operating with the first corrugating roller for corrugating a sheet of web-like material (N), which passes between said first corrugating roller and said second corrugating roller, which are provided with projections that mesh together;
   - a gluing assembly (31) with a gluing cylinder (41), which co-operates with the first corrugating roller for applying a glue on the crests of said web-like material; and
   - adjustment means for adjusting the position of the gluing cylinder with respect to the first corrugating roller;

   characterized in that said adjustment means comprise a detector for detecting a parameter indicating a variation in the speed of rotation of the gluing cylinder, the position of the gluing cylinder (41) with respect to the first corrugating roller (7) being regulated according to said variation in speed.

2. The machine according to Claim 1, **characterized in that** said gluing assembly (31) is mounted so that it can move with respect to said first corrugating roller, the position of the gluing assembly being modified according to the variation in speed of the gluing cylinder.

3. The machine according to Claim 1 or 2, **characterized in that** the gluing cylinder (41) is drawn in rotation with a peripheral speed lower than the peripheral speed of the sheet of web-like material run over said first corrugating roller.

4. The machine according to Claim 3, **characterized in that** the peripheral speed of the gluing cylinder is between 0.5% and 10% and preferably between 1 % and 5% lower than the peripheral speed of said web-like material run over said first corrugating roller.

5. The machine according to one or more of the preceding claims, **characterized in that** said gluing cylinder is carried in rotation by means of a wheel (73), which is co-axial with said gluing cylinder, and **in that** between said gluing cylinder and said wheel co-axial therewith is set a mechanism which enables an angular acceleration of the gluing cylinder with respect to the wheel itself.

6. The machine according to one or more of the preceding claims, **characterized in that** said gluing assembly is supported about an axis of oscillation (B) parallel to the axes of rotation of the first and second corrugating rollers and of the gluing cylinder, and in the working position rests against a contrast (42), the position of the axis of oscillation being modifiable for adjusting the position of the gluing cylinder with respect to the first corrugating roller.

7. The machine according to Claim 6, **characterized in that** said axis of oscillation is carried by an eccentric cam (33), associated to which is an actuator (35), the rotation of the eccentric cam by means of said actuator modifying the position of the axis of oscillation.

8. The machine according to one or more of the preceding claims, **characterized in that** said means for detecting the variation in speed of the gluing cylinder determine the amount of variation in the speed.

9. The machine according to one or more of the preceding claims, **characterized in that** said gluing cylinder (41) is driven in rotation with a transmission that enables said cylinder to rotate at a speed higher than the speed at which it is driven by said transmission.

10. The machine according to Claim 9, **characterized in that** said transmission comprises a free-wheel device.

11. The machine according to Claims 5 and 10, **characterized in that** said free-wheel mechanism is set between said gluing cylinder and said wheel (73) co-axial therewith.

12. The machine according to one or more of Claims 6 to 11, **characterized in that** said means for detecting the variation in speed of the gluing cylinder comprise an encoder (91).

13. The machine according to one or more of the preceding claims, **characterized in that** said second corrugating roller is carried by a pair of arms (13), to which is associated an actuator (17), which forces the second corrugating roller (9) against the first corrugating roller (7), and **in that** associated to said second corrugating roller (9) is a position sensor (19) for detecting the variation in position of the second corrugating roller, the signal generated by said sensor controlling the position of the gluing cylinder.

14. The machine according to Claim 13, **characterized in that** said second corrugating roller has a diameter smaller than the diameter of the first corrugating roller.

15. A method for controlling the distance between a gluing cylinder and a first corrugating roller in a machine for the production of corrugated cardboard, comprising said gluing cylinder (41), said first corrugating roller (7), and a second corrugating roller (9) co-operating with said first corrugating roller for corrugating a sheet of web-like material (N), on which said gluing cylinder applies an adhesive, **characterized by** detecting a parameter indicating a variation in the speed of rotation of the gluing cylinder, and byt adjusting the distance between said first corrugating roller and said gluing cylinder according to said variation in speed.

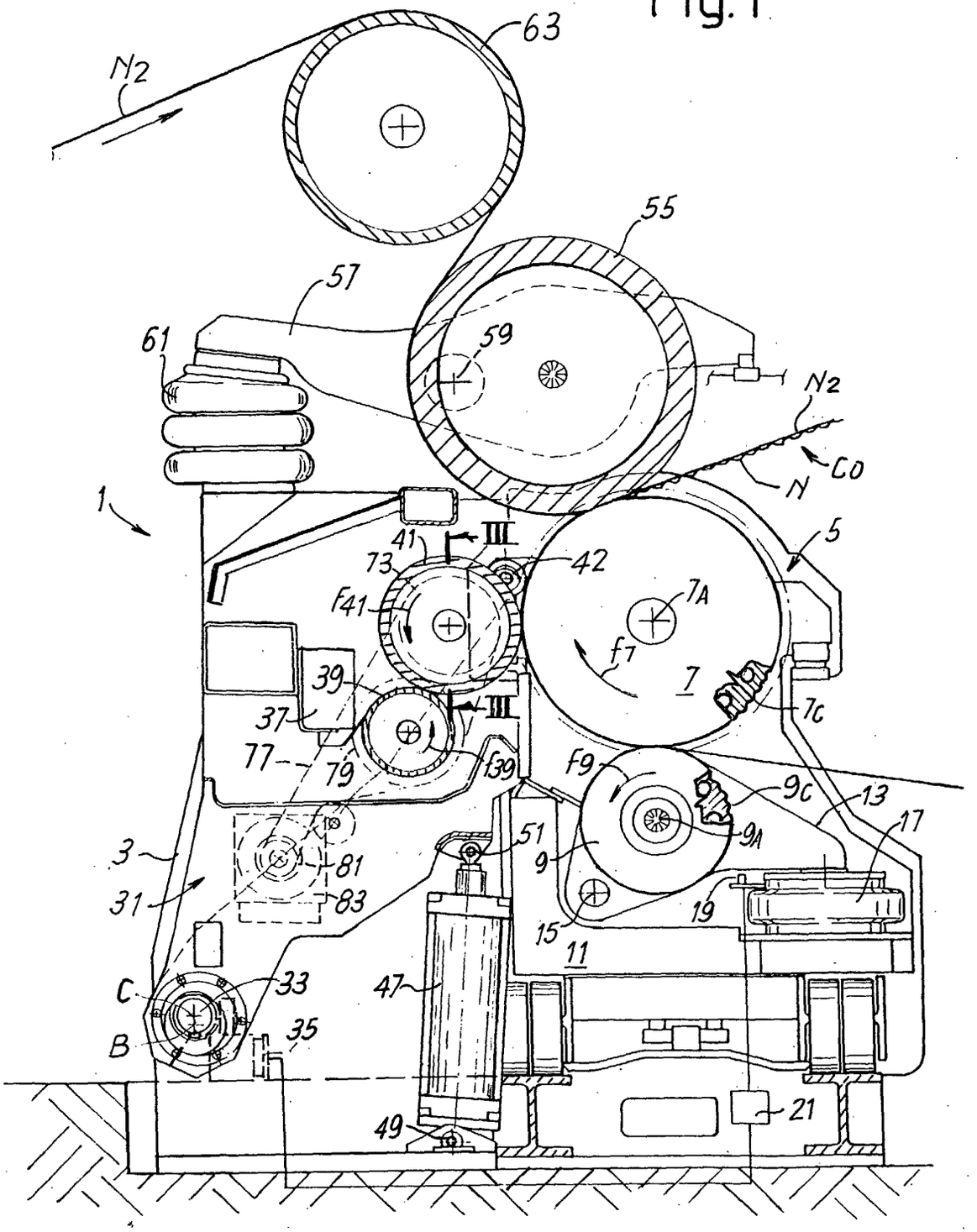
16. The method according to Claim 15, **characterized by** driving the gluing cylinder in rotation at a peripheral speed lower than the peripheral speed of the sheet of web-like paper material run over said first corrugating roller and by gradually bringing the gluing cylinder up to the first corrugating roller until the speed of rotation of the gluing cylinder increases as a result of the contact with the sheet of paper material run over said first corrugating roller.

17. The method according to Claim 15 or 16, **characterized by** driving said gluing cylinder in rotation by means of a motor-driven wheel (73) co-axial therewith, and by detecting a parameter that is a function of the variation in angular velocity between said gluing cylinder and said wheel, caused by the force of friction transmitted to said gluing cylinder by said web-like material run over the first corrugating roller.

18. The method according to Claim 15 or 16 or 17, **characterized by** the steps of:

- carrying in rotation said first and second corrugating rollers, running said sheet of paper material over said first corrugating roller;
- carrying in rotation said gluing cylinder at a peripheral speed lower than the peripheral speed of the sheet run over the first corrugating roller;
- gradually approaching the gluing cylinder to the first corrugating roller until a working position is reached determined on the basis of the detection of a variation in speed of rotation of said gluing cylinder;
- detecting the variation in the position of the second corrugating roller with respect to the axis of rotation of the first corrugating roller; and
- modifying the position of the gluing cylinder with respect to the axis of rotation of the first corrugating roller as a function of the variation of the position of the second corrugating roller with respect to the axis of rotation of the first corrugating roller.

Fig.1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37
III
77
79
f39
F9
9c
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B
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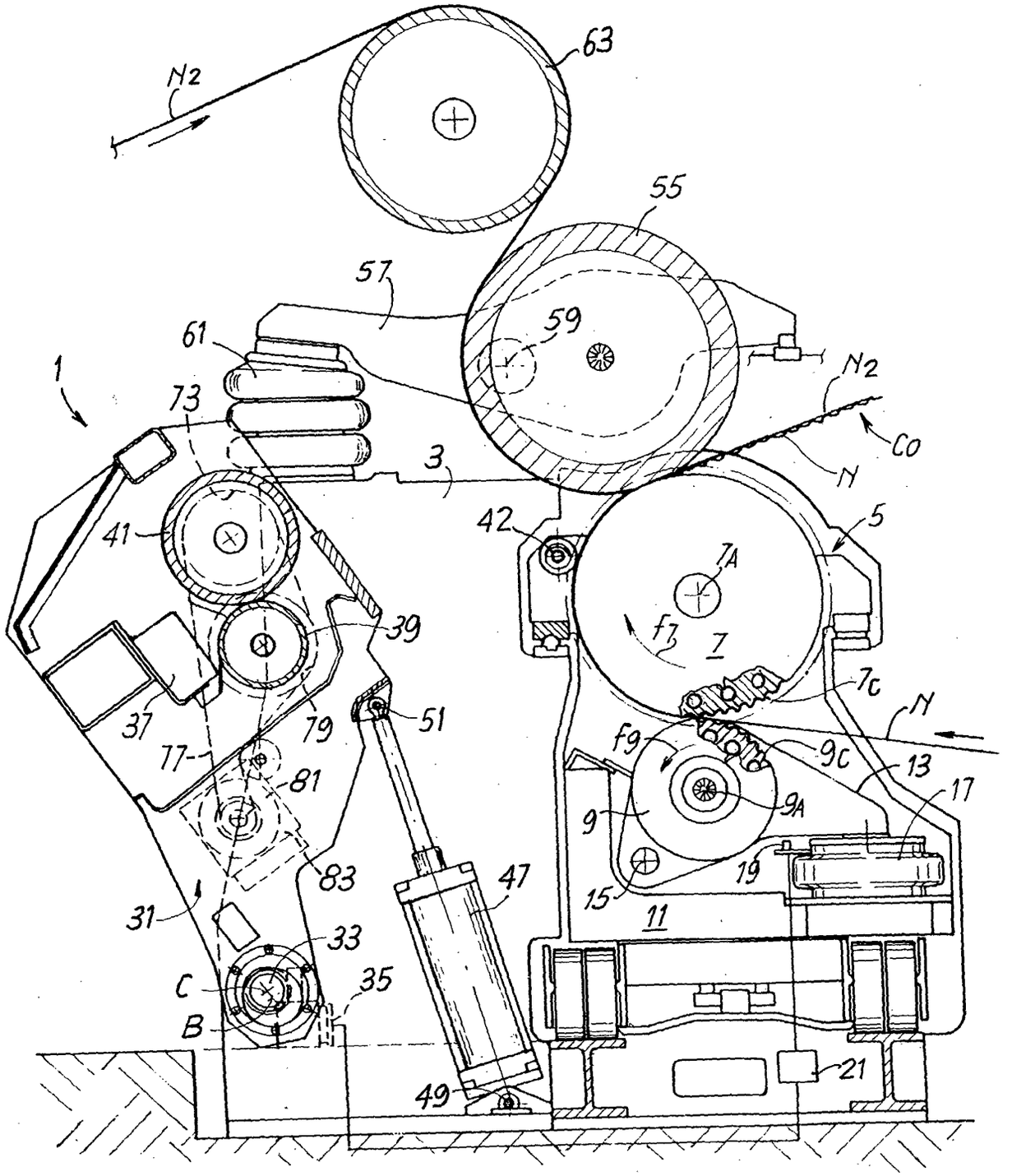
21

Fig. 2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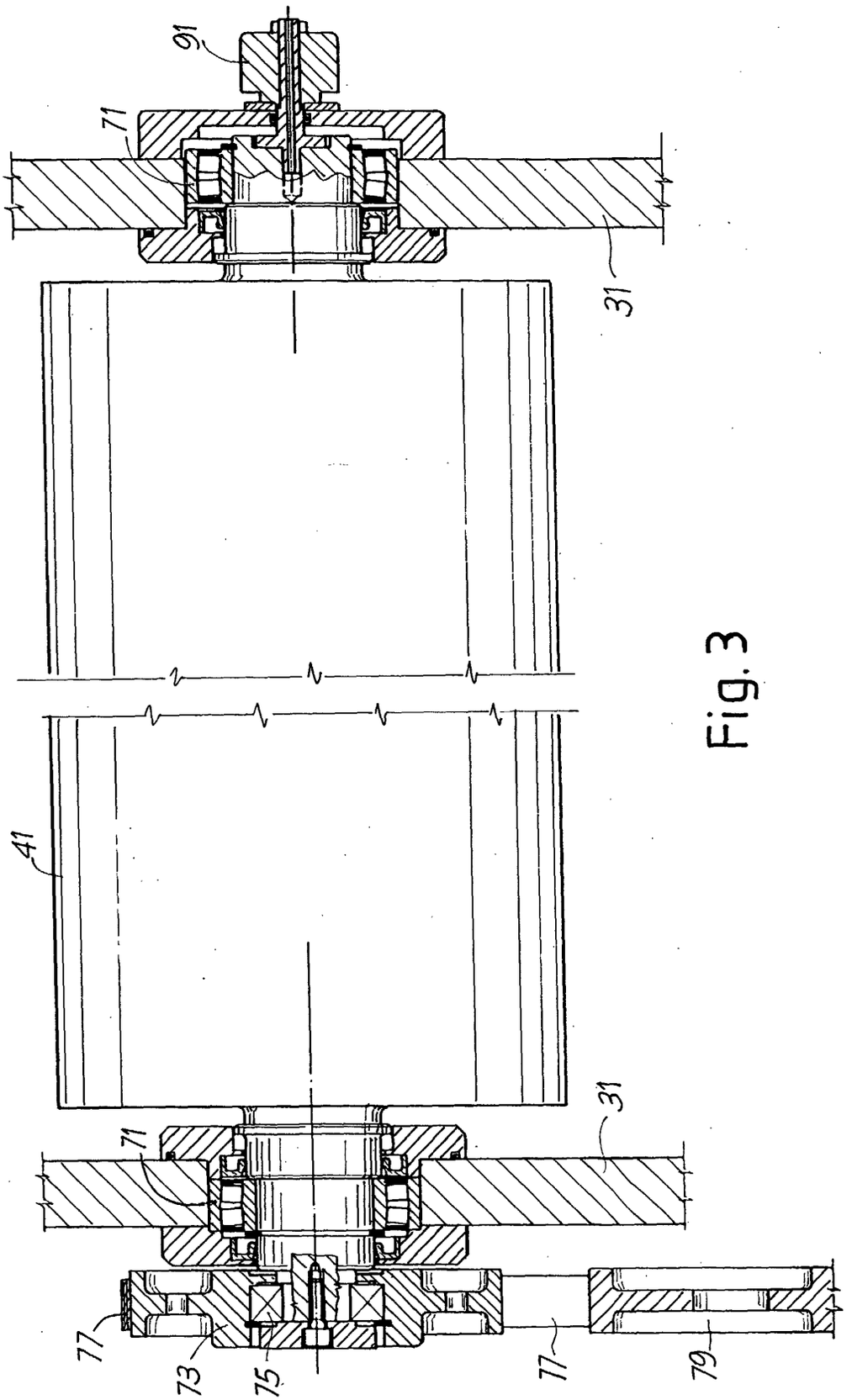

Fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 42 5306

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25 September 2002	J-E. Söderberg

CATEGORY OF CITED DOCUMENTS

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