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

(11) EP 0 619 256 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
25.02.1998 Bulletin 1998/09

(51) Int. Cl.[6]: **B65H 19/18**, B65H 23/06, B65H 16/04

(21) Application number: **94105381.1**

(22) Date of filing: **07.04.1994**

(54) Belt-shaped material feeding apparatus

Zuführeinrichtung für Bahnmaterial

Appareil pour l'alimentation d'un matériau en bande

(84) Designated Contracting States:
DE GB IT

(30) Priority: **08.04.1993 JP 81678/93**

(43) Date of publication of application:
12.10.1994 Bulletin 1994/41

(73) Proprietor: **JAPAN TOBACCO INC.**
Shinagawa-ku, Tokyo 140 (JP)

(72) Inventor:
Sakamoto, Hiroshi,
c/o Japan Tabacco Inc.
Kita-ku, Tokyo (JP)

(74) Representative:
Reinhard - Skuhra - Weise & Partner
Friedrichstrasse 31
80801 München (DE)

(56) References cited:
EP-A- 0 155 863
EP-A- 0 179 243
EP-A- 0 189 782
EP-A- 0 269 807
DE-A- 2 628 577
GB-A- 2 205 308

EP 0 619 256 B1

Description

BACKGROUND OF THE INVENTION

The present invention relates to a belt-shaped material feeding apparatus of a cigarette manufacturing machine according to the preamble of claim 1.

A cigarette manufacturing machine is provided with a winder for continuously forming cigarette rods by wrapping cut tobacco in a paper web, and an apparatus for feeding the paper web to the winder. Generally, the paper web feeding apparatus comprises two bobbin mounting shafts which are rotatably supported on the body of the apparatus. A bobbin (corresponding to a reel mentioned later) wound with the paper web is mounted on each mounting shaft by means of a bobbin holder. Thus, the feeding apparatus can be fitted with two paper web bobbins. This arrangement is intended for the improvement of productivity, allowing the paper web bobbins to be replaced without suspending the operation of the winder or the paper web supply.

For a compact design of the paper web feeding apparatus, for example, the bobbin mounting shaft on the winder side or the lower-course side sometimes may be situated in a position such that the distance between itself and an apparatus component on the lower-course side thereof is shorter than the maximum web roll radius of the paper web bobbin. In order to avoid interference between the paper web on the bobbin and the apparatus component, in this case, the bobbin is mounted on the upper-course bobbin mounting shaft as long as its roll diameter is large enough.

The paper web feeding apparatus further comprises a pulling roller for holding the paper web, in conjunction with a pinch roller, and a servomotor coupled to the pulling roller. As the pulling roller is rotated by means of the servomotor, the paper web is delivered from the paper web bobbin at a speed matched to the cigarette rod forming speed of the winder, and is fed to the winder.

When the remainder of the paper web on the bobbin mounted on the upper-course bobbin mounting shaft is reduced with the advance of the paper web supply, the rotational speed of the servomotor is increased so that the paper web is delivered from the bobbin at a speed higher than the cigarette rod forming speed. When the paper web is stored in a reservoir box of the feeding apparatus, as a result of this operation, the bobbin, having the reduced remaining web thereon, is removed from the upper-course bobbin mounting shaft, and is set on the lower-course mounting shaft. Furthermore, a virgin paper web bobbin is set on the upper-course bobbin mounting shaft, and the starting end of a paper web on this bobbin is guided by an operator to a paper web connecting section of the feeding apparatus.

When the remainder of the paper web on the lower-course bobbin is further reduced, thereafter, the starting end of the paper web on the virgin bobbin on the upper-course side is connected to the paper web on the lower-course bobbin in the paper web connecting section, and the web on the lower-course bobbin is cut in a position just on the upper-course side of the joint between the used and virgin webs. When this is done, the paper web stored in the reservoir box is supplied from the reservoir box to the winder, with the rotation of the servomotor suspended. The used lower-course bobbin is removed from the feeding apparatus body. When the paper web bobbin replacement is finished in this manner, the servomotor is rotated to start paper web supply from the virgin bobbin.

Thus, in the conventional paper web feeding apparatus described above, a complicated reel moving operation of removing the bobbin, having the reduced remaining web thereon, from one of the bobbin mounting shafts, and of mounting the same to another bobbin mounting shaft is required. Thus, it is difficult to automate the bobbin replacement and paper web supply in the conventional apparatus.

In general, the paper web feeding apparatus is provided with a brake for applying braking force to each paper web bobbin through the bobbin mounting shaft. The paper web is subjected to tension as the braking force is applied to the mounting shaft. Conventionally, a mechanical brake is used for this tensioning. It is hard, therefore, to properly adjust the tension on the paper web, as well as the braking force applied to the paper web bobbin, so that the paper web supply cannot be easily speeded up. Moreover, the mechanical brake includes many wearable parts, so that its maintenance and inspection require much time and labor.

An apparatus for feeding a belt-shaped material employed for the production of cigarettes with a cigarette manufacturing machine according to the preamble of claim 1 is already known from EP-A-155 863. However, this pre-known apparatus does not contain any paper web travelling position adjustment, and therefore, the belt-shaped material supply cannot be speeded up.

EP-A-189 782 discloses an apparatus for controlling the amount of delivery in a wrapping material feed system. However, this document does not clearly show applying the packaging material feed system to a cigarette manufacturing machine nor the disposition of rotating shafts at fixed positions of the body, which are separated from each other. Further this document contains no disclosure of elements corresponding to a variable - diameter holder and associate driving means thereof.

It is an object of the present invention to provide an apparatus according to the preamble of claim 1 in which the reel replacement and belt-shaped material supply can be automated and be speeded up.

According to the invention this object is obtained by an apparatus according to the preamble of claim 1 having the characterizing features of claim 1. Further advantageous embodiments are characterized in dependent claims 2 - 6.

Preferably, the apparatus includes a first electrical brake for applying braking force to the first rotating shaft; a second electrical brake for applying braking force to the second rotating shaft; a first detector for generating an electrical signal indicative of a diameter of the first belt-shaped material on the first reel; a second detector for generating an electrical signal indicative of a diameter of the second belt-shaped material on the second reel; and brake control means for controlling operations of the first and second electrical brakes in accordance with electrical signals from the first and second detectors.

Preferably, the belt-shaped material feeding apparatus includes a belt-shaped material connecting means for connecting a starting end portion of one of the first and second belt-shaped materials to another belt-shaped material which is in service, and for cutting another belt-shaped material at a location on upper-course side of a connection between the first and second belt-shaped materials.

The present invention is advantageous in that two reels each wound with a belt-shaped material of a maximum roll diameter can be respectively mounted to two rotating shafts of a belt-shaped material feeding apparatus, and in that belt-shaped material supply can be made from either one of the reels, with the one reel kept mounted to either one of the rotating shafts until the remaining belt-shaped material is reduced to a predetermined level. This makes it possible to eliminate a complicated reel moving operation of removing the reel, having the reduced remaining belt-shaped material, from the one rotating shaft and mounting the same to another rotating shaft. Thus, the attachment and detachment of the reels and belt-shaped material supply can be automated with ease.

Moreover, electrical brakes can be employed for an adjustment of a braking force applied to the reels through the rotating shafts of the belt-shaped material feeding apparatus. That is, in the feeding apparatus of the present invention which requires no reel movement, each reel always corresponds to the electrical brake for applying a braking force thereto. This makes it possible to use electrical brakes in the apparatus of the present invention, as distinct from a conventional apparatus which is required to use different brakes before and after reel movement for application of braking force to one reel, making it difficult to use electrical brakes which must be readjusted after the reel movement. Therefore, according to the present invention, braking force applied to the reel, and hence tension on the belt-shaped material can be properly adjusted by means of the electrical brake, so that the belt-shaped material supply can be speeded up.

Further, according to a preferred embodiment of the present invention in which the reels can be attached to and detached from the rotating shafts of the belt-shaped material feeding apparatus via variable-diameter holders, the attachment and detachment of the reels and hence the belt-shaped material supply can be automated with ease.

These and other objects and advantages will become more readily apparent from an understanding of the preferred embodiments described below with reference to the following drawing figures.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will become more fully understood from the detailed description herein below with reference to the accompanying figures, given by way of illustration only and not intended to limit the present invention in which:

Fig. 1 is a schematic perspective view showing a conventional paper web feeding apparatus of a cigarette manufacturing machine;

Fig. 2 is a schematic front view showing a paper web feeding apparatus according to one embodiment of the present invention;

Fig. 3 is a sectional view showing a reel mounting shaft of the feeding apparatus of Fig. 2 and its peripheral elements;

Fig. 4 is a fragmentary enlarged view showing the reel mounting shaft of Fig. 3 and its peripheral elements;

Fig. 5 is a fragmentary enlarged view showing the principal part of the reel mounting shaft of Fig. 3;

Fig. 6 is a partly cutaway front view of a bobbin shown in Fig. 2;

Fig. 7 is a fragmentary enlarged view showing the principal part of the bobbin of Fig. 6;

Fig. 8 is a rear view of elements shown in Fig. 3;

Fig. 9 is a front view of an automatic paper web connecting unit shown in Fig. 2;

Fig. 10 is a sectional view taken along line X-X of Fig. 9;

Fig. 11 is a rear view of the automatic paper web connecting unit shown in Fig. 9;

Fig. 12 is a fragmentary enlarged view showing the principal part of a cutter mechanism shown in Fig. 10;

Fig. 13 is a front view of a shaft of the cutter mechanism shown in Fig. 12;

Fig. 14 is a plan view of the shaft shown in Fig. 13;

Fig. 15 is a bottom view of a holder of the cutter mechanism shown in Fig. 10;

Fig. 16 is a sectional view taken along line XVI-XVI of Fig. 15;

Fig. 17 is a partly cutaway front view of a front knife of the cutter mechanism shown in Fig. 10;

Fig. 18 is a bottom view of the front knife shown in Fig. 17;

Fig. 19 is a view showing a state in which paper web connection is started with the starting end of a virgin paper web held against the end face of a press block, in the paper web connecting unit

shown in Fig. 9;

Fig. 20 is a view showing the way a paper web in service is cut in the paper web connecting unit;

Fig. 21 is a view showing the way the virgin paper web is connected to the paper web in service;

Fig. 22 is a view showing a completion of the paper web connection;

Fig. 23 is a diagram showing the timing for the paper web connection in the paper web feeding apparatus shown in Fig. 2; and

Fig. 24 is a schematic block diagram schematically showing a control unit of the paper web connecting unit along with its peripheral elements.

DETAILED DESCRIPTION

Referring to Fig. 1, there is shown a conventional cigarette manufacturing machine, in which a bobbin 2 wound with a paper web 1 is removably mounted for rotation on a bobbin mounting shaft (not shown) of a paper web feeding apparatus 4 by means of a bobbin holder 3. The paper web 1 is fed to a winder (not shown) of the cigarette manufacturing machine through a paper web connecting section 5 and a reservoir box 6. The web 1 is guided by the winder as it travels in one direction. In this process of traveling, cut tobacco is supplied to the winder, and is wrapped in the paper web 1 to form a continuous rod-shaped cigarette or cigarette rod. Thereafter, the cigarette rod is cut into individual cigarettes with a predetermined length.

The paper web 1 is fed from the bobbin 2 by rotating a pulling roller (delivery roller) 7. Thus, the web 1 is pulled and delivered as the roller 7 rotates. A rotating shaft of the roller 7 is connected to an output shaft of a servomotor (not shown) by means of gears so that the speed of delivery of the paper web 1 can be matched to the cigarette rod forming speed of the winder by controlling the rotational speed of the output shaft of the servomotor. The paper web feeding apparatus 4 incorporates a mechanical brake, such as a band or pad, and a braking force corresponding to the diameter of the web roll on the bobbin 2 is applied to the bobbin 2 by means of the brake. Thus, a tension corresponding to the web roll diameter is applied to the paper web 1.

A remaining paper web detecting lever 8 outputs a signal when the remainder of the paper web 1 in service is reduced below a predetermined level, that is, when the roll diameter of the bobbin 2 is reduced below a predetermined level. On receiving this signal, a control device (not shown) gives an alarm, thereby informing an operator of the situation, and increases the rotational speed of the pulling roller 7 so that the paper web 1 is delivered at a speed higher than the cigarette rod forming speed, whereupon the web 1 is stored in the reservoir box 6. Perceiving the alarm, the operator removes the bobbin 2 in service and the bobbin holder 3 associated therewith from a bobbin mounting shaft on the left-hand side of Fig. 1, and then mounts the bobbin 2 on a right-hand bobbin mounting shaft by using the bobbin holder 3, as shown in Fig. 1. Further, the operator mounts a bobbin 2' wound with a new or virgin paper web 1' on the left-hand mounting shaft by using a bobbin holder 3', and guides the starting end (leading end) of the web 1', which is pasted with a double-coated tape, to the paper web connecting section 5 through a guide roller. When preparing for the connection of the paper web 1 in service and the virgin paper web 1' is finished, the paper web supply from the bobbin 2 is restarted.

During the paper web supply, a remaining paper web detecting lever 9 detects the roll diameter of the in-service bobbin 2 mounted on the right-hand bobbin mounting shaft. When the remainder of the paper web 1 is further reduced to a predetermined level, the control device stops the pulling roller 7 to suspend the delivery of the paper web 1, and connects the paper webs. Thus, the starting end of the virgin paper web 1' is pasted on the in-service paper web 1 in the connecting section 5, and the remaining portion of the web 1 which follows the pasted portion is cut off. During this paper web connection, the paper web stored in the reservoir box 6 is fed to the winder, so that the winding operation can be executed without interruption. The emptied holder 2, along with the bobbin holder 3, is removed from the paper web feeding apparatus 4.

In a predetermined time after the completion of the connecting operation, the pulling roller 7 is driven again to start the delivery of the virgin paper web 1'. The position of the joint or doubled portion of the paper web is detected by means of paper web joint sensor (not shown), and those cigarettes (e.g., five in number) which correspond to the joint are removed automatically. These processes of operation are repeatedly executed to effect continuous production of cigarettes.

When the remainder of the paper web on the bobbin 2 in service becomes insufficient, in the conventional paper web feeding apparatus, however, the bobbin 2 and the bobbin holder 3 should be removed from the left-hand mounting position and set in the right-hand mounting position to be ready for paper web connection. At the same time, the bobbin 2' wound with the virgin paper web 1' must be set in the left-hand mounting position by means of the bobbin holder 3'. Thus, the preparations for the paper web connection entail troublesome manual attachment and detachment of the bobbins and the bobbin holders. It is difficult, therefore, to automate the paper web-supply. Using the mechanical brake, moreover, the conventional paper web feeding apparatus cannot easily stabilize the tension applied to the paper webs.

The following is a description of a paper web feeding apparatus as a belt-shaped material feeding apparatus according to one embodiment of the present invention.

The paper web feeding apparatus, which constitutes part of a cigarette manufacturing machine, serves

to feed a paper web to a winder of the machine.

General Configuration

Referring to Fig. 2, the paper web feeding apparatus 10 comprises two bobbins 12 and 12' fitted with reels 17 and 17' which are wound with paper webs 1 and 1', respectively. The paper web from one of the reels is fed to the winder (not shown) through a reservoir box 16 and a printing section (not shown) by rotating a pulling roller 15 by means of a servomotor (designated by numeral 250 in Fig. 24) for use as roller driving means in a manner such that the web is held between the roller 15 and a pinch roller 15a. The pinch roller 15a, in conjunction with the pulling roller 15, constitutes roller means for delivering the paper web.

The paper web feeding apparatus 10 further comprises a mechanism for applying tension to the paper web traveling from the apparatus 10 toward the winder and a mechanism for adjusting the traveling position of the paper web, whereby the travel of the paper web can be stabilized.

Furthermore, the paper web feeding apparatus 10 comprises an automatic paper web connecting unit 14 and a reel mounting unit. The connecting unit 14 connects the paper web on one reel to the paper web on the other reel when the remainder of the web on the first reel is reduced to a critical degree. The reel mounting unit is used to set the reels in the paper web feeding apparatus 10 so that the reels are removable. Thus, the paper web can be continuously fed to the winder, and manual operations for the paper web connection and reel attachment and detachment can be reduced considerably.

In the paper web feeding apparatus 10 according to the present embodiment, the reel mounting unit, tensioning mechanism, and paper web traveling position adjusting mechanism are arranged in and around two rotating shafts 24 and 24' for use as reel mounting shafts on which the reels 17 and 17' are mounted by means of the bobbins 12 and 12', respectively. Thus, the feeding apparatus 10 enjoys a compact design.

The following is a detailed description of various parts of the paper web feeding apparatus 10.

Rotating Shaft (Reel Mounting Shaft)

Referring to Figs. 3 and 4, an outer cylinder 20 is fixed to a front wall 11, which constitutes part of the body of the paper web feeding apparatus 10, by means of bolts. An inner cylinder 21 is fitted in the outer cylinder 20 so as to be slidable and nonrotatable with respect to the cylinder 20. The hollow rotating shaft 24 is rotatably supported in the inner cylinder 21 by means of bearings 25a and 25b. Thus, the shaft 24 is supported for rotation in the paper web feeding apparatus body. The other rotating shaft 24' is also supported for rotation in the apparatus body.

More specifically, the front end of the outer cylinder 20 is fitted in a large hole 11a which is bored through the front wall 11. A flange, which is formed substantially on the middle portion of the outer peripheral surface of the outer cylinder 20, is fixed to the front wall 11 by means of the bolts. A key way 20a is formed extending axially on the inner surface of the outer cylinder 20, while an annular groove 20b is formed extending circumferentially on the outer peripheral surface of the rear end portion of the cylinder 20. A mating key 21a for the key way 20a is fixed to the outer peripheral surface of the inner cylinder 21, whereby the cylinder 21 is fitted in the outer cylinder 20 so as to be slidable in the axial direction and nonrotatable.

The rotating shafts 24 and 24' are located in positions such that they do not interfere with the reels 17 and 17' with their maximum web roll diameters when the reels are mounted on their corresponding shafts.

Reel Mounting Unit

The reel mounting unit (bobbin clamping mechanism) is provided with the bobbins 12 and 12' as holder means for removably mounting the reels 17 and 17' on the rotating shafts 24 and 24'. Since bobbins 12 and 12' have the same construction, only the bobbin 12 will be described below.

The bobbin 12 has a variable-diameter holder with a variable outside diameter which is mounted on the rotating shaft 24. The holder includes movable holder elements 37, e.g., four in number, which are supported on the shaft 24 for movement in the radial direction of the shaft 24. Each holder element 37 is movable between a reel mounting position, in which its outer peripheral surface is pressed against a shaft hole defining surface of the reel, and a reel removing position, in which its outer peripheral surface is separated inward from the shaft hole defining surface of the reel with respect to the radial direction of the rotating shaft. More generally, the variable-diameter holder is designed so that its outside diameter is variable between a first diameter such that the holder can be pressed into a shaft hole of the reel 17 and a second diameter such that the holder can be disengaged from the reel shaft hole. The outside diameter of the variable-diameter holder is the diameter of an imaginary circle which is touched by the respective outer peripheral surfaces of the movable holder elements 37.

The reel mounting unit further comprises a holder drive mechanism for changing the outside diameter of the holder. The holder drive mechanism associated with the bobbin 12 includes a driving shaft 27 arranged for axial reciprocation in the hollow of the rotating shaft 24, and a cylinder actuator for reciprocating the shaft 27. The cylinder actuator is formed of, e.g., a spring single-acting air cylinder 51, whose cylinder chamber is selectively communicated with a compressed air source 210 or the atmosphere by means of a three-way solenoid

valve 211, which operates under the control of a control unit 200, as shown in Fig. 24.

When the supply of compressed air to the air cylinder 51 is stopped, a rod 54 is advanced by the agency of a spring 55, whereupon the outside diameter of the holder of the bobbin 12 increases to the level of the first diameter, so that the reel 17 is unremovably supported by means of the bobbin 12. As the compressed air is supplied, on the other hand, the rod 54 is retreated to reduce the outside diameter of the holder to the level of the second diameter, so that the reel 17 is allowed to be removed from the bobbin 12.

Preferably, a robot 220 is used to transport the reel between a reel storage space and the paper web feeding apparatus, and signals are transferred between the control unit 200 and a robot control unit 230 for controlling the operation of the robot, as shown in Fig. 24. In this arrangement, the control units 200 and 230 cooperate to control the operation of the robot 220 for the reel transportation and the operation of the reel mounting unit for the reel attachment and detachment. In this case, the attachment and detachment of the reel to and from the paper web feeding apparatus are automated. In Fig. 24, numeral 240 designates various sensors for detecting the robot operation.

The following is a further description of the reel mounting unit constructed in this manner.

As shown in Fig. 3, the air cylinder 51 is fixed to a support plate 46 on another support plate 45, which is fixed to a large-diameter flange 21c on the rear end of the inner cylinder 21 across a given space. The rod 54 (Fig. 4) of the cylinder 51 is loosely fitted in the rotating shaft 24, and its distal end is connected to the rear end of the shaft 27. A return spring 55 (Fig. 4) is interposed compressed between a flange on the distal end of the rod 54 and the support plate 46.

A thick large-diameter flange 24a is formed on the front end of the rotating shaft 24. Holes 24b, e.g., four in number, are bored through the peripheral wall of the flange 24a so as to be arranged at regular intervals in the circumferential direction of the flange. Each hole 24b extends in the radial direction of the shaft 24. The shaft 27 is fitted in the hollow of the shaft 24 by means of a bearing for relative rotation and axial sliding motion. A taper cam 28 is rotatably mounted on the front end of the shaft 27 by means of a thrust bearing 29 and a bearing 30. The rear half portion of the cam 28 is in the form of a cylinder having a uniform diameter, and the front portion thereof forms a taper surface tapered toward the front end. In other words, the front portion of the cam 28 is in the form of a truncated cone.

As shown in Fig. 5, a shaft 31 is slidably fitted in each hole 24b of the flange 24a, and a slit 31a is formed in the outer peripheral surface of shaft 31 so as to extend along the axis of the shaft 31. The proximal end of the shaft 31 is loosely fitted in a hole of a spring shoe 32, and faces the taper cam 28 across a narrow gap. A roller 33 is rotatably mounted on the proximal end of the shaft 31 by means of a shaft bolt 34 and a nut 35 (Fig. 7). As shown in Fig. 7, a spring 36 is interposed compressed between the spring shoe 32 and the respective peripheral surfaces of the head of the bolt 34 and the nut 35. The spring 36 causes the shaft 31 to withdraw, and presses the roller 33 against the taper cam 28 for rolling motion.

As shown in Figs. 5 and 6, the middle portion of each movable holder element 37, substantially in the form of a quadrant, is fixed to the distal end of the shaft 31 by means of a bolt 38. One end of a pin 39, the other end of which is fitted in a hole 24c bored in the end face of the flange 24a, is slidably fitted in the slit 31a of shaft 31. Thus, the shaft 31 is slidable, though nonrotatable, toward and away from the rotating shaft 24 in its corresponding hole 24b of the flange 24a. As the taper cam 28 reciprocates in the axial direction, the shaft 31 slides toward or away from the rotating shaft 24 in the hole 24c of the flange 24a with the roller 33 rolling, whereby variable-diameter holder, formed of the four holder elements 37, expands or contracts in diameter.

Paper Web Traveling Position Adjusting Mechanism

The paper web traveling position adjusting mechanism moves the bobbins 12 and 12' back and forth, thereby adjusting the travel of the paper webs 1 and 1'. An arrangement of this mechanism on the side of the bobbin 12 is identical with that on the side of the bobbin 12'. The following is a description of the arrangement on the side of the bobbin 12 only.

The traveling position adjusting mechanism includes a traveling position adjusting knob 13 (Fig. 3). The knob 13 extends through a hole 11b in the front wall 11, and is fixed to a shaft which is rotatably supported on the wall 11 by means of a bearing 57. A toothed pulley 58 is fixed to the rear end of the shaft of the knob 13. A toothed belt 59 is passed around and between the pulley 58 and a toothed pulley 22 which is screwed on the inner cylinder 21 of the bobbin 12.

As shown in Fig. 4, the toothed pulley 22 is in the form of a large ring, and a thread formed on its inner peripheral surface is engagedly fitted on a thread 21b of the inner cylinder 21. A ring-shaped flange 22a protrudes axially from the front end face of the pulley 22, covering the whole outer peripheral edge of the end face. A plurality of pins 23 are screwed in the flange 22a so as to be arranged at regular intervals in the circumferential direction of the flange. The respective tip ends of the pins 23 are slidably fitted in the annular groove 20b of the outer cylinder 20. Thus, the pulley 22 is supported on the outer cylinder 20 so as to be rotatable with respect to the cylinder 20 and axially immovable.

By rotating the knob 13, the toothed pulley 22 is rotated by means of the toothed belt 59 which is in engagement with the toothed pulley 58 of the knob 13, and the inner cylinder 21 is axially moved with respect to the outer cylinder 20 to move the bobbin 12 back and

forth, whereby the travel of the paper web is adjusted. Meanwhile, the paper web traveling position adjustment is performed such that an edge of the paper web is aligned with reference lines (not shown) formed on guide plates 62, 62' (mentioned later).

Tensioning Mechanism

The tensioning mechanism applies braking force to the rotating shafts 24 and 24', thereby tensioning the paper webs 1 and 1' delivered from the reels 17 and 17'. An arrangement of this mechanism on the side of the web 1 is identical with that on the side of the web 1'. The following is a description of the arrangement on the side of the paper web 1 only.

The tensioning mechanism is composed of a powder brake 50 for use as an electrical brake, a rotary encoder 52 for generating a predetermined number of pulses with every revolution of the reel 17, a timing sensor (designated by numeral 260 in Fig. 24) for generating a pulse with every revolution of the pulling roller 15, and the control unit 200. The control unit 200 determines the diameter of the roll of the paper web 1 on the reel 17 in accordance with pulse outputs from the encoder 52 and the sensor 260, and controls the operation of the powder brake 50 in accordance with the roll diameter so that the braking force applied to the rotating shaft 24 has an optimum value. The web roll diameter of the reel 17 is equal to the product of the diameter of the pulling roller 15 and the number of revolutions of the roller 15 for each revolution of the reel 17. Thus, the roll diameter can be calculated on the basis of the pulse outputs from the rotary encoder 52 and the sensor 260 and the roller diameter. The optimum braking force is previously set so that the braking force decreases in a curve of second degree, for example, as the roll diameter is reduced.

As shown in Fig. 3, the powder brake 50 and the rotary encoder 52 are supported by means of the support plate 45 which is fixed to the flange 21c of the inner cylinder 21. The powder brake 50 has its input shaft 50a fixed to the support plate 46 by means of a bracket 47 and its output shaft 50b fixedly fitted with a gear 53, which is in mesh with a gear 26 on the rotating shaft 24. Also, the brake 50 includes an input-side element (driving member) and an output-side element (driven member), arranged for relative rotation across a powder gap, and an exciting coil 50c (Fig. 24) disposed around the brake 50 so that magnetic flux can be passed through high-permeability powder (magnetic iron powder) which fills the powder gap. The coil 50c is connected to the control unit 200.

When the input-side element is rotating with the exciting coil de-energized, the powder in the powder brake 50 is pressed against the operating surface of the input-side element by centrifugal force. Thus, the input- and output-side elements are not connected at all, so that no torque is transmitted from the input-side element to the output-side element. When the exciting coil is energized, the particles of the powder are coupled in a chain, and torque is transmitted from the input-side element to the output-side element by coupling force between the powder particles and frictional force between the powder and the operating surface. The transmitted torque can be controlled by adjusting the exciting power of the exciting coil, that is, exciting current.

The input side of the powder brake 50 is fixed in the aforesaid manner, and the output side engages the gear 26 of the rotating shaft 24 through the medium of the gear 53. Accordingly, the output-side torque or braking force applied to the shaft 24 can be freely controlled by adjusting the exciting current. Thus, the braking force can be set with higher accuracy for the powder brake 50 than for the mechanical brake, so that an optimum tension can be applied to the paper web with stability. Moreover, the brake 50 enjoys high wear resistance, and its maintenance and inspection are easy.

A gear 56, which is fixed to the shaft of the rotary encoder 52, is in mesh with the gear 26 (Fig. 3) of the rotating shaft 24. The encoder 52 is connected electrically to the control unit 200.

Automatic Paper Web Connecting Unit

The automatic paper web connecting unit, which is designated by numeral 14 in Fig. 2, connects the used and virgin paper webs and cuts the used web by simply moving and pressing a pair of press blocks 70 and 70' against each other. As shown in Figs. 9 to 11, the connecting unit comprises a clamp mechanism 65 for pressing the press blocks 70 and 70' against each other and a cutter mechanism 66 for cutting the paper web.

The clamp mechanism 65 is provided with the press blocks 70 and 70' which are arranged for relative movement in the direction to cross feed paths for the paper webs 1 and 1' so that they can be pressed against each other. Thus, the webs 1 and 1' can be retained on the respective opposite faces of the blocks by suction under negative pressure. The cutter mechanism 66 includes a rotating shaft 80 rotatable between the feed paths for the paper webs 1 and 1', on the upper-course side of the blocks 70 and 70', first and second knives 86 and 86' fixed to the blocks 70 and 70', respectively, a third knife 81 fixed to the shaft 80, and a rotary cylinder 82. The cylinder 82 serves to rotate the rotating shaft 80 between a first rotational position, in which the third knife 81 faces the first knife 86, and a second rotational position in which the third knife 81 faces the second knife 86'. As the blocks 70 and 70' move toward each other, the used paper web is cut by means of the third knife 81 and the first or second knife 86 or 86', depending on the rotational position of the shaft 80.

More specifically, the automatic paper web connecting unit 14 comprises guide rollers 60 and 60' arranged side by side on the upper portion of the front

face of the front wall 11 of the paper web feeding apparatus, guide rollers 61 and 61' arranged side by side substantially in the center of the front face of the wall 11, and guide plates 62 and 62' located directly under the rollers 60 and 60', respectively, as shown in Fig. 9. The guide rollers 60, 61 and 61' and the guide plate 62 define the feed path (indicated by two-dot chain line in Fig. 9) for the paper web 1, while the guide rollers 60', 61 and 61' and the guide plate 62' define the feed path (indicated by two-dot chain line in Fig. 9) for the paper web 1'. The feed paths for the paper webs 1 and 1' join each other on the lower-course side of the guide roller 62.

The clamp mechanism 65 and the cutter mechanism 66 are arranged between the guide plates 62 and 62' and the guide rollers 61 and 61', and a speed controller 67 is disposed under the mechanisms 65 and 66.

The clamp mechanism 65 is composed of the left- and right-hand press blocks 70 and 70', sliders 71 and 71' (Figs. 10 and 11) coupled to the blocks 70 and 70', respectively, and an air cylinder 72 as an actuator for driving the sliders. The blocks 70 and 70' are slidably placed on their corresponding rails 76, which are horizontally fixed to the front face of the front wall 11 of the paper web feeding apparatus. The front end portion of the block 70 which faces the block 70' is formed of a somewhat elastic material, e.g., a hard rubber member, so as to absorb an impact force acting on the paper webs 1, 1' when the blocks 70, 70' are brought into urged contact with each other through the paper webs, thereby preventing the paper webs from being cut by the impact force. As shown in Fig. 10, moreover, a number of small holes 70a are bored in an end face of the block 70. The holes 70a communicate with a vacuum unit (not shown) by means of a hollow portion (not shown) in the press block 70 and an air pipe 74, one end of which is connected to the rear face of the block 70. As the vacuum unit is operated, the paper web 1 is attracted to and held on the end face of the block 70 by means of negative pressure produced in those openings of the small holes which are directed to the block end face. The air pipe 74 is provided with, for example, a manual on-off valve (not shown). The press block 70' is constructed in the same manner as the press block 70.

A support base 75 (Figs. 10 and 11) is fixed substantially to the center of the rear face of the front wall 11, and the two rails 76 are fixed to the top surface of the base 75. These rails horizontally extend parallel to each other at a predetermined distance. The sliders 71 and 71' are arranged on the rails 76 and 76', respectively, so as to be slidable without a possibility of their slipping off the rails. The sliders 71 and 71' penetrate their corresponding slots 11c and 11c' bored through the front wall 11, and are fixed to the press blocks 70 and 70', respectively. Thus, the blocks 70 and 70' are movable in unison with their corresponding sliders 71 and 71'.

Drive means for moving the press blocks 70 and 70' toward and away from each other includes the air cylinder 72 and connecting rods 79 and 79' for connecting a rod 77 of the cylinder 72 to the blocks 70 and 70', respectively. The upper end of the main body of the air cylinder 72 is fixed to the center of the lower portion of the support base 75. The rod 77 of the cylinder 72 extends vertically, and a bracket 78 is fixed to the distal end of the rod 77. One end of each of the connecting rods 79 and 79' is coupled to the bracket 78, and the other ends of the rods 79 and 79' are connected to the sliders 71 and 71', respectively.

The air cylinder 72 is of a double-acting type, and each of two cylinder chambers thereof is allowed to be selectively communicated with a compressed air source (not shown) or the atmosphere through a three-way valve (not shown). The three-way valve is connected electrically to the control unit 200 (Fig. 24). When the paper web feeding apparatus is not in a predetermined operating state such that the drive of the pulling roller 15 is stopped, manual operation of the three-way valve is prohibited under the control of the control unit 200. When the feeding apparatus is in the predetermined operating state, the manual operation of the valve is permitted. When compressed air is supplied to one cylinder chamber of the air cylinder 72, the rod 77 of the cylinder 72 advances to separate the sliders 71 and 71' from each other, as shown in Figs. 9 and 11. When the compressed air is supplied to the other cylinder chamber to retreat the rod 77, on the other hand, the respective opposite faces of the sliders 71 and 71' are pressed against each other.

As shown in Figs. 9 to 12, the cutter mechanism 66 is composed of the rotating shaft 80, the front knife 81, the rotary cylinder 82 as an actuator, gears 83, 84 and 85, the rear knives 86 and 86', etc.

As shown in Figs. 13 and 14, a tapped hole 80b is bored in the end face of a rear portion 80a of the rotating shaft 80, and a slit 80d is formed in a front portion 80c of the shaft 80, extending along the axis of the shaft 80 and diametrically penetrating the shaft 80. A thread is formed on the distal end of the front portion 80c of the shaft 80. The rotating shaft 80 extends penetrating a hole 11d (Fig. 12), which is bored through that portion of the front wall 11 just over the middle position between the press blocks 70 and 70', and is rotatably supported in the wall 11 by means of a support member 90 and a bearing 91. The gear 83 is fixed to the rear end of the shaft 80 by means of a bolt 92, which is screwed in the tapped hole 80b.

A cylindrical holder 93 is fitted on the front portion 80c of the rotating shaft 80. As shown in Figs. 15 and 16, a slit 93a is formed on one side of the peripheral wall of the holder 93, corresponding to the slit 80d of the shaft 80, and a pair of tapped holes 93b and a pair of bolt holes 93c are formed on the other side. Two aligned pin holes 93d are bored diametrically through the distal end of the holder 93. The front knife 81 can be inserted in the respective slits 80d and 93a of the shaft 80 and

the holder 93. As shown in Figs. 17 and 18, an edge 81a is formed on the lower portion of the knife 81, and a pair of tapped holes 81c are bored individually through the opposite ends of an upper portion 81b of the knife 81.

As shown in Fig. 12, the holder 93 is fitted on the front portion 80c of the shaft 80 in a manner such that its slit 93a is located under the slit 80d of the shaft 80 so as to be in alignment therewith. The upper portion 81b of the front knife 81 is inserted in the slit 93a. A support plate 94 is fixed to the outer peripheral surface of the upper portion of the holder 93 by means of a pair of bolts 95 which are screwed individually in the tapped holes 93b. Bolt holes are bored through the plate 94 so as to be in alignment with the bolt holes 93c of the holder 93.

The bolts 96 penetrate their corresponding bolt holes of the support plate 94 and the bolt holes 93c of the holder 93, and are screwed individually in the tapped holes 81c of the front knife 81, thereby supporting the knife 81 so that its height can be adjusted. The front knife 81 is fixed to the holder 93 by means of a pair of fixing nuts 97 which are screwed individually on the bolts 96. A pin 98 extends through the slit 80d of the rotating shaft 80 so that its ends are fitted individually in the pin holes 93d of the holder 93, whereby the holder 93 is nonrotatably anchored to the shaft 80. A cap 99 is screwed on the distal end of the shaft 80.

Referring again to Fig. 10, the rotary cylinder 82 is horizontally attached to the rear face of the front wall 11 of the paper web feeding apparatus by means of a support base 100 above the rotating shaft 80. A gear 85 is fixed to the front end of a rotating shaft of the cylinder 82. The gear 85 is in mesh with an idle gear 84 which is in engagement with the gear 83 on the rotating shaft 80. As shown in Fig. 12, the idle gear 84 is rotatably supported by means of the support member 90. As shown in Fig. 11, the proximal end of an arm 101 is fixed to the rear end of the shaft of the cylinder 82, and an adjusting bolt 102 is threadedly fixed to the distal end of the arm 101.

A stopper 103 is fixed to the support base 100 such that it can retain the adjusting bolt 102. When the rotating shaft of the rotary cylinder 82 is in a predetermined rotational position (rotation end position), a head 102a of the bolt 102 is caused to abut against the stopper 103, thereby holding the cylinder shaft in position. The rotary cylinder 82 includes, for example, a vane 82a, which is rotatable in unison with the shaft of the cylinder 82, and two cylinder chambers 82b, 82c divided by the vane, as shown in Fig. 24. Each cylinder chamber is selectively communicated with the compressed air source 210 or the atmosphere by means of a three-way valve 82d or 82e which is operated under the control of the control unit 200. The rotating shaft of the air cylinder 82 is rotated for approximately 90° by supplying compressed air to one of the cylinder chambers of the cylinder 82.

The rear knives 86 and 86' are arranged on the upper surfaces of the press blocks 70 and 70', respectively, of the clamp mechanism 65 (Fig. 9) so as to face the edge 81 of the front knife 81 on the rotating shaft 80. As the blocks 70 and 70' slide, the rear knives 86 and 86', in conjunction with the front knife 81, cut the paper web 1 or 1'.

General Operation

The following is a description of the operation of the paper web feeding apparatus constructed in this manner.

When air is supplied to the air cylinder 51 of the clamp mechanism for the bobbin 12 shown in Figs. 3 and 4, in order to mount the reel 17, wound with the paper web 1, on the right-hand bobbin 12 (as in Fig. 2), the rod 54 is drawn into the body of the cylinder 51 to move the shaft 27 to the right of Figs. 3 and 4. As a result, the taper cam 28 retreats toward the body of the paper web feeding apparatus. As the cam 28 retreats in this manner, the shafts 31 attached to the rotating shaft 24 are drawn radially inward by the agency of the urging force of the spring 36 (Fig. 7), so that the variable-diameter holder, formed of the four movable holder elements 37 (Fig. 6), contracts to the second diameter. Thereupon, the reel 17 is allowed to be mounted on the bobbin 12.

Then, the reel 17 wound with the paper web 1 is mounted on the holder, and air is supplied to the air cylinder 51. When this is done, the rod 54 of the cylinder 51 is forced out, so that the shaft 27 moves to the left of Figs. 3 and 4, whereupon the taper cam 28 is pushed out forward. When the cam 28 is pushed out in this manner; the shafts 31 are pushed radially outward against the urging force of the spring 36, so that the holder is expanded to the first diameter to fix or clamp the reel 17. Thereupon, mounting the reel 17 on the bobbin 12 is finished.

The bobbin 12 is of a stationary type such that it is continually fixed to the body of the paper web feeding apparatus. The outside diameter of the bobbin 12 is variable between a first diameter such that the reel can be mounted on the bobbin and a second diameter such that the reel 17 can be removed from the bobbin. Thus, the attachment and detachment the reel 17 to and from the bobbin 12 can be easily automated.

The reel 17', wound with the paper web 1', is mounted on the left-hand bobbin 12' (Fig. 2) in the same manner as the reel 17 on the bobbin 12.

Here let it be supposed that the paper web 1 on the reel 17 mounted on the right-hand bobbin 12 of Fig. 2 is being delivered through the automatic paper web connecting unit 14 by means of the pulling roller 15, to be fed to the winder (not shown) via the reservoir box 16. In this situation, the rod 77 of the air cylinder 72 in the connecting unit 14 is extended, so that the press blocks 70 and 70' are separated from each other, as shown in Figs. 9 and 11. At the same time, the shaft 80 of the cut-

ter mechanism 66 is locked to the rotational position shown in Fig. 9, so that the front knife 81 faces the rear knife 86 which is fixed to the left-hand press block 70.

The paper web 1 passes the guide roller 60 and the guide plate 62, and is then guided to the guide roller 61 through a narrow gap between the press block 70 and the front knife 81, and further to the pulling roller 15 (Fig. 2) via the guide roller 61'. The pulling roller 15 is driven by means of the servomotor 250 (Fig. 24) through the medium of a transmission mechanism such as gear means. At this time, the rotational speed of the output shaft of the servomotor is controlled by means of the control unit 200, and the paper web 1 is delivered at a speed matched to the cigarette rod forming speed of the winder.

When the paper web 1 is delivered in this manner, the bobbin 12 rotates in unison with the rotating shaft 24. Thereupon, the powder brake 50 is rotated by means of the gear 26 fixed to the shaft 24 through the medium of the gear 53, and the shaft of the rotary encoder 52 is rotated by means of the gear 56 (Fig. 3). As the reel 17 on the bobbin 12 rotates, the encoder 52 delivers its pulse output. As the pulling roller 15 rotates, on the other hand, the timing sensor 260 delivers its pulse output. In response to the pulse outputs from the encoder 52 and the sensor 260, the control unit 200 calculates the web roll diameter of the reel 17, adjusts the braking force of the powder brake 50 to the optimum braking force in accordance with the roll diameter, and applies the optimum tension to the paper web 1. Thus, the tension applied to the web 1 is stabilized.

The braking force of the powder brake 50 is controlled in three stages, e.g., heavy (for outside diameter of 550 to 400 ∅), medium (for 400 to 300 ∅), and light (for 300 to 190 ∅), depending on the roll diameter of the paper web 1. In this braking force control, the braking force is controlled so as to decrease in a curve of second degree as the web roll diameter is reduced. Thus, the braking force is controlled so as to decrease at a higher rate in a larger-diameter region as the roll is reduced, to decrease at a medium rate in a medium-diameter region, and to decrease at a lower rate in a lower-diameter region.

Preferably, the braking force is controlled depending on the operation mode of the paper web feeding apparatus, as well as that of the winder. There are operation modes which include, for example, a low-speed mode, high-speed mode, stopping mode, and suspension mode. In the high-speed mode for high-speed travel of the paper web, the braking force control is effected so that a smaller braking force than that for the lower-speed mode is applied to the paper web. In the stopping mode during which the operations of the winder and the paper web feeding apparatus are stopped following their steady operating state, the rotational speed of the pulling roller 15 is gradually reduced, and finally, the roller 15 ceases to rotate. In the braking force control in the stopping mode, therefore, the delivery of the paper web from the reel can be stopped without causing the web to slacken or break. In the braking force control in the suspension mode during which the pulling roller 15 is kept in suspension after the termination of the stopping mode, moreover, the braking force is applied to the paper web according to the web roll diameter lest the reel rotate unexpectedly.

Since the powder brake 50 is controlled by means of electromagnetic force, it wears little, and its maintenance and inspection are easy.

When the remainder of the paper web 1 in service is reduced below a predetermined level (e.g., 176 to 178 ∅ in terms of reserve diameter), the web 1 is delivered at a higher speed (e.g., 20% higher than usual) than the speed of consumption under the control of the control unit 200 (Fig. 23), and is stored in the reservoir box 16 (Fig. 2). Then, the reel 17' wound with the virgin paper web 1' is mounted on the left-hand bobbin 12'. In mounting the reel 17' on the bobbin 12', the reel 17' is automatically transported by means of the robot or the like. As shown in Fig. 19, a double-coated tape 110 is pasted on one side of the starting end 1'a of the web 1'. When the manual on-off valves (not shown) attached to the air pipes 74 and 74' are opened, air is sucked from the inside of the press blocks 70 and 70' through the pipes by means of the vacuum unit, while the outside air is sucked in through the small holes 70a in the respective end faces of the blocks. Thus, a negative pressure is produced on the block end faces such that the starting end 1'a of the web 1' can be attracted to the end faces. In this state, the operator prepares for the connection of the paper webs by causing that side of the starting end 1'a opposite to the side pasted with the double-coated tape 110 to be retained on the end face of the press block 70' by suction (Fig. 19).

Then, the paper web supply from the reel 17 is restarted. When the remainder of the paper web 1 on the reel 17 is further reduced, the drive of the pulling roller 15 is stopped under the control of the control unit 200 (Fig. 23), and the delivery of the web 1 from the reel 17 is suspended. When the roller 15 is stopped, the three-way valve for allowing or preventing the compressed air supply to the air cylinder 72 (Fig. 11) is allowed to be operated manually. In order to connect the paper web 1 and the virgin paper web 1', therefore, the operator manually operates the three-way valve associated with the rod retreating cylinder chamber so that the compressed air is supplied to this chamber. Thereupon, the rod 77 of the cylinder 72 retreats, so that the press blocks 70 and 70' move toward each other in the directions of arrows A and A' of Fig. 20. Accordingly, the rear knife 86 fixed to the block 70, in conjunction with the front knife 81, cuts the paper web 1 slidingly. The moment the web 1 is cut, its terminal end 1a is attracted to the end face of the press block 70 by sucking force.

Further, the press blocks 70 and 70' move toward each other in a manner such that the terminal end 1a of the paper web 1 and the starting end 1'a of the paper

web 1' retained individually on them by suction. When the opposite faces of the blocks are pressed against each other, as shown in Fig. 21, the respective ends 1a and 1'a of the webs 1 and 1' are bonded by means of the double-coated tape 110 under pressure. Subsequently, the three-way valve associated with the rod advancing cylinder chamber of the air cylinder 72 is manually operated so that the compressed air is supplied to this chamber. Thereupon, the rod 77 of the cylinder 72 advances, so that the press blocks 70 and 70' move away from each other in the directions of arrows B and B' of Fig. 22, thereby releasing the paper webs 1 and 1'. Then, the blocks 70 and 70' return to their respective original positions.

Furthermore, when it is detected by a sensor 270 that the press blocks 70, 70' pressed against each other are separated, a corresponding one of valves 82d, 82e associated with the rotary cylinder 82 of the cutter mechanism 66 (Fig. 9) is operated under the control of the control unit 200 which responds to a detection output of the sensor 270, so that the rotating shaft of the cylinder 82 rotates. As a result, the shaft 80 rotates in the direction of arrow C of Fig. 22, whereby the rotational position of the front knife 81 is shifted so that the knife 81 faces the rear knife 86', which is fixed to the press block 70', to be ready for the paper web connection in the next stage (Fig. 23).

When connecting the paper webs 1 and 1' is finished, the pulling roller 15 is rotated (Fig. 23) to deliver the virgin paper web 1'. The position of the joint or doubled web portion at which the terminal end 1a of the web 1 and the starting end 1'a of the web 1' are lapped and connected is detected by means of the paper web joint sensor (not shown), and a plurality of cigarettes (e.g., five in number) are automatically removed from a double-web inspection/cutting drum section (not shown).

When the remainder of the paper web 1' on the bobbin 12' becomes insufficient, a virgin paper web is set anew on the bobbin 12 in the same manner as aforesaid, the starting end of the new web is connected to the paper web 1' in service, and the web 1' is cut. In this manner, virgin paper webs are set alternately on the bobbins 12 and 12' to ensure continuous paper web supply. Mounting the reels on the bobbins 12 and 12', starting reservation, connecting the paper webs, etc. are controlled by means of the control unit 200 which operates in response to signals from a timing disk on the back of the pulling roller 15 and the rotary encoders (only one of which is designated by numeral 52) attached individually to the bobbins 12 and 12'. Thus, the supply of the paper webs to the bobbins 12 and 12' and the paper web connection can be automatically executed after making only simple arrangements.

It is to be understood that the present invention is not limited to the embodiment described above, and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention.

According to the above-described embodiment, for example, the present invention is applied to the paper web feeding apparatus of the cigarette manufacturing machine. The invention may, however, be also applied to packaging material feeding apparatuses, such as one for the cigarette manufacturing machine.

In the foregoing embodiment, moreover, a desired one of the two paper webs, fed along the two paper web feed paths, is cut by means of one cutter mechanism. Alternatively, however, two cutter mechanisms may be used corresponding to the paper webs, individually.

According to the above embodiment, moreover, the compressed air supply to the air cylinder 72 and the negative pressure supply to the press blocks 70 and 70' are controlled by means of the manual valves. Alternatively, however, the compressed air supply and the negative pressure supply may be controlled by using solenoid valves which operate, for example, under the control of the control unit 200.

According to the embodiment described herein, furthermore, the solenoid valve 211 which operates under the control of the control unit 200 is used to supply the compressed air to the air cylinder 51 for driving the variable-diameter holder, and the solenoid valves 82d and 82e are employed for compressed air supply to the rotary cylinder 82. Alternatively, however, a manual valve may be used for this purpose.

From the above-described embodiments of the present invention, it is apparent that the present invention may be modified as would occur to one of ordinary skill in the art without departing from the spirit and scope of the present invention which should be defined solely by the appended claims. All such modifications as would be obvious to one of ordinary skill in the art should not be regarded as a departure from the scope of the invention, and should be included within the scope of the invention as defined solely by the appended claims.

Claims

1. An apparatus (10) for feeding a belt-shaped material (1, 1') employed for the production of cigarettes with a cigarette manufacturing machine comprising:

   a body having a front wall (11);
   a first reel (17) mounted on the front end of a rotating shaft (24) rotatably supported on and extending through said front wall (11) to be rotated in unison with said shaft (24) to thereby deliver the belt-shaped material (1) wound on the first reel (17) therefrom;
   a second reel (17') mounted on the front end of a second rotating shaft (24'), said second shaft (24') being rotatably supported on and extending through said front wall (11) and being located at a distance from the first shaft (24), so

that no interference to and between the belt-shaped materials (1, 1') occurs even when said first and second reels (17, 17'), respectively, wound with the first and the second belt-shaped materials of a maximum roll diameter, are mounted individually on said first and second rotating shafts (24, 24');

a first and a second holder means (12, 12') for removably mounting said first and second reel (17, 17') on the front end of said first and second shafts (24, 24'), respectively;

each of said first and second holder means (12, 12') including a plurality of movable holder elements (37) cooperating with each other to constitute a corresponding one of variable-diameter holders,

each of said movable holder elements (37) having a single shaft portion (31) which is supported by an associated one of the first and second rotating shafts (24, 24') for movement in the radial direction of said associated one rotating shaft, and a plurality of springs (36) respectively fitted around the shaft portions (31) of the movable holder elements (37) and operable to urge said plurality of movable holder elements (37) inwardly in a radial direction of an associated one of said first and second rotating shafts (24, 24'), and

first and second holder driving means (27, 51) including a driving shaft (27) arranged for reciprocation in an axial direction of a corresponding one of said first and second rotating shafts (24, 24') in a cylindrical hollow of said corresponding one rotating shaft, and cylinder means (51) disposed on a side close to the rear end of said corresponding one rotating shaft in an interior of the body of said belt-shaped material feeding apparatus (10), for reciprocating said driving shaft (27);

said driving shaft (27) having a conical distal end portion (28) against which abut respective radial inner ends of said plurality of movable holder elements concerned (37), so that said plurality of movable holder elements (37) move between a reel mounting position, in which their outer surfaces are pressed against an inner surface of the reel concerned (17 or 17'), and a reel removing position, in which the outer surfaces are separated from the inner surface of the reel (17 or 17'), as said driving shaft (24) reciprocates,

characterized by an outer hollow cylinder (20) fixed to the front wall (11) of said belt-shaped material feeding apparatus (10);

an inner hollow cylinder (21) fitted in said outer cylinder (20), said inner cylinder (21) being slidingly movable but unrotatable relatively to said outer cylinder (20), a corresponding one of the first and second rotating shafts (24, 24') being rotatably fitted to the inner cylinder (21); and

an adjusting mechanism (13, 22, 58, 59) for adjusting a traveling position of a corresponding one of said first and second belt-shaped materials (1, 1');

wherein said adjusting mechanism (13, 22, 58, 59) includes a pulley (22) rotatably but axially immovably supported by said outer cylinder (20) and coupled by threads to said inner cylinder (21), for causing an axial motion of said inner cylinder (21), a knob (13) having a shaft portion which is rotatably supported by the front wall (11) of said belt-shaped material feeding apparatus (10) and which extends through the body (11) of said apparatus (10), and transmission means (58, 59) for transmitting a rotation of said knob (13) to said pulley (22), whereby an axial position of the holder means (12 or 12') mounted to a corresponding one of said first and second rotating shafts (24, 24') is adjusted by said knob (13).

2. The apparatus according to claim 1, further including a first and a second detector (52, 260) for generating an electrical signal indicative of the diameter of said belt-shaped material (1, 1') on said first and second reel (17, 17'), respectively, and

brake control means (200) for controlling operations of first and second electrical brakes (50) for applying braking force to said shafts (24, 24'), respectively, in accordance with electrical signals from said first and second detectors (52, 260).

3. Apparatus according to claim 1 or 2, wherein each of said first and second electrical brakes (50) is a powder brake (50) which includes:

an input shaft (50a) fixed to the body of the belt-shaped material feeding apparatus (10);

an output shaft (50b) coupled to a corresponding one of said first and second rotating shafts (24, 24').

4. The apparatus according to claim 3, wherein each powder brake (50) is disposed on the side close to the inner end of a corresponding one of said first and second rotating shafts (24, 24'),

each of said output shafts (50b) of said first and second electrical brakes (50) being gear-coupled to the corresponding one of said first and second rotating shafts (24, 24'), via a first gear (53) fixed to the output shaft (50b) and a second gear (26) fixed to the inner end of the corresponding one rotating shaft and disposed in

mesh with the first gear (53).

5. The apparatus according to the preceding claim, further comprising a belt-shaped material connecting means (14) for connecting a starting end portion of one of the first and second belt-shaped materials (1, 1') to other of said belt-shaped materials (1, 1'), and for cutting said other belt-shaped material just prior to a connection between the first and second belt-shaped materials (1, 1').

6. The apparatus according to claim 1, further including:

roller means comprising a pulling roller (15) and operable to deliver the belt-shaped material (1); and
roller driving means (250) for drivingly rotating said pulling roller (15), to thereby rotate associated ones of said first and second reels (17, 17'), and said first and second rotating shafts (24, 24').

Patentansprüche

1. Vorrichtung (10) für das Zuführen eines bahnförmigen Materials (1, 1'), die für die Produktion von Zigaretten bei einer Zigarettenherstellungsmaschine verwendet wird, bestehend aus:

einem Aufbau mit einer Vorderwand (11);
einer ersten Rolle (17), die auf dem vorderen Ende einer Drehwelle (24) montiert ist, welche drehbar an der Vorderwand (11) gehalten ist und sich durch diese hindurch zur gleichförmigen Drehung mit der Welle (24) ersteckt, um dadurch das bahnförmige Material (1), das auf der ersten Rolle (17) aufgewickelt ist, von dieser abzugeben; einer zweiten Rolle (17'), die auf dem vorderen Ende einer zweiten Drehwelle (24') montiert ist, wobei die zweite Welle (24') drehbar an der Vorderwand (11) gelagert ist und sich durch diese hindurch erstreckt und in einer Entfernung von der ersten Welle (24) derart angeordnet ist, daß zwischen den bahnförmigen Materialien (1, 1') selbst dann keine Beeinträchtigung auftritt, wenn die erste und die zweite Rolle (17, 17'), die jeweils mit dem ersten und dem zweiten bahnförmigen Material mit einem maximalen Rollendurchmesser bewickelt sind, einzeln auf die erste und die zweite Drehwelle (24, 24') montiert sind;
einer ersten und einer zweiten Halteeinrichtung (12, 12') zur lösbaren Montage der ersten und der zweiten Rolle (17, 17') jeweils auf dem vorderen Ende der ersten und der zweiten Welle (24, 25');
wobei zu jeder der ersten und zweiten Halteeinrichtung (12, 12') zahlreiche bewegbare Halteelemente (37) gehören, die zur Bildung eines entsprechenden Halters von Haltern mit variablen Durchmesser zusammenwirken,
wobei jedes der bewegbaren Halteelemente (37) einen einzelnen Wellenabschnitt (31), der mittels einer zugeordneten Welle von der ersten und der zweiten Drehwelle (24, 24') zur Biegung in der radialen Richtung der zugeordneten Drehwelle gelagert ist, und zahlreiche Federn (36) besitzt, die jeweils um die Wellenabschnitte (31) auf den bewegbaren Halteelementen (37) befestigt und für das Drücken der zahlreichen bewegbaren Halteelemente (37) nach innen in eine Radialrichtung einer zugeordneten Welle von der ersten und zweiten Drehwelle (24, 24') betätigbar sind, und
ersten und zweiten Halterantriebseinrichtungen (27, 51) mit einem Antriebsschaft (27), die für eine hin- und hergehende Bewegung in einer axialen Richtung einer zugeordneten Welle von der ersten und der zweiten Drehwelle (24, 24') in einem zylindrischen Hohlraum der zugeordneten Eindrehwelle vorgesehen ist, und mit einer Zylindereinrichtung (51), die in einer Seite nahezu im hinteren Ende der entsprechenden einen Drehwelle in einem Inneren des Aufbaus der Vorrichtung (10) für das Zuführen des bahnförmigen Materials zur Hin- und Herbewegung des Antriebsschafts (27) angeordnet ist;
wobei der Antriebsschaft (27) einen konischen distalen Endabschnitt (28) besitzt, gegen den entsprechende radiale innere Enden der zahlreichen betreffenden bewegbaren Halteelemente (37) derart anstoßen, daß die zahlreichen bewegbaren Halteelemente (37) zwischen einer Rollenmontagestellung, in der ihre Außenflächen gegen eine Innenfläche der entsprechenden Rolle (17) bzw. (17') gepreßt sind, und einer Rollenentfernungsstellung bewegbar sind, in der die Außenflächen von der Innenfläche der Rolle (17) oder (17') beabstandet sind, wenn sich der Antriebsschaft (27) hin- und herbewegt;
gekennzeichnet durch einen äußeren hohlen Zylinder (20), der an der Vorderwand (11) der Vorrichtung (10) für das Zuführen von bahnförmigem Material befestigt ist;
einen inneren Hohlzylinder (21), der in dem Außenzylinder (20) befestigt ist, wobei der innere Zylinder (21) bzgl. des Außenzylinders (20) gleitend verschiebbar, jedoch nicht drehbar ist, wobei eine entsprechende Welle von der ersten und der zweiten Drehwelle (24, 24') drehbar an dem inneren Zylinder (21) befestigt ist; und durch einen Einstellmechanismus (13, 22, 58, 59) zur Einstellung einer Laufstellung

eines entsprechenden Materials von dem ersten und dem zweiten bahnförmigen Material (1, 1');

wobei der Einstellmechanismus (13, 22, 58, 59) eine Riemenscheibe (22), die drehbar jedoch axial und beweglich durch den Außenzylinder (20) gehalten und über Gewinde mit dem inneren Zylinder (21) zur Veranlassung einer axialen Bewegung des inneren Zylinders (21) gekoppelt ist, eine Rolle (13) mit einem Wellenabschnitt, der drehbar durch die Vorderwand (11) der Vorrichtung (10) für das Zuführen von bahnförmigen Material gehalten ist und der sich durch den Aufbau der Vorrichtung (10) erstreckt, und eine Übertragungseinrichtung (58, 59) zur Übertragung einer Drehung der Rolle (13) auf die Riemenscheibe (22) aufweist, wobei eine axiale Stellung der Halteeinrichtung (12 bzw. 12'), die auf einer entsprechenden Welle von der ersten und zweiten Drehwelle (24, 24') montiert ist, durch die Rolle (13) eingestellt wird.

2. Vorrichtung nach Anspruch 1, zu der weiterhin ein erster und ein zweiter Fühler (52, 260) zur Erzeugung eines elektrischen Signals, das repräsentativ für den jeweiligen Durchmesser des bahnförmigen Materials (1, 1') auf der ersten und der zweiten Rolle (17, 17') ist, und eine Bremskontrolleinrichtung (200) zur Steuerung der Betätigung der ersten und zweiten elektrischen Bremsen (50) zum Aufbringen einer Bremskraft auf die jeweiligen Wellen (24, 24') gemäß elektrischen Signalen von den ersten und den zweiten Fühlern (52, 260) gehören.

3. Vorrichtung nach Anspruch 1 oder 2, bei der jede von der ersten und der zweiten elektrischen Bremse (50) eine Pulverbremse (50) ist, welche einer Eingangswelle (50a), die an dem Aufbau der Vorrichtung (10) für das Zuführen von bahnförmigen Material befestigt ist, und eine Ausgangswelle (50) besitzt, die mit einer entsprechenden Welle von der ersten und der zweiten Drehwelle (24, 24') gekoppelt ist.

4. Vorrichtung nach Anspruch 3, bei der jede Pulverbremse (50) an der Seite nahe dem inneren Ende einer entsprechenden Welle von der ersten und zweiten Drehwelle (24, 24') angeordnet ist, wobei jede der Ausgangswellen (50b) der ersten und zweiten elektrischen Bremsen (50) mit der entsprechenden Welle von der ersten und zweiten Drehwelle (24, 24') über ein erstes Zahnrad (53), das an der Ausgangswelle (50b) befestigt ist, und ein zweites Zahnrad (26), das an dem inneren Ende der entsprechenden Drehwelle befestigt ist und mit dem ersten Zahnrad (53) verzahnt gekoppelt ist.

5. Vorrichtung nach einem vorangehenden Anspruch, weiterhin mit einer Bahnmaterialverbindungseinrichtung (14) für das Verbinden eines Anfangsendabschnitt eines bahnförmigen Materials von dem ersten und dem zweiten bahnförmigen Material (1, 1') mit dem anderen des bahnförmigen Materials (1, 1'), und zum Schneiden des anderen bahnförmigen Materials unmittelbar vor einer Verbindung zwischen dem ersten und dem zweiten bahnförmigen Material (1, 1').

6. Vorrichtung nach Anspruch 1, weiterhin mit einer Rolleneinrichtung, die eine Zugrolle (15) besitzt und für die Abgabe des bahnförmigen Materials (1) betätigbar ist; und mit einer Rollenantriebseinrichtung (250) für den Drehantrieb der Zugrolle (15) zum Drehen der zugeordneten Rolle von den ersten und zweiten Rollen (17, 17') und der ersten und zweiten Drehwellen (24, 24').

Revendications

1. Appareil (10) destiné à introduire un matériau (1, 1') sous forme de bande utilisé pour la fabrication de cigarettes avec une machine de fabrication de cigarettes comprenant:

un corps à paroi frontale (11);

un premier rouleau (17) disposé sur l'extrémité frontale d'un arbre rotatif (24) monté de manière à pouvoir tourner sur et s'étendant à travers ladite paroi frontale (11) de façon à tourner conjointement avec ledit arbre (24) pour ainsi délivrer le matériau (1) sous forme de bande enroulé sur le premier rouleau (17);

un second rouleau (17') disposé sur l'extrémité frontale d'un second arbre rotatif (24'), ledit second arbre (24') étant disposé de manière à pouvoir tourner sur et s'étendant à travers ladite paroi frontale (11) et étant disposé à distance du premier arbre (24) si bien qu'aucune interférence n'intervient en direction et entre lesdits matériaux (1, 1') en forme de bandes, même lorsque lesdits premier et second rouleaux (17, 17'), formés par les premier et second matériaux en forme de bandes présentant un diamètre d'enroulement maximal, sont montés individuellement sur lesdits premier et second arbres rotatifs (24, 24');

un premier et un second moyens de support (12, 12') destinés à monter de manière amovible les premier et second rouleaux (17, 17') sur l'extrémité frontale des premier et second arbres (24, 24');

chaque moyen de support (12, 12') comprenant une série d'éléments de support mobiles (37) concourant l'un avec l'autre pour former un élément de support composé de plusieurs élé-

ments de support de diamètre variable,

chaque élément de support mobile (37) présentant un bout d'arbre unique (31) qui est porté par un élément associé aux premier et second arbres rotatifs (24, 24') pour bouger dans la direction radiale de l'arbre de rotation associé, et une série de ressorts (36) disposés autour du bout d'arbre (31) des éléments de support mobiles (37) et pouvant être utilise's pour amener ladite série d'éléments de support mobiles (37) vers l'intérieur dans une direction radiale de l'élément associé aux premier et second arbres rotatifs (24, 24'), et

des moyens d'entraînement (27, 51) des premier et second éléments de support comprenant un arbre d'entraînement (27) disposé de manière à prendre un mouvement alternatif dans une direction axiale de l'arbre correspondant composé des premier et second arbres rotatifs (24, 24') dans un creux cylindrique de l'arbre rotatif, et un vérin cylindrique (51) disposé sur un côté proche de l'extrémité arrière de l'arbre rotatif correspondant à l'intérieur de l'appareil (10) introduisant le matériau en forme de bande, destiné à actionner d'un mouvement alternatif ledit arbre d'entraînement (27); ledit arbre d'entraînement (27) présentant une extrémité distale conique (28) contre laquelle butent les extrémités internes radiales de la série d'éléments de support mobiles (37) concernés, si bien que les éléments de support mobiles (37) se déplacent entre une position de montage du rouleau, dans laquelle leurs surfaces externes sont pressées contre une surface interne du rouleau concerné (17, 17'), et une position d'enlèvement du rouleau, dans laquelle les surfaces externes sont séparées de la surface interne du rouleau (17 ou 17') à mesure que l'arbre d'entraînement (24) exerce un mouvement alternatif,

caractérisé par un cylindre creux externe (20) fixé à la paroi frontale (11) de l'appareil (10) destiné à introduire le matériau en forme de bande;

un cylindre creux interne (21) disposé dans ledit cylindre externe (20), ledit cylindre interne (21) pouvant être coulissé légèrement mais ne pouvant pas tourner par rapport au cylindre externe (20), l'arbre correspondant des premier et second arbres de rotation (24, 24') étant monté de manière à pouvoir tourner dans le cylindre interne (21); et

un mécanisme d'ajustement (13, 22, 58, 59) destiné à ajuster une position de déplacement d'un matériau correspondant des premier et second matériaux (1, 1') en forme de bandes;

dans lequel ledit mécanisme d'ajustement (13, 22, 58, 59) comprend une poulie (22) montée de manière à pouvoir tourner mais immobile axialement sur le cylindre interne (20) et reliée par un filetage par des fils au cylindre interne (21), afin d'entraîner un mouvement axial du cylindre interne (21), un bouton (13) solidaire d'un axe monté de manière à pouvoir tourner sur la paroi frontale (11) de l'appareil (10) destiné à introduire le matériau sous forme de bande et qui s'étend à travers le corps (11) de l'appareil (10), et des moyens de transmission (58, 59) destinés à transmettre le mouvement de rotation du bouton (13) à la poulie (22), la position axiale des moyens de support (12 ou 12') montés sur un arbre correspondant des premier et second arbres de rotation (24, 24') étant réglée par ledit bouton (13).

2. Appareil suivant la revendication 1, comprenant en outre un premier et un second détecteurs (52, 260) destinés à produire un signal électrique indiquant le diamètre du matériau (1, 1') en forme de bande sur lesdits premier et second rouleaux (17, 17'), et

un moyen de contrôle des freins (200) destiné à contrôler les opérations des premier et second freins électriques (50) afin de freiner les arbres (24, 24') suivant les signaux électriques des premier et second détecteurs (52, 260).

3. Appareil suivant la revendication 1 ou 2, caractérisé en ce que lesdits premier et second freins électriques (50) sont un frein à poudre (50) qui comprend:

un arbre d'entrée (50a) fixé au corps de l'appareil (10) destiné à introduire le matériau sous forme de bande;

un arbre de sortie (50b) couplé à un des premier et second arbres rotatifs (24, 24').

4. Appareil suivant la revendication 3, caractérisé en ce que chaque frein à poudre (50) est disposé sur le côté proche de l'extrémité interne d'un des premier et second arbres rotatifs (24, 24'),

chaque arbre de sortie (50b) des premier et second freins électriques (50) étant couplé par transmission un des premier et second arbres rotatifs (24, 24') par l'intermédiaire d'un premier engrenage (53) fixé à l'arbre de sortie (50b) et un second engrenage (26) fixé à l'extrémité interne de l'arbre rotatif correspondant et connecté au premier engrenage (53).

5. Appareil suivant la précédente revendication, comprenant en outre un moyen de connexion (14) du matériau sous forme de bande destiné à connecter une extrémité de départ de l'un des deux matériaux

(1, 1') sous forme de bandes à l'autre matériau (1, 1') sous forme de bande et destiné à couper ledit matériau avant une connexion entre les premier et second matériaux (1, 1') sous forme de bandes.

6. Appareil suivant la revendication 1, comprenant en outre:

des éléments à roulette comprenant une roulette de traction (15) et pouvant fonctionner afin de fournir ledit matériau (1) en forme de bande; et
un moyen d'entraînement (250) de la roulette destiné à assurer l'entraînement en rotation de la roulette de traction (15), pour ainsi faire tourner les premier et second rouleaux (17, 17') et lesdits premier et second arbres rotatifs (24, 24').

FIG. 1

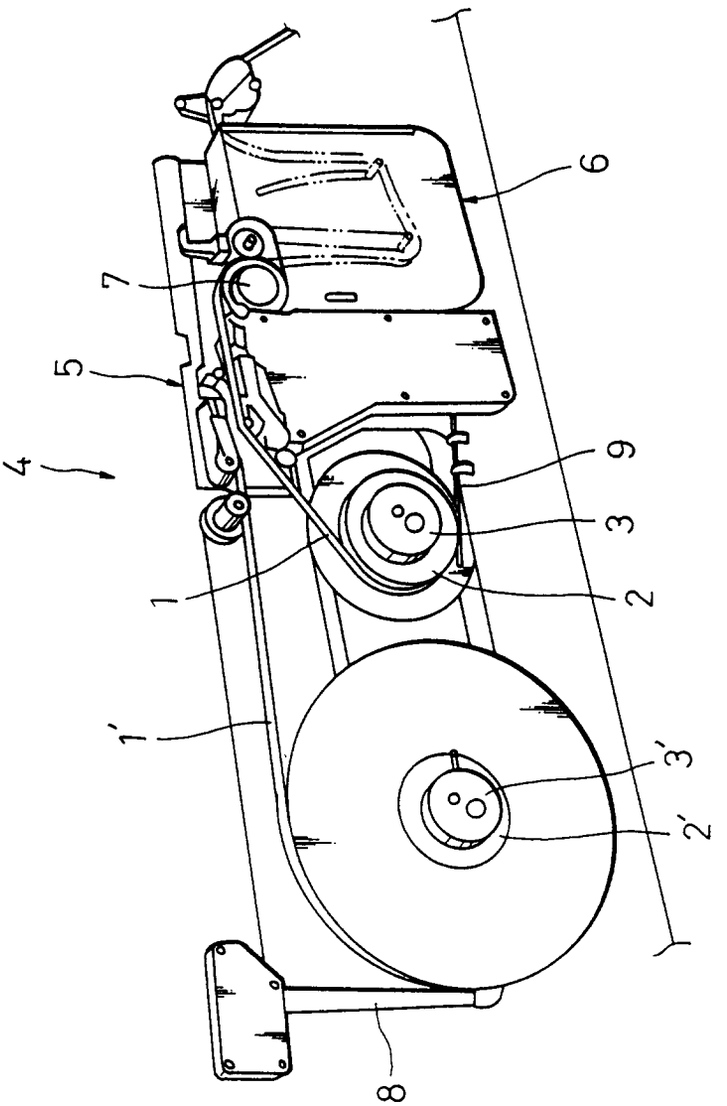


FIG. 2

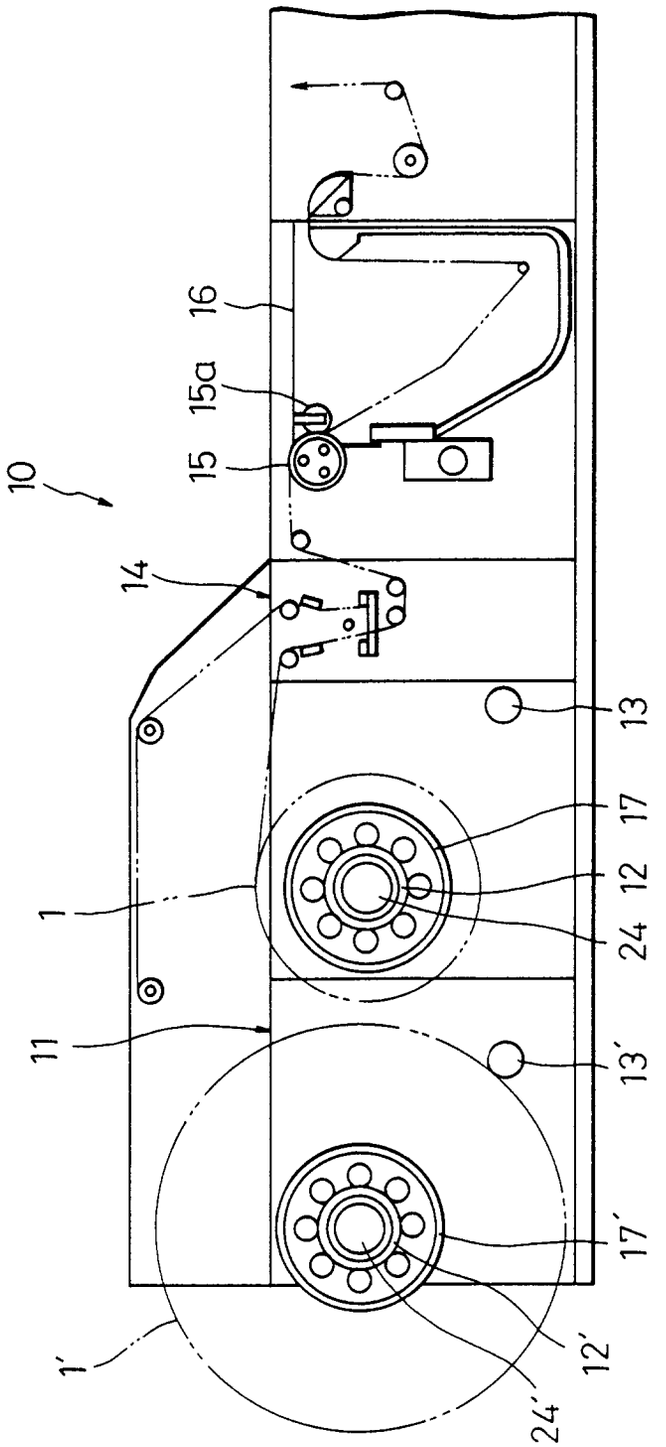


FIG. 3

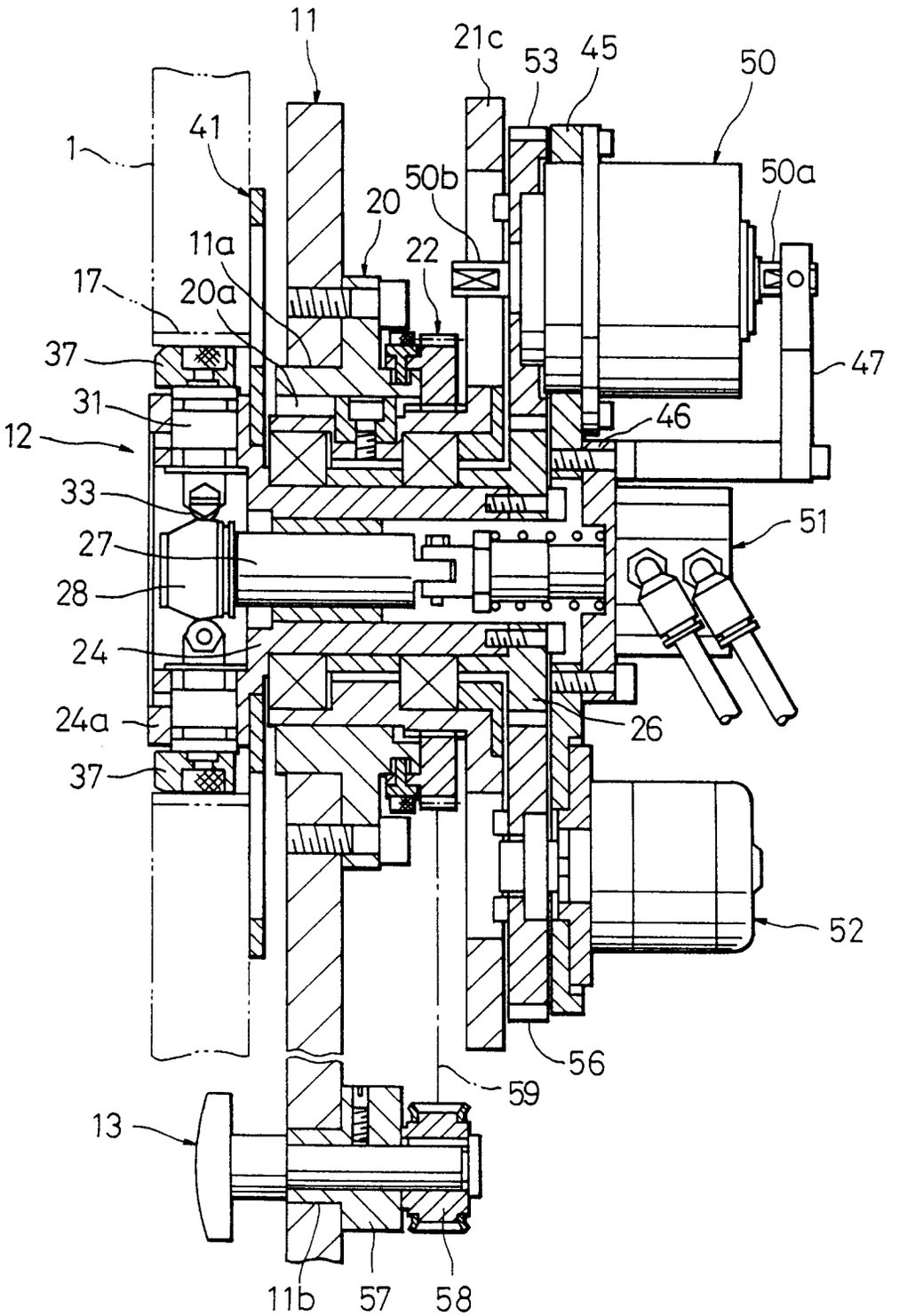

11
21c
53
45
50
41
1
50b
50a
20
11a
22
17
20a
47
37
31
46
12
33
51
27
28
24
24a
26
37
52
56
59
13
11b
57
58

FIG. 4

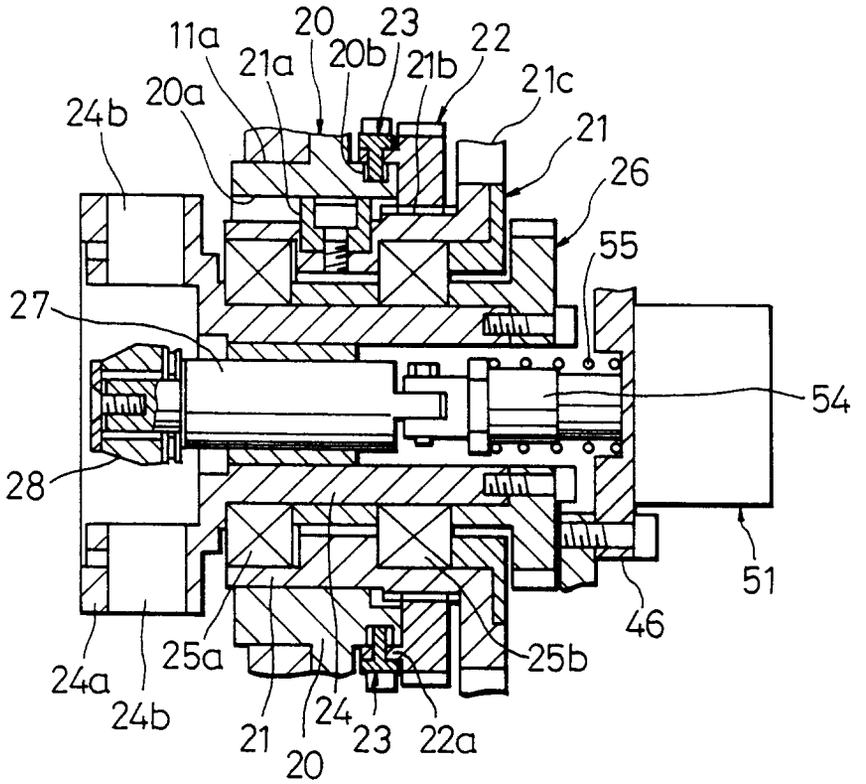

11a
20
23
21a
20b
21b
22
21c
24b
20a
21
26
55
27
54
28
51
46
25a
25b
24a
24b
21
24
23
22a
20

FIG. 5

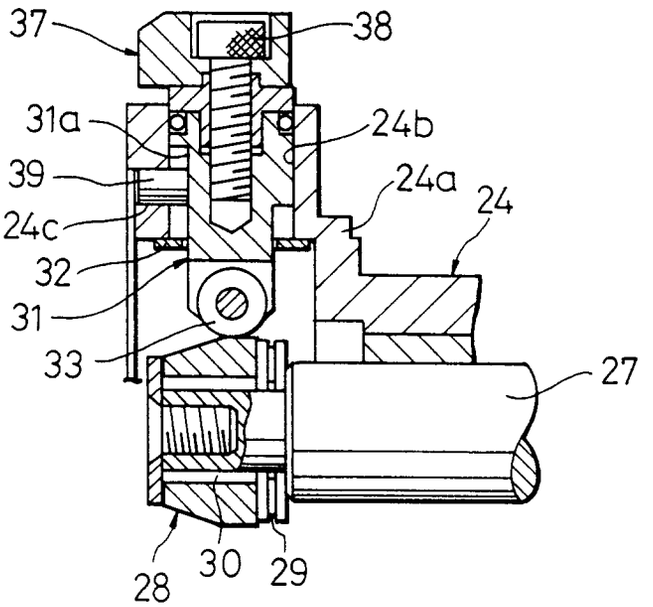

37
38
31a
24b
39
24a
24
24c
32
31
33
27
28
30
29

FIG. 6

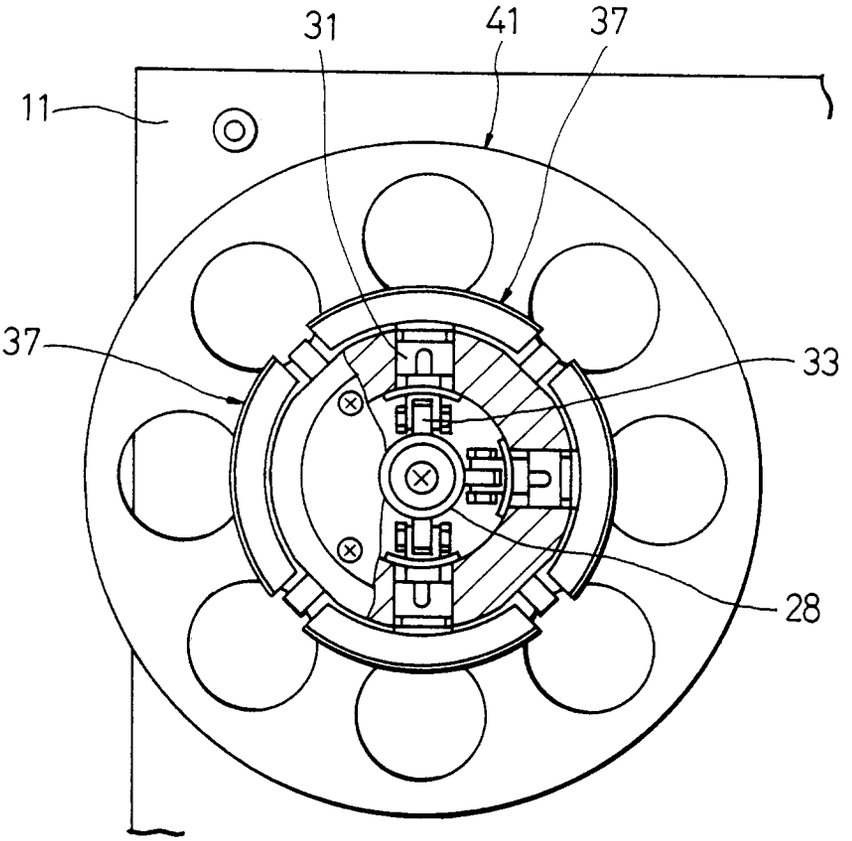


FIG. 7

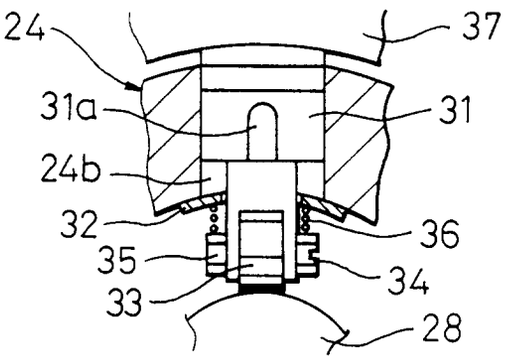


FIG. 8

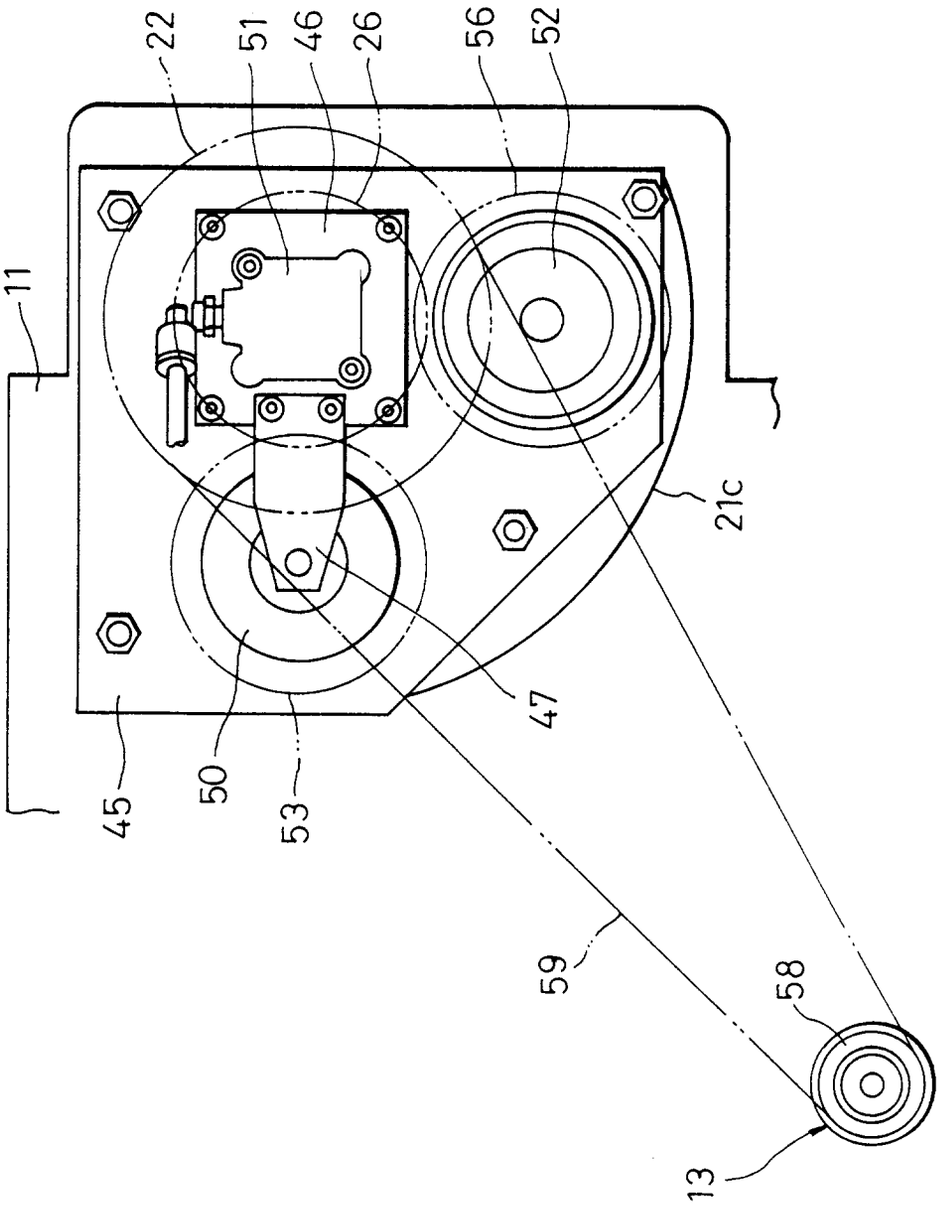


FIG. 9

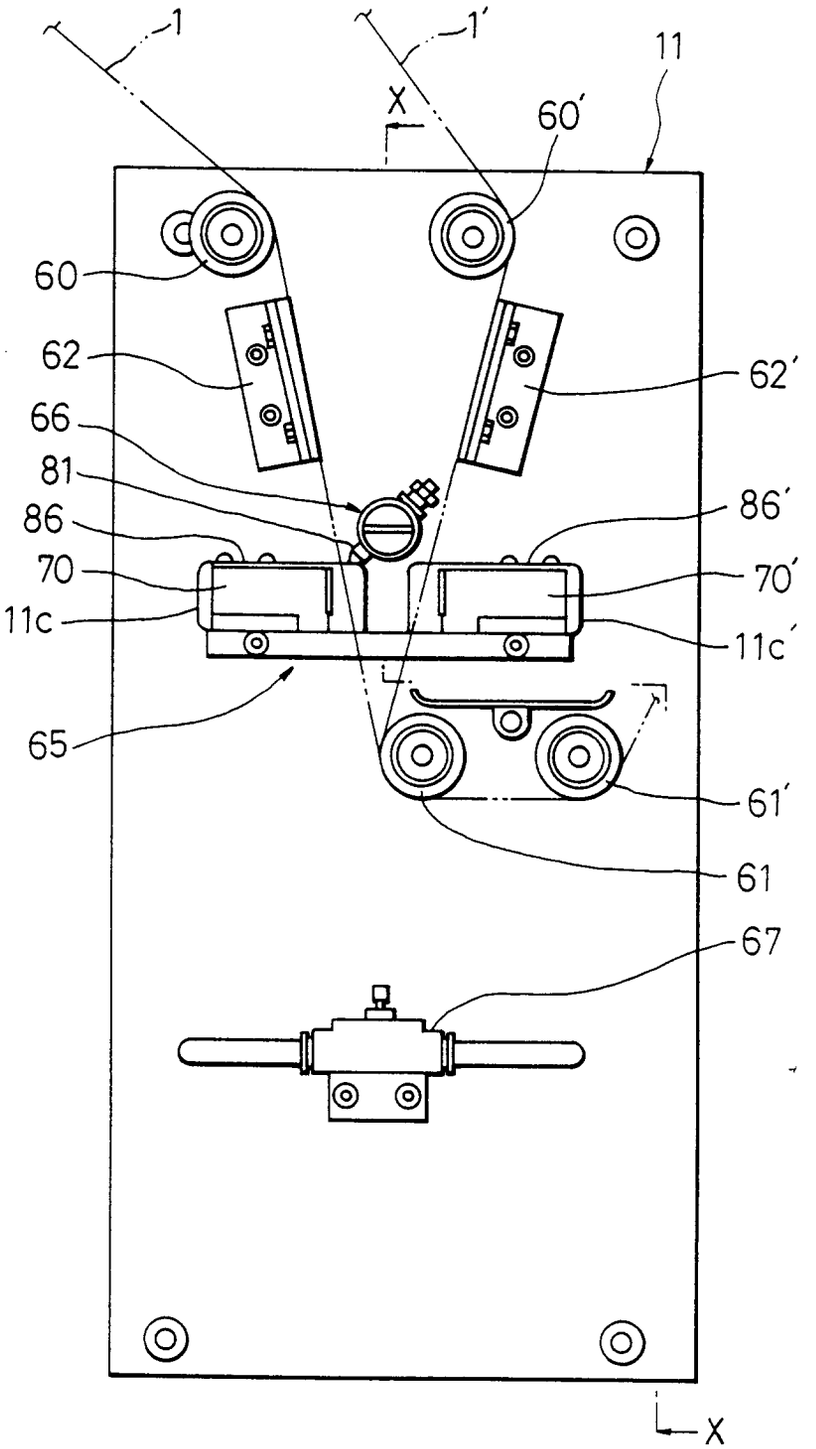


FIG. 10

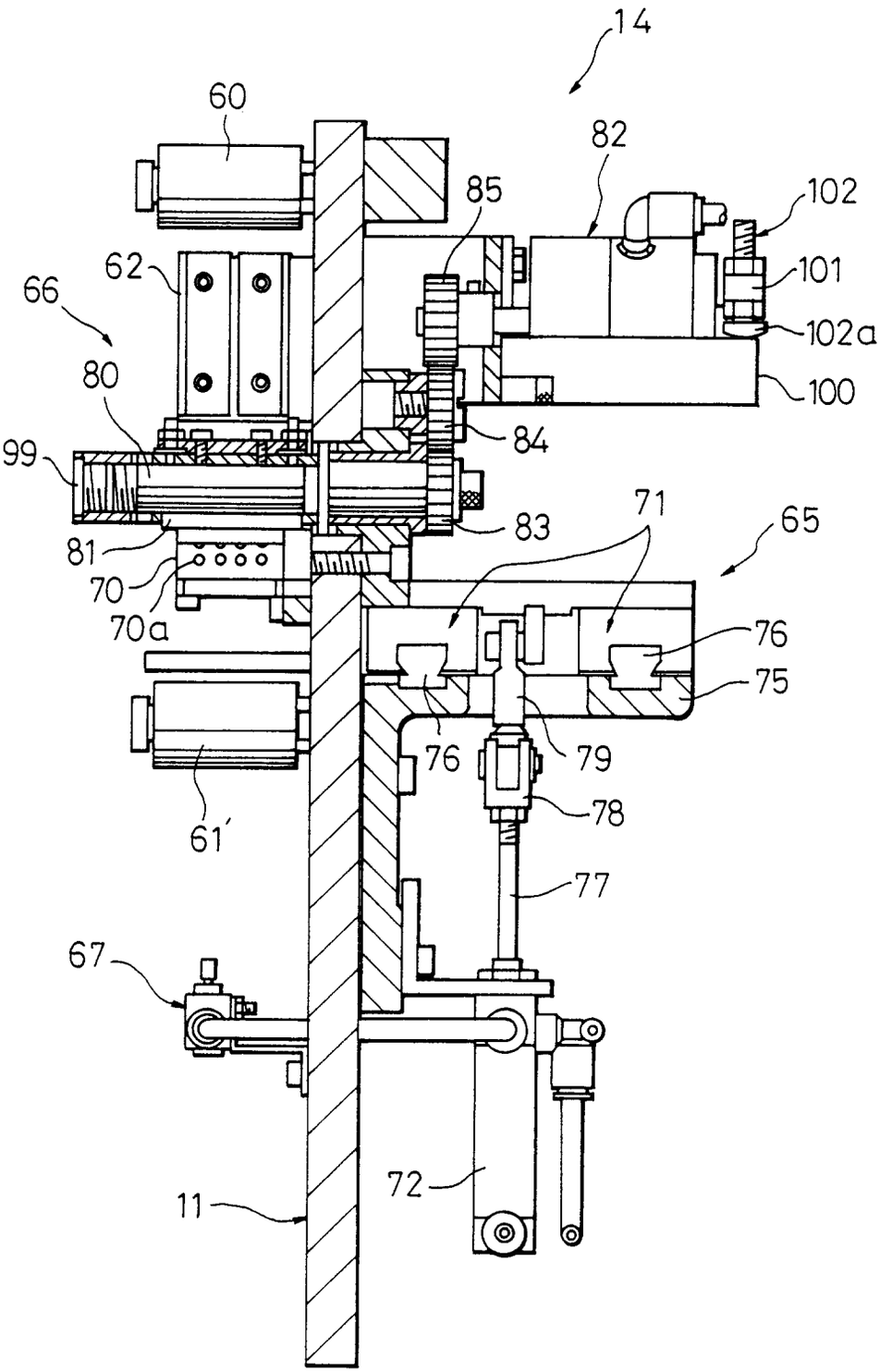

14
60
82
85
102
62
101
66
102a
80
100
99
84
71
65
83
81
70
70a
76
75
76
79
61'
78
77
67
72
11

FIG. 11

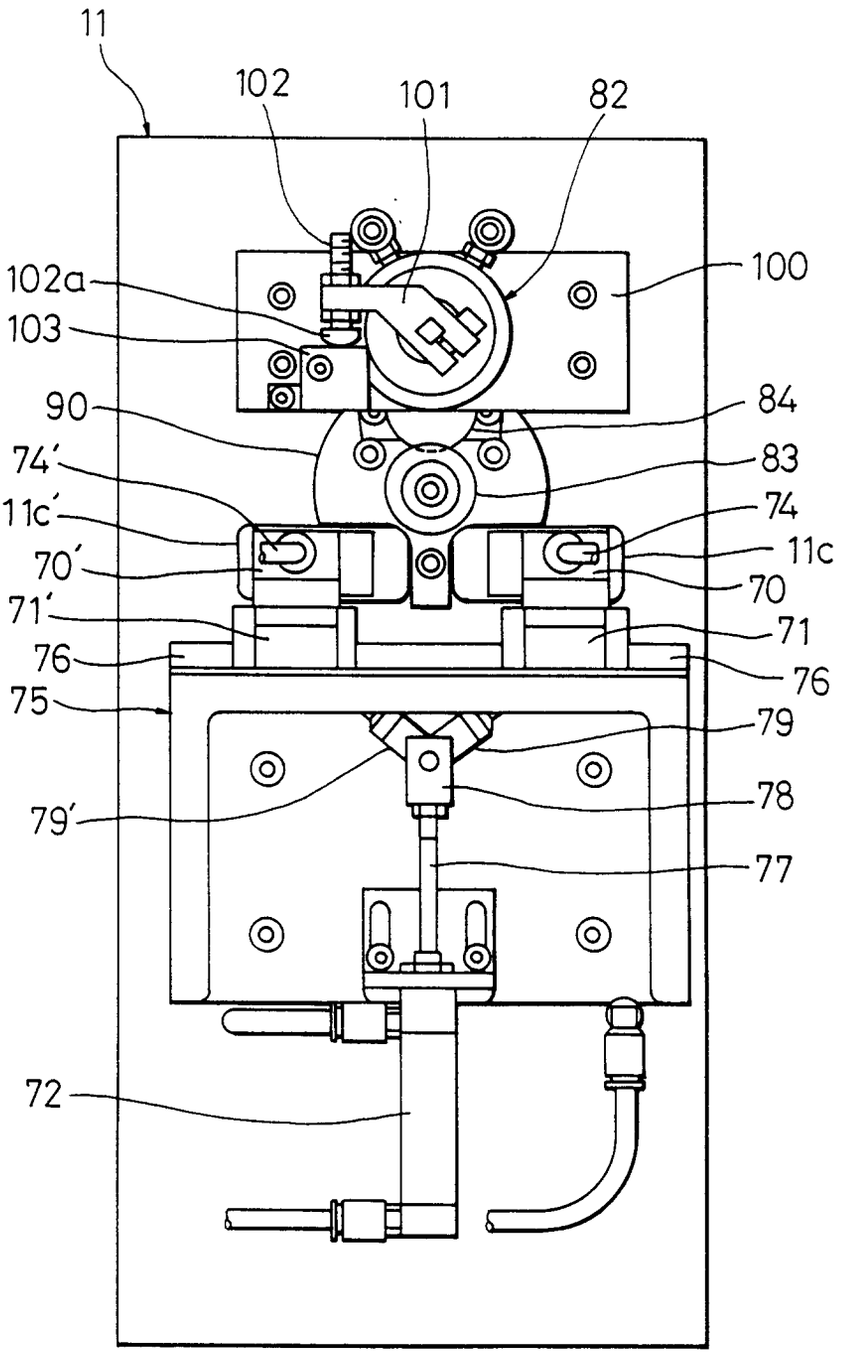

11
102
101
82
102a
103
100
90
84
74'
83
11c'
74
70'
11c
70
71'
71
76
76
75
79
79'
78
77
72

FIG. 12

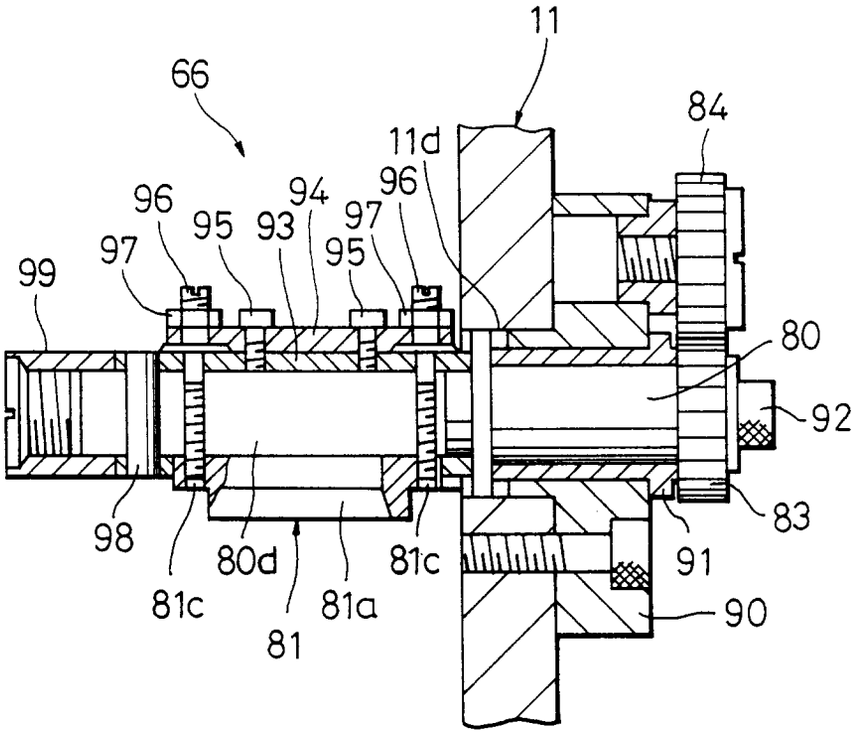

11
66
84
11d
96
94
96
95
93
97
97
95
99
80
92
98
80d
81c
81c
81a
81
91
83
90

FIG. 13

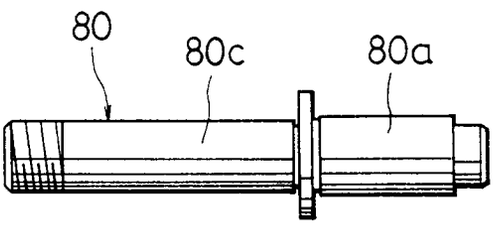

80
80c
80a

FIG. 14

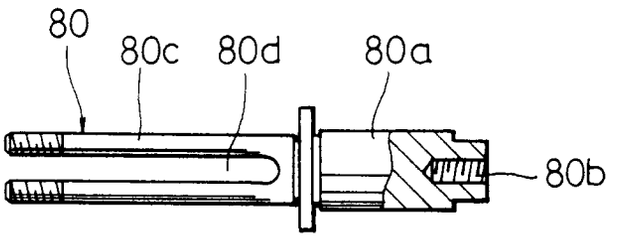


FIG. 15

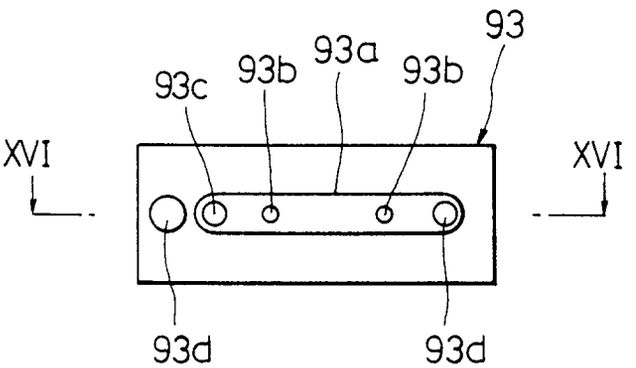


FIG. 16

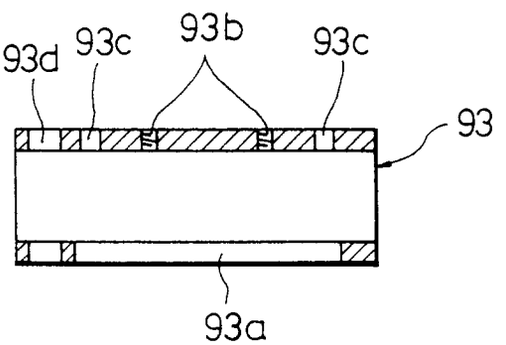


FIG. 17

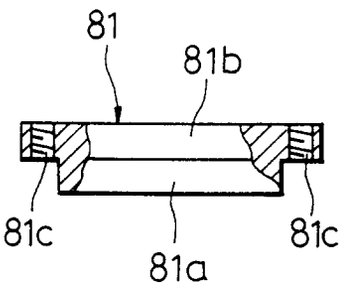


FIG. 18

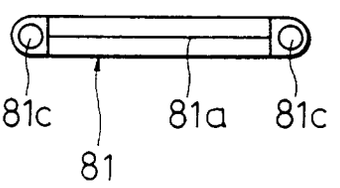


FIG. 19

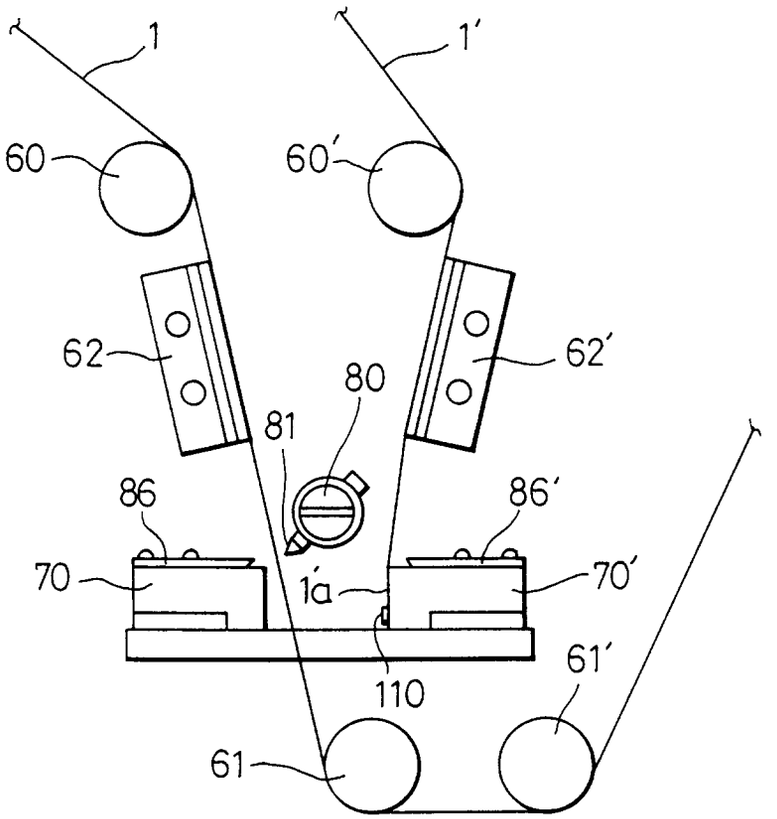

1
1'
60
60'
62
62'
80
81
86
86'
70
1a
70'
61'
110
61

FIG. 20

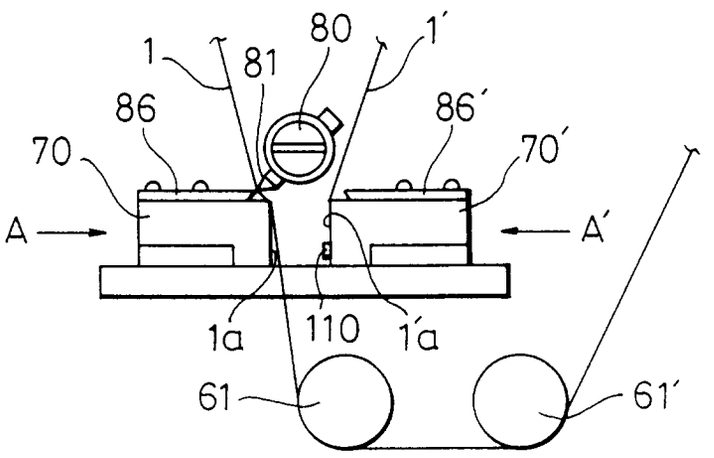

80
1
1'
81
86
86'
70
70'
A
A'
1a
110
1'a
61
61'

FIG. 21

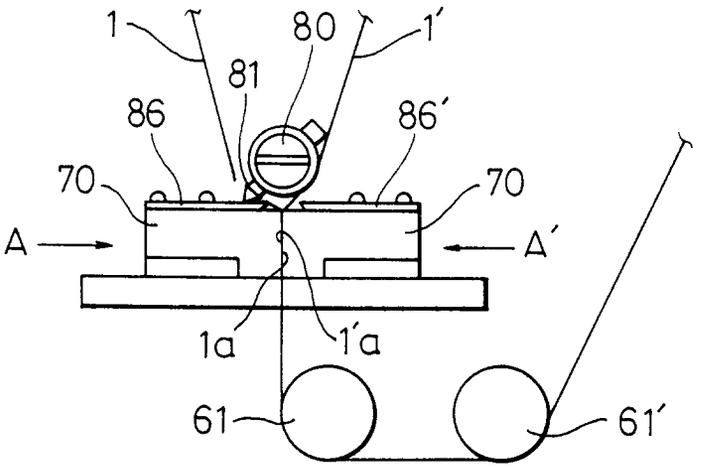

1
80
1'
81
86
86'
70
70
A
A'
1a
1'a
61
61'

FIG. 22

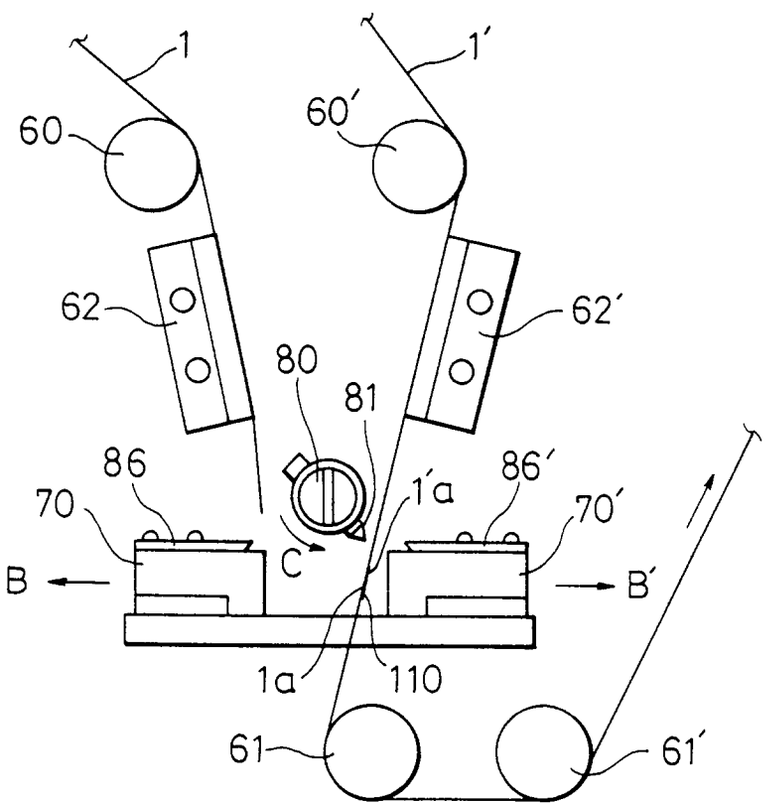

1
1'
60
60'
62
62'
80
81
86
86'
70
1'a
70'
B
C
B'
1a
110
61
61'

FIG. 23

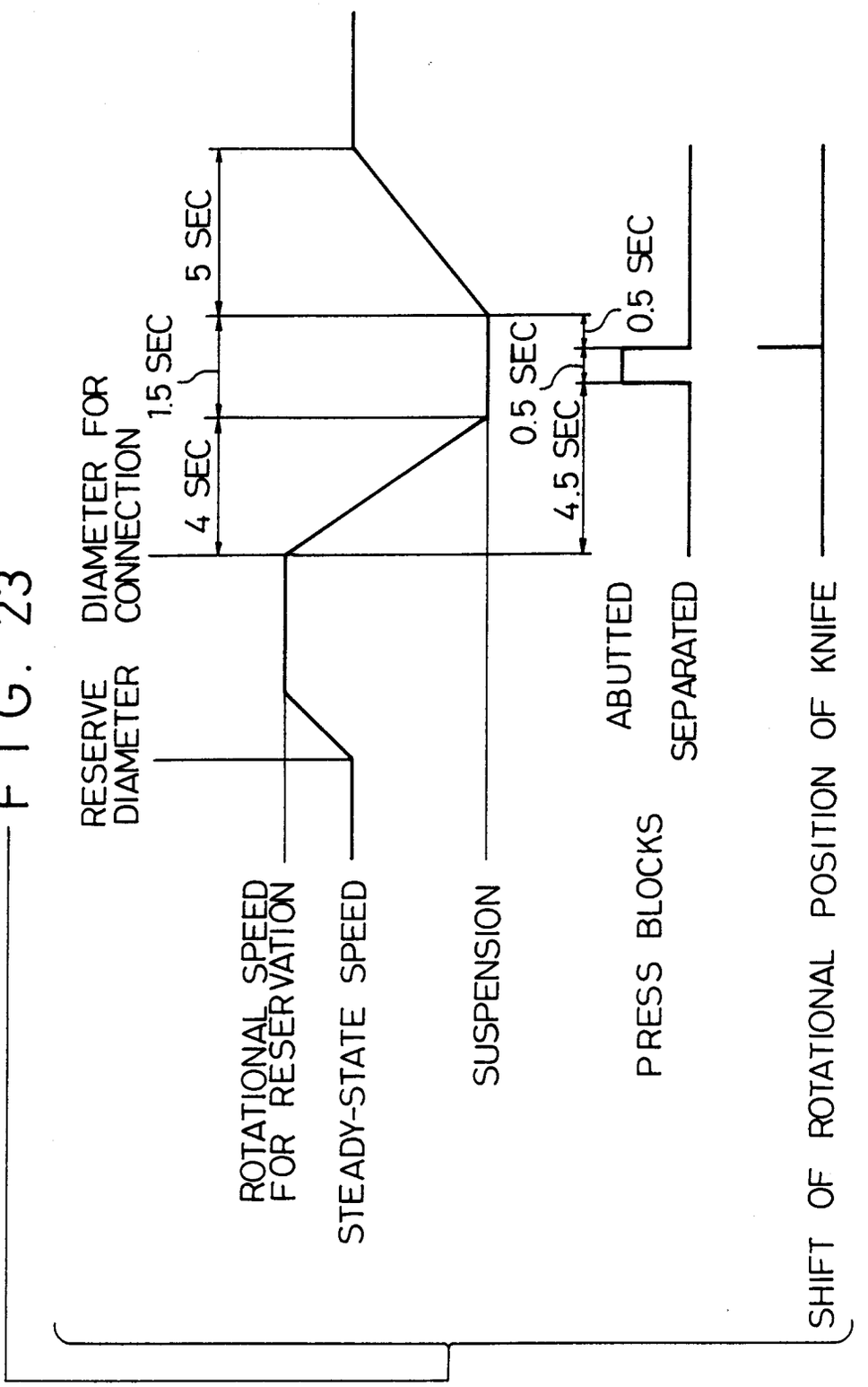
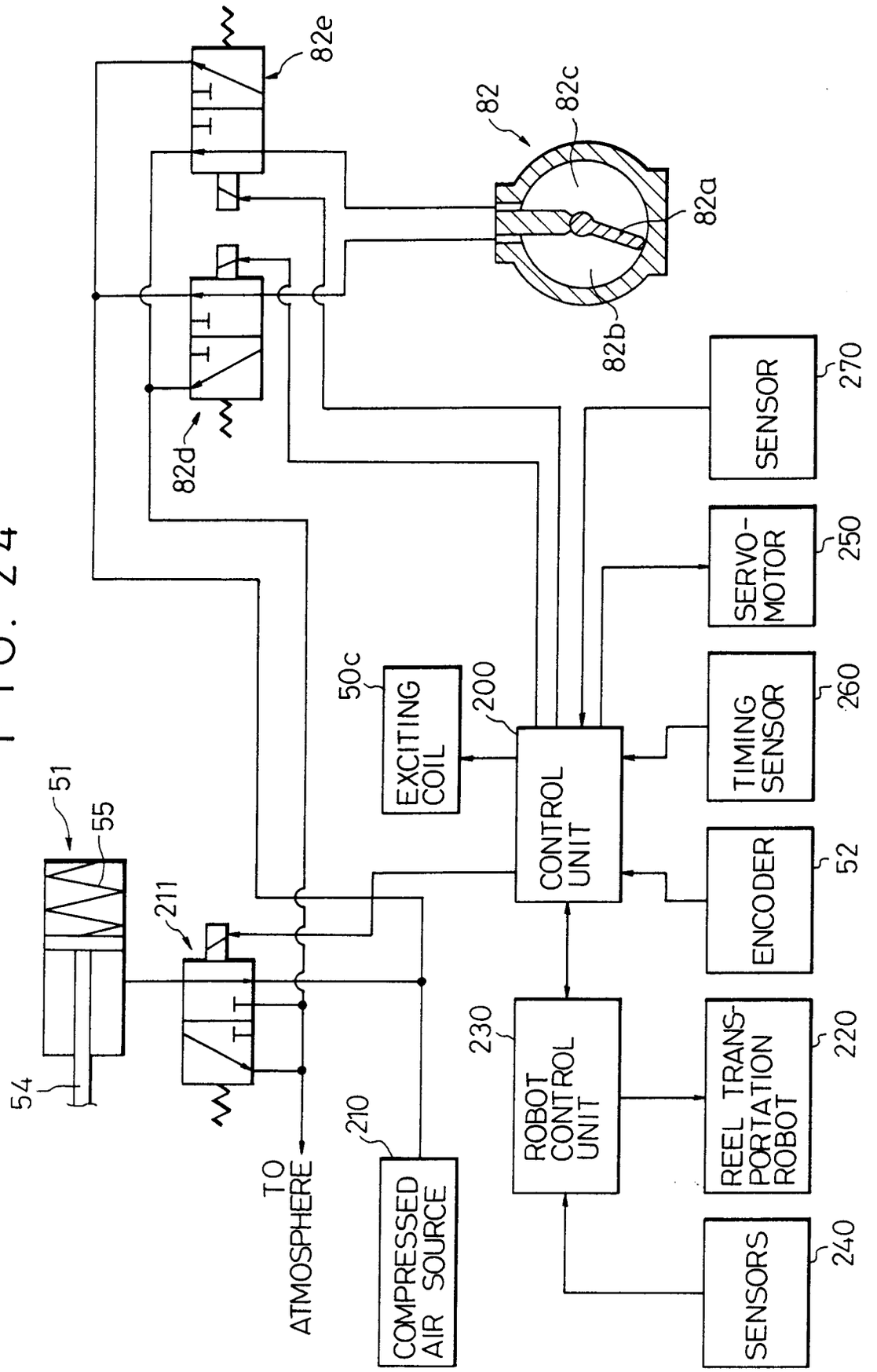

RESERVE DIAMETER
DIAMETER FOR CONNECTION
5 SEC
1.5 SEC
4 SEC
0.5 SEC
4.5 SEC
0.5 SEC
ROTATIONAL SPEED FOR RESERVATION
STEADY-STATE SPEED
SUSPENSION
ABUTTED
SEPARATED
PRESS BLOCKS
SHIFT OF ROTATIONAL POSITION OF KNIFE

FIG. 24


82e
82
82c
82a
82b
82d
SENSOR
270
SERVO-MOTOR
250
TIMING SENSOR
260
ENCODER
52
REEL TRANS-PORTATION ROBOT
220
SENSORS
240
ROBOT CONTROL UNIT
230
CONTROL UNIT
200
EXCITING COIL
50c
51
55
211
54
TO ATMOSPHERE
210
COMPRESSED AIR SOURCE