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## (54) New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane.

(57) The new system of entry and inclusion of weft refers to a new concept of weaving. The weft proceeds from the rear part of the weaving machine, where weft accumultors are located, and advances forward between the warps let off on the full width, to the line of cloth formation, traversing sheds of variable plane.

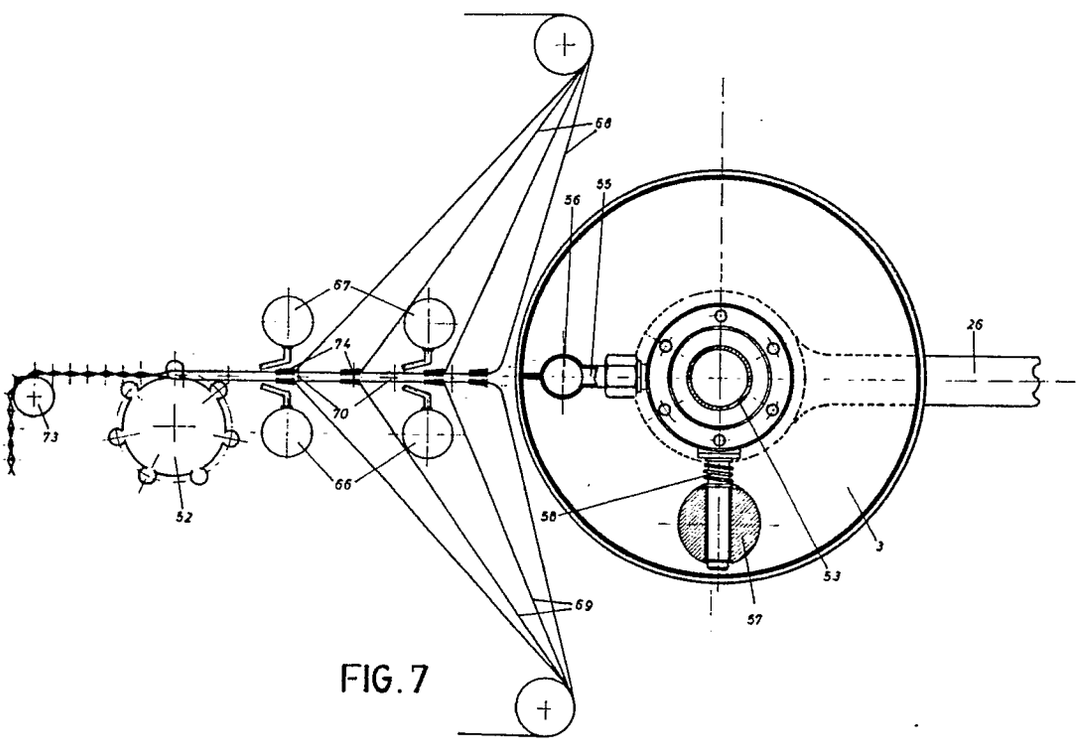


FIG. 7

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# NEW SYSTEM OF ENTRY AND INCLUSION OF THE WEFT THREAD IN A WEAVING MACHINE AND ITS INTERLACING BY THE FORMATION OF SHEDS OF VARIABLE PLANE

The present Patent of Invention relates to a new system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane.

The current looms and weaving machines are based on the following systems: weft pullers, nippers with transfer, projectile, air nozzles, water nozzles, two-phase, flat undulating sheds, and circular machines.

The fundamental objective of many weaving machine makers is based on the search for increased speeds and gains in greater outputs, accompanied no doubt by many electronic improvements which also result in improvements of quality and automation; it has been possible to exceed the insertion limit of 2,000 meters per minute.

The physical-mechanical, theoretical and practical or real performance of the system which constitutes the "weaving machine - dobby", has permitted deducing the relationships which make it possible to determine the increase of revolutions of the weaving machines, and to analyze the mechanical and physical limits of the high outputs.

At present, more or less complex models are used to represent the weaving machines as a closed oscillating system of multiple masses, and with them their kinematic and dynamic behavior can basically be determined..

The increase in speed, therefore, has its limits; it also requires performance ratings of the threads to be used, so that often the maximum speeds of the looms and their efficiencies are far from those that can theoretically be reached.

The future of high-output weaving is further determined by thread ruptures in connection with the stresses undergone by the warps, and the rubbing on the various parts with which they come in contact, between threads, heddles, reed, etc.

Superposed on the static tension are the dynamic tensions to which the warp threads are subjected, which are 3,000 times greater, while circulating through the working zone (states Dr. H. Weinsdorfer, of the Institut fur Textil- und Verfahrenstechnik (ITV), Denkendorf, GFR).

With increasing speed of the machine, the losses of strength occur due to the extreme strains to which the threads are subjected during the process of change of position of the shed.

Also the weft threads are subjected to high tensions, which increase with the speed of insertion.

In the paper of E. Wirth, engineer of Lindauer Dornier GFR, titled "Reflections on High-Output Weaving", given during the "5th Reutlinger Weberei-Kolloquium", which took place on December 6 and 7, 1988, titled "A STEP IN HIGH OUTPUT WEAVING", he stated that "... the weaver does not choose the fastest insertion system, but the one which produces fewer thread ruptures, and also that he usually pays much attention to the geometry of the shed...".

During the weaving process, detachment of size occurs, the threads become worn, fibers become detached, fluff occurs which creates problems in the machine itself, the microclimate of the weaving room changes, the dust and fuzz reach a disturbing magnitude which has important consequences for the productivity.

The loom with shed of variable plane of the present invention is a machine of new design whose basic elements are its simplicity, absence of enormously heavy and rigid masses in intermittent motion, on the contrary, its operation is rotatory and continuous.

It has been known from time immemorial that "the loom is an irrational machine", it works by fits and starts, some of its organs accelerate to the maximum and then they are braked at full speed, to obtain higher speeds and hence outputs.

The loom with shed of variable plane does not insert wefts transversely, and therefore it eliminates the intermittence of the introduction of these threads, and therefore also eliminates the intermittence of the batten.

The weft is introduced from the rear forward and enters simultaneously over its entire width. The width, therefore, is not a limitation of the speed of weft insertion. Theoretically the loom may have any desired width; the time of weft insertion is always the same; in practice the loom will have several times the width of a conventional one.

The batten is of a different design; it is a cylinder with numerous cams, it acts in a rotatory manner and continuously compresses the approaching wefts, and when they reach its sphere of action they are displaced and compressed toward the weaving line.

Both the weft insertion and the compression of the batten on the picks take place continuously without intermittences. There are no heddles, the shed forms by another system.

The noise level is greatly reduced with the disappearance of the mechanisms which fundamentally produce it; the masses in motion are much smaller, and therefore also the stresses which the machine exerts are less, and consequently the sound level is lower.

In the introduction reference was made to the

importance of the shed and the tensions to which the warp threads are subjected. In this new machine the shed will oscillate between 2 and 8 mm, depending on the diameter of the weft threads to be worked. Thus the tensions which the warps undergo will be very low.

The weft threads will simply be tensioned, disposed in weft-holding devices located behind the interlacing mechanisms, and therefore subjected to insignificant tensions.

Ruptures due to warp or weft tensions will therefore not occur. Because of this, the quality of the yarns should not be of capital importance, as is required by the high-speed weaving machines now existing on the market. For this fact alone the output and efficiency will increase notably, regardless of the speed the machine can reach because of its design.

The interlacing devices, which at the same time constitute the shed, will have an approximate length of 5 mm, and therefore the friction zone will be this only, and there will be contact once and for a very short time, for the warp as well as for the weft threads; the defibering that may occur will be very little and the detachment of dust from the sizing materials also very limited.

In the present weaving machines, the wefts have a very limited number of colors; in the system of the shed of variable plane there may be up to 400, as many different colors as there are grooves in the weft-holding device; this gives it color combination options not attainable with the conventional systems.

The speed of the machine is estimated at a minimum of 1500 insertions per minute; to this must be added that as the introduction is simultaneous over the entire width, the output will be determined by the width of each machine.

Considering a useful width of 5 meters, the theoretical output will be 5 x 1500 = 7500 meters per minute.

To facilitate the explanation, there are attached hereto 10 sheets of assembly drawings, showing the main mechanisms of the new system of entry and inclusion of the weft thread in the weaving machine and its interlacing by the formation of sheds of variable plane.

In the drawings:

Figure 1 shows the weft-holding cylinders and system of creation of vacuum.

Figure 2 is the weft transporting mechanism.

Figure 3 comprises the weft fastening and cutting mechanism.

Figure 4 represents the thread guide.

Figure 5 shows the warp tension regulating mechanism.

Figure 6 illustrates the weft detachment system.

Figure 7 is the weft inclusion system.

Figure 8 shows the mechanism for connection of the weft-holding cylinders.

Figure 9 is the interlacing mechanism.

Figure 10 represents the shed of variable plane.

The new system of entry and inclusion of the weft thread in the weaving machine of the present invention consists of a main shaft (1), provided at its ends with a flywheel (2) of six arms. Each of them serves as support for a weft-holding cylinder (3).

On its envelope or outer surface this cylinder has fluted strips whose purpose is to accommodate the weft threads, to which end there are holes for the passage of the outside air on the bottom of the grooves.

The shaft of this cylinder (3) is also hollow and perforated.

At one end of shaft (1) is a distributor (8), provided with joints connected by flexible tubes to the weft-holding cylinders.

A vacuum pump (9) creates a vacuum in said distributor (8) and exhausts through the holes in the outer surface of the weft-holding cylinder, thus keeping the weft threads adhering to said surface.

The assembly of the main shaft, flywheel and weft-holding cylinders rotates about said axis, and also each cylinder rotates about its axis. For this, the necessary auxiliary mechanism, bearings (4), (5) and (6), supports (7) and drives are provided.

The weft transporting mechanism consists of fastening rings (10), concentric with the weft-holding cylinder (3), which takes and fastens one end of the weft threads. The rings, with the threads move longitudinally and at the end of their excursion release said threads, which adhere to the weft-holding cylinder.

There are, suitably arranged, a support and guides (17), by which a reduction gear (14) integral with the fastening rings is shifted.

The drive wheel (15) and the guide wheels (16) on bearings (12) facilitate the shifting. The reduction gear is mounted on a carriage (13) which in turn supports the guide wheels. The actuation of this reduction gear is obtained by means of current connector rollers (18). The entire assembly is fireproofed.

A stop mechanism at end of stroke actuates the trigger (11) which by an angular displacement moves one of the two fastening rings (10) relative to the other, to release the weft threads.

The weft fastening and cutting mechanism is mounted at the front end of the weft-holding cylinder (3) and on the cylinder head (19), by means of a sleeve (20) with cap (76) which serves as support for a knife-holding disk (23), counter-knife (21) and knife (22) with sharp teeth at their periphery, and which, acting like scissors, produces the cutting of the wefts.

Two disks acting in the manner of gripping pliers, also toothed, located at both ends of the cylinder (3), retain the wefts.

The assembly operates in the following steps:

1. The fastening rings (10) clamp the wefts and transport them over the mechanisms and over the weft-holding cylinder, to end of stroke.
2. At that moment the gripping pliers (71) and (72) nearest said end of stroke clamp the wefts and retain them.
3. The fastening rings open and return toward beginning of stroke.
4. When the rings have passed the front pliers (71) and (72), the latter also clamp and retain the deposited wefts.
5. At the suitably established distance, the fastening rings again take up the wefts, retaining them while the knives (21) and (22) cut the wefts.
6. The pliers (71) and (72) of both ends open again, and the cycle repeats.

On the arm of the support (26) are situated two actuators, one (27) which at the proper moment actuates and angularly displaces the knife relative to the counter-knife, producing the cut, and actuator (75) which similarly to (27) actuates and displaces the clamping disks.

The washers (24) and the retention ring (28) maintain said knife, counter-knife and clamping disks at the end piece of the cylinder shaft (25).

Thread guide (50), formed by a cylindrical tube (30) provided with a fixed axle (29), relative to which it can rotate, which action is favored by a series of ball bearings (31) and (35), provided for this purpose. The separating rings (32) and covers (33) complete the mechanism.

A support made up of a body (37) and a foot (41) comprises an axle (36), and serves as support for the axle of the thread-guide (29); the spring (38), which can receive an initial tension by means of the sleeve (39) and the threaded sleeve (40), acts as shock absorber, so that properly adjusted it forms part of the warp tension regulating mechanism.

The warp is in contact with the thread guide (50), which like the support (37) have been described before. The thread-guide assembly and supports transmit the tension variations of the warp threads to the actual regulator, by means of the angle lever (47).

This entire assembly constitutes the warp tension regulating mechanism.

Although the warp tension regulating device has been described above, for which a system has been devised, the regulating device may be any other of those found on the market, but it would substantially reduce the operating time of the machine in question, due to the number of stoppages that would have to be made when changing lower and upper beams so that the efficiency of the machine would be substantially reduced.

The speed of the machine will lead to a rapid exhaustion of the warp from the beams; to avoid this problem it is suggested to place a special creel, suitably disposed so that the cones of appropriate dimensions and weights and with the ends of the threads joined with the heads of the following cones, permit continuous operation without stops and without reduction of efficiency on this account.

The creel must not be of conventional type in view of the volume they occupy, but of a new design as in an existing experimental prototype, where, if the threads so require, they can also be sized and dried at the exit from the creel and while the weaving machine is in operation.

When said angle iron is displaced, to the right or left, an adjustable tie rod (48), connected to the lever (49), which rests against the support (51), actuates the adjustable pulleys of a speed variator (46); by means of a reduction gear (44) this variator sets in motion the warp beam on the rim (42) of which is a braking mechanism (43).

A reduction gear (45), of constant speed, acts directly on the speed variator which by means of its belt transmits movement to the beam.

Weft detachment system. The detachment and transport of weft occurs by air jet.

The weft-holding cylinder (3) rotates on its hollow and perforated shaft (53) to exhaust and evacuate the interior of the cylinder, the effect indicated in figure 1 being obtained.

At the opposite end of shaft (53) an end piece (54) is disposed, through which, when appropriate, compressed air is introduced. This air passes through the nozzle (55) to a collector (56) also provided with outlet orifices, whence the air is conducted to the outside traversing the holes in the cylinder (3), thus detaching the weft threads.

The collector (56) is arranged as indicated in the detail of Sheet #6, so that it always remains in the same position, without rotating, on the shaft (53) . This is so owing to the action of the counterweight (57), compensated with a spring (58). The counterweight and spring are secured to a support (59) which permits rotating the shaft (53) by means of the ball bearings (60).

Weft inclusion system. The weft having been detached, its transport occurs by air jet; for this there are duly oriented dispersers (66) and (67) which convey the unwound weft (70) bertweem the warps (68) and (69), and the interlacing mechanisms (74), up to the batten disk (52) which compresses them in the fabric, thus carrying out the inclusion of the weft over its entire width and all at once.

The fabric passing over the cylinder which acts

as breastboard (73) is taken up by the respective beam.

The mechanism of connection of the weft-holding cylinders. The system to which the present invention relates permits weaving in variable widths, which can be several times greater than the current maximum widths; to avoid deformations due to the length and weight thereof that would occur, they are limited by means of intermediate supports, hence the need for the mechanism of connection of the weft-holding cylinders illustrated in Sheet #8.

Joining of the weft-holding cylinders (3) is done by means of their common shaft (53). Said shaft is interrupted and mounted on a coupling sleeve (61) which permits passage of the vacuum flow and at the same time also lets pass compressed air from the air chamber (64) circulating through the air passages (63). On shaft (53) are mounted several ball bearings (65) which facilitate the rotation of the shaft.

The interlacing of the warp and weft threads, that is, the crossing between threads and picks, is done with an assembly of interlacing mechanisms by which the fabric is formed.

These mechanisms, described below, are located side by side, juxtaposed, so that each thread of the warp is conducted through a certain path of the interlacing mechanism.

The interlacing mechanism consists of a series of identical cylinders as can be seen in figures 9-2 and 9-3.

Each cylinder is formed by two equal suitably assembled parts, the development of which is shown in figure 9-1.

Between the two pieces a clearance is left which permits passage of the weft thread; this clearance is of variable width and adequate in each case for the titer of the thread and the material which the machine is to work.

Each warp thread is passed according to the path shown schematically in figure 9-1, and of variable thickness -e-, in accordance with the titer and type of yarn to be worked.

To obtain the minimum interlacing two threads are required, and therefore two of these interlacing mechanisms will intervene to form plain cloth (I e I). This group of two elements will be repeated as many times as is necessary in the width of the cloth.

If another weave is desired, serge or satin, as many mechanisms will intervene as are necessary, properly arranged to permit the different evolutions of the repeat of the weave, and analogously these assemblies will be repeated as many times as is necessary in the width of the cloth.

As support of the two parts which constitute the cylinder or interlacing mechanism, there are in the interior thereof, in the manner of a shaft, two pieces deriving from the cutting of a cylinder of an inside diameter øi as can be seen in figure 9-2, the flat part of which has been recessed, for the purpose of allowing the weft thread to pass between the two parts, acting at the same time as weft guide.

This recess will leave in each case a clearance or passage of variable width adequate for the titer and type of yarn. To permit easy entry of the weft thread, these two pieces will have blunt or rounded edges.

The cylinder constituted by the assembly of the two above described pieces, of outside diameter øe, figure 9-2, will rotate in both directions a number of degrees suitable for the weave being made, while the weft thread will move between the two flat parts of the guide cylinder, and meanwhile the two assembled pieces will rotate bringing their respective grooves into coincidence with the horizontal through which the weft passes up to the opposite end where it will come out, thus permitting the passage of the weft in perfect horizontal position.

This two-piece cylinder will be provided with a toothed rim on its surface in the manner of a toothed cylinder, whose pitch -g- and tooth height -f- will be suitable for the outside diameter øe of the cylinder, as the latter can vary according to titer and material to be worked.

By this toothed rim it can be driven in its rotatory movements.

For cloth to be made, threads must be interlaced with picks. Each warp thread is conducted by each of the interlacing mechanisms, one thread per mechanism.

The weft thread is supplied from the weft inclusion system, figure 7, and it is forced to follow the path marked in figures 9-2 and 9-3, along the axis X-X, so that it traverses the entire length L in horizontal position.

While the advance of the weft takes place, the two-piece cylinder rotates to the right and then to the left, or vice versa, a certain number of degrees, thus permitting that the grooves existing between the two assembled pieces are, by means of these rotations, in perfect synchronism with the groove of the central axis X-X, so that the weft can move through the interlacing mechanism and simultaneously the crossing of the warp threads takes place, so that the thread of the upper part of the interlacing mechanism passes to the lower part, and the second thread which is in the second interlacing mechanism in the lower part passes to the upper part, whereby the position of the warp threads will have changed, a crossing thereof taking place, whereby the first crossing of the weft thread has occurred, whereby the first pick is

crossed in front.

Thereafter the first mechanism which carries the warp thread in the upper part descends, and simultaneously the second mechanism, the one which carries the second warp thread and is present in the lower part, ascends, whereby a new crossing occurs, this time in the posterior part of the first pick.

Thus it has been possible to interlace it; thereafter the second pick comes in between the two mechanisms, which continue to be in the raised and lowered positions; when this second pick has passed, both mechanisms descend to the neutral or initial position, the first cycle being completed.

By successively repeating these movements, new cycles take place, giving rise to the formation of the cloth.

When the desired weave is different from plain cloth, as described above, one proceeds analogously but taking into account in each case the particular interlacing indicated by the repeat of the weave and acting on assemblies of interlacing devices.

The up and down movement of the two mechanisms in the case of plain cloth and of those which intervene in the other cases is very short; this up and down movement constitutes the second part of the shed, thus permitting the passage of the weft thread, constituting the second pick, which closes the evolution of the repeat of the plain cloth.

The shed has two phases; in the first it occurs by rotations of the interlacing mechanisms, and in the second by means of the up and down movement of the interlacing mechanisms, and therefore it constitutes a shed of variable plane.

The mechanism of figure 10 is the one which produces the rotations, the separation, and the approximation of the cylinders or cylinder assemblies which constitute the interlacing mechanism or mechanisms, which bring about and govern the formation of the two stages of the shed, called because of this special characteristic, shed of variable plane, to distinguish it from the conventional looms or weaving machines whose shed takes place as some heddles go up and others go down but the threads always move in a single vertical plane.

This mechanism is formed by two worm type screws (75), provided with double grooving (two threads running in opposite direction to each other), so as to produce, continuously and without interruptions, rotations in one direction and then in the opposite direction, of the toothed rims (76) which in this manner will rotate a certain number of degrees, in order to place the groove thereof in horizontal line and coincident at all times with the horizontal shaft divided into two parts (77), in a manner synchronized and coincident with the passage of the weft, so that the weft passes always following a horizontal path, and simultaneously the toothed rims permit the passage of the weft through their grooves causing the warp threads to change position, in order thus to permit the change of place of the warp threads, whereby the crossing of these threads is obtained; the one which initially was in high position now occupies the low position and vice versa.

The upper part of the support axles (77) of the rims are joined to the box (78) which supports the assembly with the upper worm, by means of a supporting tie-rod (86), while the lower part of the support axles of the rims are joined to the box which supports the assembly of the lower worm, by means of another supporting tie-rod (86).

In the initial position which we shall call the neutral position, the rotation of the worm screws (75) will permit the advance of the picks, thus bringing about the entry of the odd picks, constituting at the same time the first phase of the shed.

The actuation of the worm screws will be produced by the eccentric (79) in its rotational movement. This eccentric will have its inner perimeters toothed, having two, four or more cams whose height will be a function of the opening of the shed, that is, of the separation between toothed rims (80); the worm screws return to the neutral position, and in order that their thread will not come in contact with the toothed rims supported by the opposite worms, the thread will be omitted, so that they alone will drive the toothed rims a certain number of degrees in one direction and then the same number (of degrees ) in the opposite direction.

In the interior of the grooves of the eccentric (79), two toothed wheels (81) - one in the upper and one in the lower part thereof - will be forced to rotate by contact with the teeth of the eccentric, and consequently will cause the worms to move, which in turn will force the toothed rims (80) to rotate.

The toothed eccentric (79) is integral with the shaft (82), from which it receives movement, and the same eccentric (79) also serves to separate and approach the worms and the toothed rims (77) joined to them, so that they separate from the neutral line, leaving enough space for a second pick to pass between the odd and even rim assemblies. During the separation the shed opens, the pick passes, and a return to the neutral position occurs, that is, the shed closes, whereby the second phase of the shed takes place; this justifies the name of shed of variable plane; rotations are carried out in one and then in the opposite direction and, after opening, passage of the second pick and closing.

Another eccentric (83), also integral with the

same shaft (82) and identical with (79) but without teeth at its inner profiles, carries out the same evolutions as (79); its mission is to support the boxes (78) which carry the assembly of worm and toothed rims.

The eccentric (83) moves the wheel (84) which turns simply due to the profile of the eccentric, as there are no toothed grooves in this case, since the only thing that matters is to raise and lower the assembly of cylinders of worms; this occurs by means of the tie-rod (85), which raises and lowers them as a function of the displacement of the cams of the eccentric (83).

In the separated position of the worm screws, the toothed wheels (81) will continue to rotate and with them the worms (75), first in one and then in the opposite direction, then the screws will approach and stay as needed for the passage of a new pick, that is, as in the initial position.

The mechanism of figure 10 is one of the possible existing mechanisms for producing the movement of the variable plane shed devices, as for example, replacing the thread or serrations by friction systems or devices or the like, etc.

## Claims

1. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane.

2. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane, according to claim 1, characterized in that the weft inclusion between the warp threads occurs simultaneously over the entire width of the fabric and all at once.

3. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane, according to claim 1, characterized in that the weft comes from the rear of the loom and advances let off over the entire width forward, to the line of formation of the fabric.

4. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that it has weft-holding cylinders whereon the weft threads are accommodated.

5. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that each weft-holding cylinder contains on its outer surface fluted strips whose function is to accommodate the weft threads.

6. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that it contains in the flutes or grooves of the weft-holding cylinder orifices which by internal suction of the cylinder and by effect of vacuum keep the weft threads adhering on the grooved surface.

7. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that has, at one of its ends, a distributor provided with joints which by flexible tubes are connected to the weft-holding cylinders.

8. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that it has a vacuum pump which creates a vacuum in said distributor, exhausts through the orifices in the outer surface of the weft-holding cylinder and thus keeps the weft threads adhering to said surface.

9. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that the assembly of the main shaft, flywheel and weft-holding cylinders rotates relative to the main axis, and also each cylinder rotates on its axis.

10. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that it has a weft-transporting mechanism, formed by fastening rings concentric with the weft-holding cylinder, which takes up and fastens one end of the weft threads, which rings together with the threads move longitudinally and at end of stroke release said threads, which still adhere to the weft-holding cylinders.

11. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that it has a support and guides by which a reduction gear integral with the fastening rings is shifted.

12. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that it has a drive wheel and guide wheels on bearings facilitating the displacement, the reduction gear of which is mounted on a carriage which in turn supports guide wheels, the actuation of this reduction gear being obtained by means of current connector rollers, and this entire assembly being fireproofed.

13. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to the first claim, characterized in that it releases the weft threads by means of a stop mechanism located at end of stroke, which actuates a trigger which, by an angular displacement, separates one of the two fastening rings releasing the thread.

14. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized by a weft holding and cutting mechanism, at the front end of the weft-holding cylinder and at the cylinder head, by means of a sleeve there is mounted an oversleeve (cap) which serves as support for a knife-holding disk, counterknife and knife, these contain at their periphery a suitably sharpened toothing which, acting in scissor fashion, produces the cut of the wefts.

15. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized by two disks which act in the manner of gripping pliers, also toothed, which, located at both ends of the cylinder, retain the wefts.

16. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claims 1 to 15, characterized in that the gripping disk mechanism acts according to the following sequences:

1. the fastening rings clamp the wefts and transport them over the mechanisms and the weft-holding cylinder, to the end of the stroke;
2. at that moment the gripping pliers nearest said end of stroke clamp the wefts and retain them;
3. the fastening rings open and return to start of stroke;
4. when the rings have passed over the front pliers, these also clamp and retain the deposited wefts;
5. at the suitably established distance the fastening rings again take up the wefts, retaining them while the knives cut the wefts;
6. the gripping pliers of both ends again open and the cycle repeats.

17. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that on the support arm two actuators are disposed, one of which acts at the proper moment angularly displacing the knife relative to the counter-knife, producing the cut, and the other acts in similar manner displacing the clamping disk.

18. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized by a washer and retention ring maintaining said knife, counter-knife and clamping disk at the endpiece of the cylinder shaft.

19. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized by a thread-guiding cylinder and a support formed by a body and a foot, which contain an axle and serve as support for the axle of the thread-guiding cylinder, the spring which can receive an initial tension by means of sleeves, acts as shock absorber, so that, suitably adjusted, it forms part of the warp tension regulating mechanism.

20. New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane, according to claims 1 and 19, characterized in that the warp being in contact with the thread-guide and supports, they transmit the variations of tension of the warp threads to the actual regulator, by means of an angle lever.

21. Mew system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claims 1, 19 and 20, characterized in that, as said angle lever moves, to the right or left, an adjustable tie rod connected to the lever which rests against the support actuates the adjustable pulleys of a speed varia-

tor, and by a speed reducer this variator sets the warp beam in motion, on the rim of which a brake mechanism is disposed.

**22.** New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claims 1, 19, 20 and 22, characterized in that with a reduction gear of constant speed acting directly on a speed variator, it transmits movement to the beam through its belt.

**23.** New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that the detachment and transportation of weft occurs by means of an air jet produced by a compressor or blower installed for that purpose.

**24.** New system of entry and inclusion of the weft thread on a weaving machine and its interlacing by the formation of sheds of variable plane, according to claims 1, 4, 5 and 6, characterized in that the weft-holding cylinder rotates on its hollow and perforated shaft, to exhaust and evacuate the interior of the cylinder to keep the weft threads adhering on its grooved surface.

**25.** New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claims 1 and 23, characterized in that there is disposed at the end opposite the shaft of the weft-holding cylinder, an end piece through which, when desired, compressed air is introduced; this air passes through the nozzle to the collector also provided with outlet orifices, whence the air is conveyed to the outside traversing the holes in the weft-holding cylinder, thus detaching the weft threads.

**26.** New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that there is disposed inside the weft-holding cylinder a collector in a manner that it always remains in the same position, without rotating, on the shaft, owing to the action of a counterweight, compensated with a spring, the counterweight and the spring being secured to a support which permits the shaft of the weft-holding cylinder to rotate by means of ball bearings.

**27.** New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane, according to claim 1, having a weft inclusion system, characterized in that, the weft having been detached, the transportation thereof occurs by means of an air jet, to which end properly oriented diffusors have been disposed, which conduct the detached weft between the warps and the interlacing mechanisms, to the batten disk which compress them in the fabric, the inclusion of the weft thus taking place over its full width and all at once.

**28.** New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claim 1, characterized in that it permits weaving in variable widths, which can be several times greater than the present maximum widths to avoid the typical deformations due to the length and weight that would occur, the widths of the weft-holding cylinders being limited by means of intermediate supports, and hence the need for the mechanism of connection of the weft-holding cylinders.

**29.** New system of entry and inclusion of the weft thread in a weaving machine and its interlacing by the formation of sheds of variable plane according to claims 1 and 28, characterized in that the coupling of the weft-holding cylinders occurs by means of their common axle, which is interrupted and is mounted on a coupling sleeve which permits the passage of the vacuum flow, and at the same time also lets pass the compressed air coming from the air chamber which circulates through the air passages.

**30.** New system of entry and inclusion of the weft thread in a weaving machine and its interlacing, by formation of sheds of variable plane according to claim 1, characterized in that the sheds are made by means of an assembly of interlacing mechanisms, placed side by side, so that each thread of the warp is conducted along a certain path of the interlacing mechanism.

**31.** New system of entry and inclusion of the weft thread in a weaving machine and its interlacging by formation of sheds of variable plane according to the first claim, characterized in that the interlacing mechanism is formed by a series of small cylinders, which are formed by two equal parts appropriately assembled.

**32.** New system of entry and inclusion of weft

thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that each cylinder of the interlacing mechanism is formed by two equal assembled parts, between which a clearance of variable width is left, where the weft thread passes through, and suitable for titers and materials to be worked.

**33.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that each thread of the warp is passed along a given path.

**34.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that as support of the two parts that constitute the interlacing mechanism or cylinder, there are inside the latter, as shaft, two pieces deriving from the cutting of a cylinder of inside diameter øi, on which the flat part has been recessed, to permit passage of the weft thread between the two parts, acting at the same time as guide thereof.

**35.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that the cylinder formed by the assembly of the two pieces, according to claims 31, rotates in both directions a suitable number of degrees, while the weft thread moves between the two assembled pieces in horizontal position to the opposite end.

**36.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that the cylinder composed of the two pieces, according to claim 31, is provided with a toothed rim at its periphery, whose pitch -g- and tooth height -f- will be suitable for the type of cylinder diameter øe necessary for the material to be woven, this toothed rim being what permits its rotatory movements and its grooving may have various inclinations relative to the horizontal in order to be properly driven.

**37.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that the weft is forced to follow the path along the horizontal axis X - X, so that it traverses its entire length -L- in horizontal position.

**38.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that while the advance of the weft takes place, the cylinder formed by the two assembled pieces according to claim 31 rotates to the right and then to the left, or vice versa, thus permitting that the grooves between the two assembled pieces are brought by rotations into perfect synchronism with the groove of the axis X - X, so that it is possible to advance the weft in its displacement through the interlacing mechanism and simultaneously there occurs the first crossing of the warp threads, so that the thread which was in the upper part passes by means of these rotations to the lower part, and the one which was in the lower part passes to the upper part, whereby the positions of the threads of the warp have been changed, a crossing taking place between the two, the first crossing having originated in front of the weft thread.

**39.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that, the first crossing having been made, according to claim 38, thereafter the first mechanism or assembly of mechanisms which carry the threads of the warp, those of the upper part descend, and the second mechanism or assembly of mechanisms of the lower part ascent, whereby a second crossing takes place, this time in back of the first pick, the interlacing of the first pick being thus obtained, one crossing of the warp threads in front and the other in back.

**40.** New system of entry and inclusing of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that after the interlacing according to claims 38 and 39, a second pick then occurs between the two mechanisms, one of them being in the lowered position and the other in raised position, both mechanisms later returning to the original or starting position.

**41.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that by succes-

sively repeating the movements and evolutions cited in claims 37, 38, 39 and 40, new cycles are reproduced, giving rise to the formation of fabric with plain cloth weave.

**42.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that when a weave other than plain weave is desired, for example serge or satin, the interlacing devices must be combined appropriately so that in each pick some interlace and others do not, causing the device which must effect the take to interlace, in a manner similar to the conventional system.

**43.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that the mechanism of variable plane is formed by two worm screws provided with two threads so as to produce continuously and without interruptions revolutions in one direction and then in the opposite direction at the toothed rims which in this manner will rotate a certain number of degrees, for the purpose of placing the groove thereof in horizontal line and coincident with the passage of the weft, so that the weft passes always following a horizontal path and simultaneously the toothed rims permit the passage of the weft through their grooves causing the warp threads to change position, permitting in this manner the crossing of the threads of the warp, the one which initially was in high position now occupies the low position and vice versa.

**44.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that the upper parts (77) of the rim-supporting axles are joined to the box which supports the assembly with the upper worm screw by means of a supporting tie rod (86), while the lower parts of the support axles of the rims (77) are connected to the box which supports the lower worm screw assembly, by means of another supporting tie rod (86).

**45.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that, in the initial or neutral position, the rotation of the worm screws will permit the advance of the picks, thus bringing about the entry of the odd picks, constituting at the same time the first phase of the shed.

**46.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that the actuation of the worm screws will be produced by the eccentric (79) in its rotatory movement, said eccentric being toothed at its inner perimeters, having two, four or more cams depending on the opening of the shed, that is, on the separation between toothed rims (80) and the speeds that it is desired to reach.

**47.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane, according to the preceding claim, characterized in that when the worm screws return to the neutral position, and in order for their thread not to come in contact with the toothed rims supported by the opposite worms, the thread will be omitted, so that they will actuate only the toothed rims a certain number of degrees in one direction and then the same number [of degrees] in the opposite direction.

**48.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that between the toothed inner profiles of the eccentric (79) there are two toothed wheels (81), one in the upper part and the other in the lower part, which will be forced to rotate by contact with the teeth thereof and consequently will bring about movement in the worm screws which in turn will force the toothed rims (80) to rotate.

**49.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane, according to claim 1, characterized in that the toothed eccentric (79) is integral with the axle (82), from which it receives movement, and this same eccentric (79) also fulfills the mission of separating and approaching the worm screws and the toothed rims (77) connected to them, whereby they separate from the neutral line leaving sufficient space for a second pick to pass between the odd and the even rim assemblies, there occurring during the separation the opening of the shed, the passage of the pick, and return to the neutral position, that is the shed closes, and in this manner the second phase of the shed takes place, which

justifies the name of shed of variable plane; rotations occur in one and then in the opposite direction and thereafter opening passage of the second pick and closing.

**50.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that another eccentric (83) also integral with the same axle (82) and identical to (79), but without toothing at its inner profiles, carries out the same evolutions as (79), its mission being to support the boxes (78) which carry the assembly of worm and toothed rims, this taking place by means of the tie rod (85) which raises and lowers them as a function of the displacement of the cams of the eccentric (83).

**51.** New system of entry and inclusion of weft thread in a weaving machine and its interlacing by formation of sheds of variable plane according to claim 1, characterized in that the mechanism of figure 10 is one of the possible existing mechanisms for producing the movement according to claims 1 to 50, as for example replacing the threads or toothing by friction systems or devices or the like.

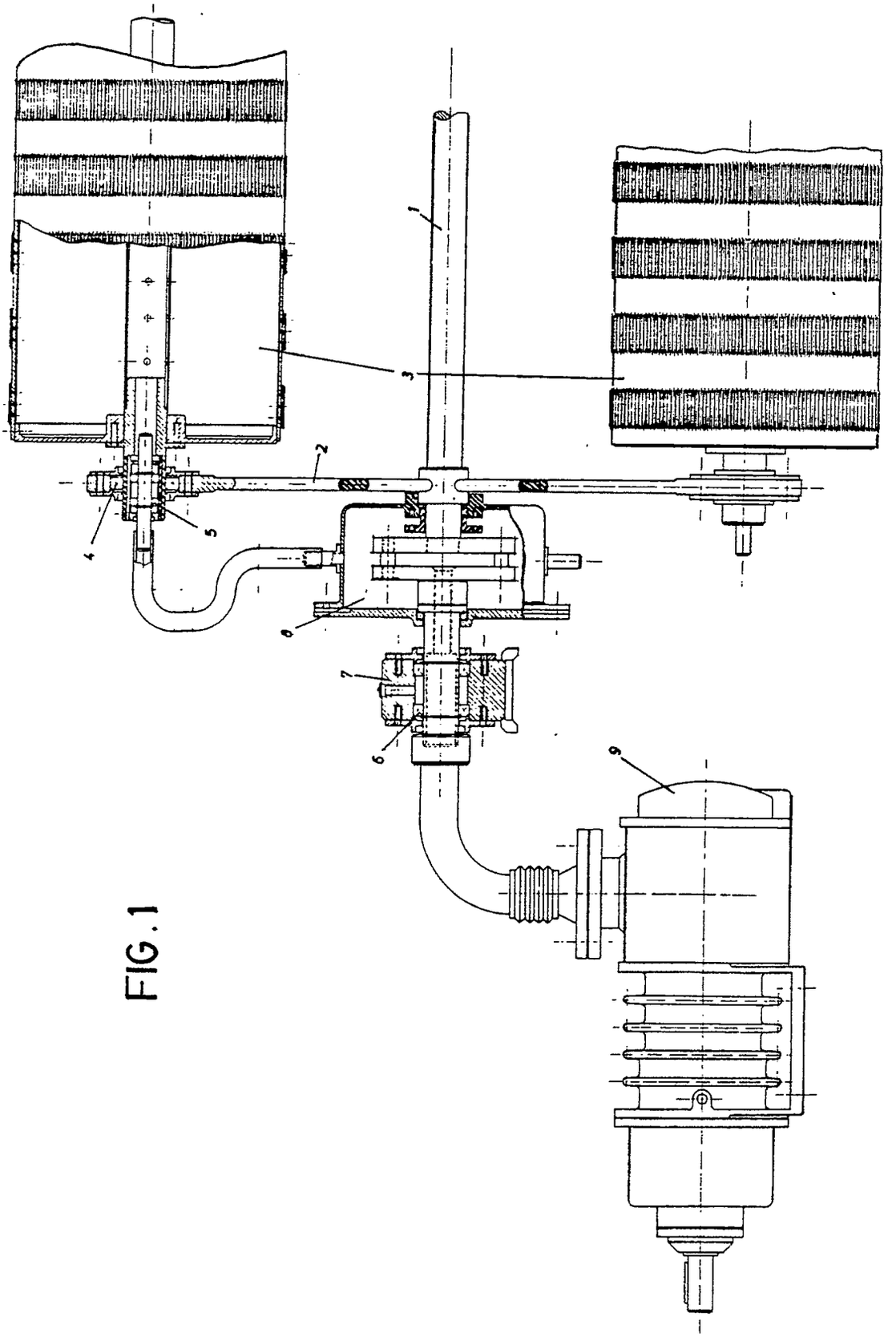



FIG. 1

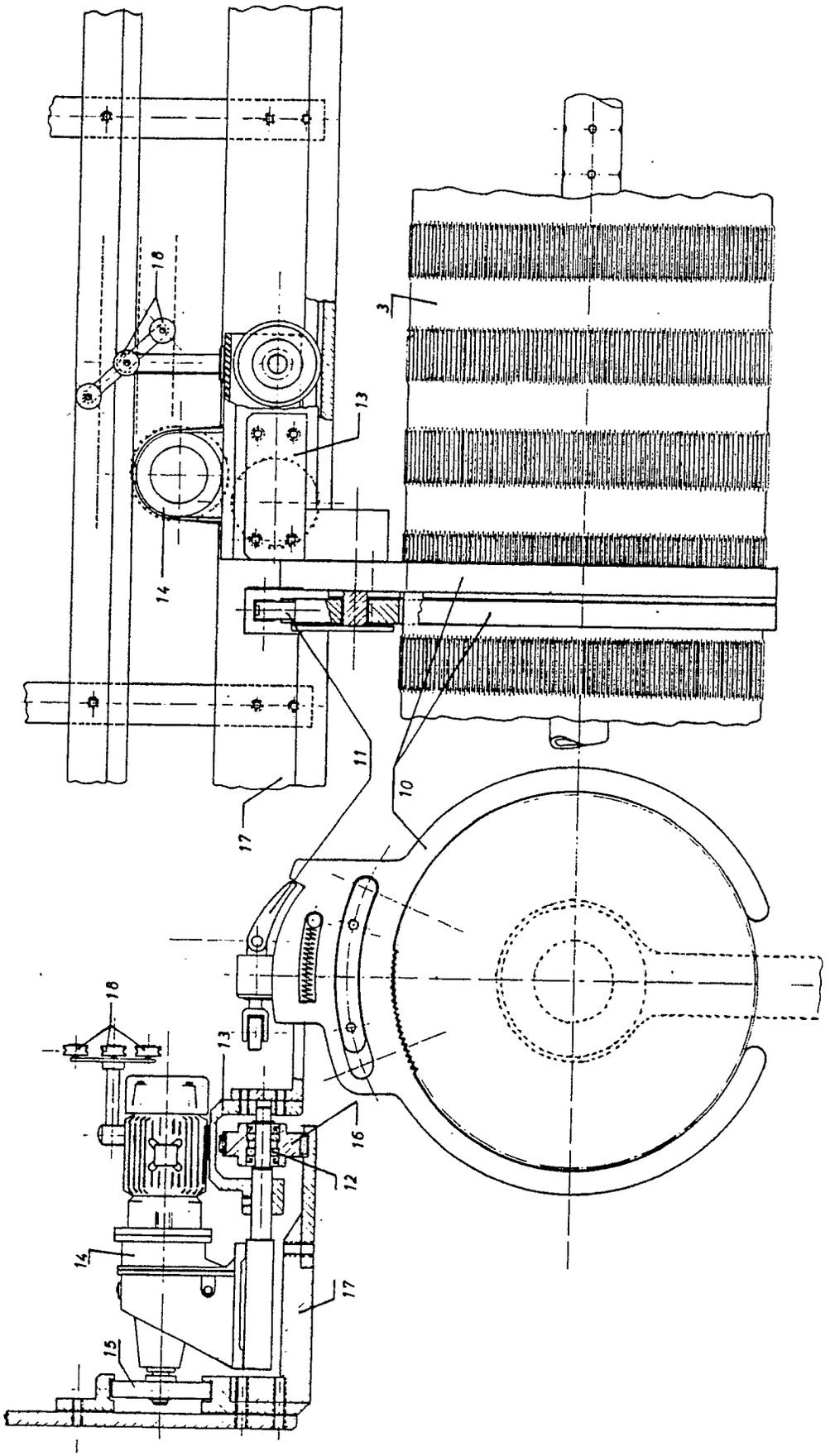



FIG.2

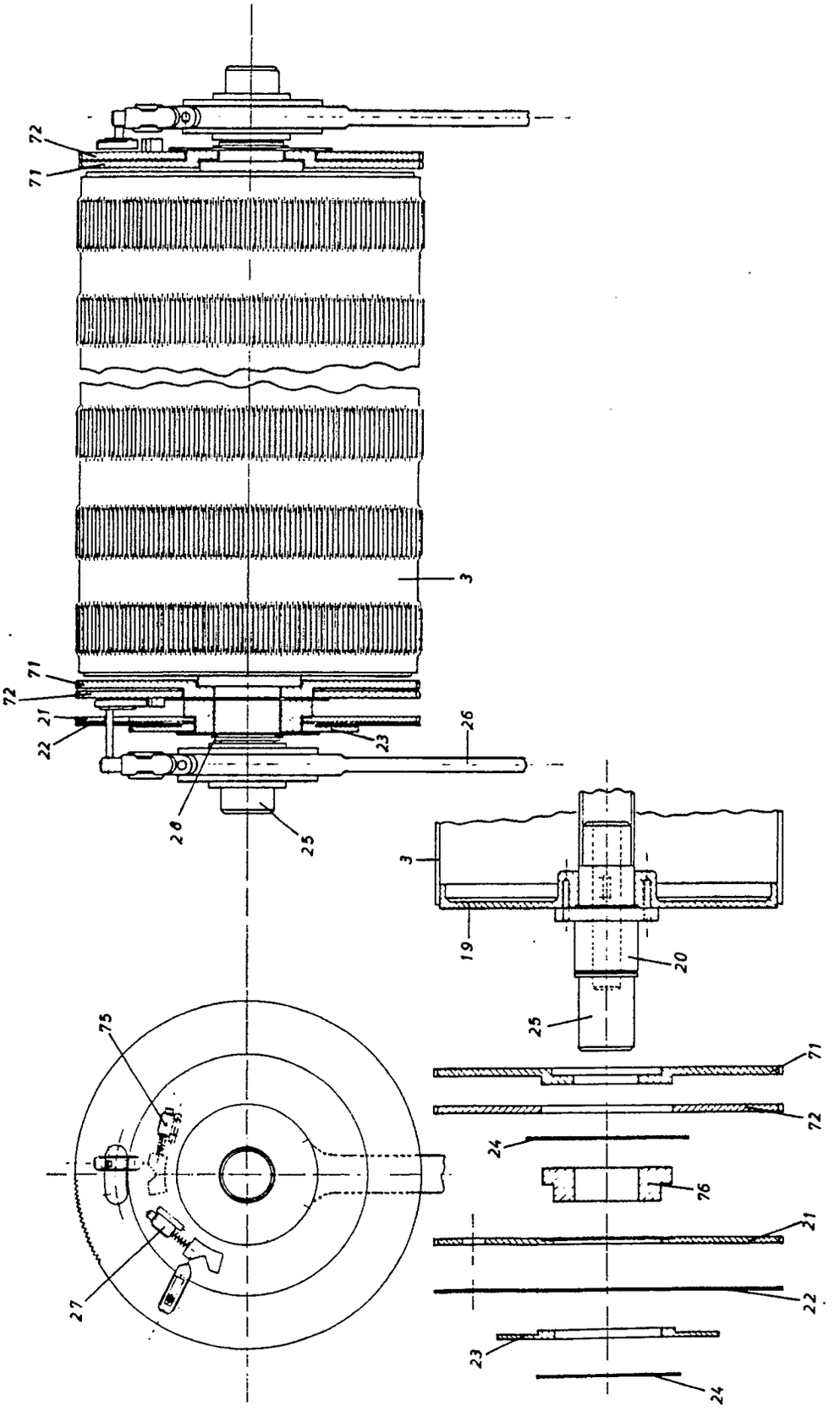



FIG. 3

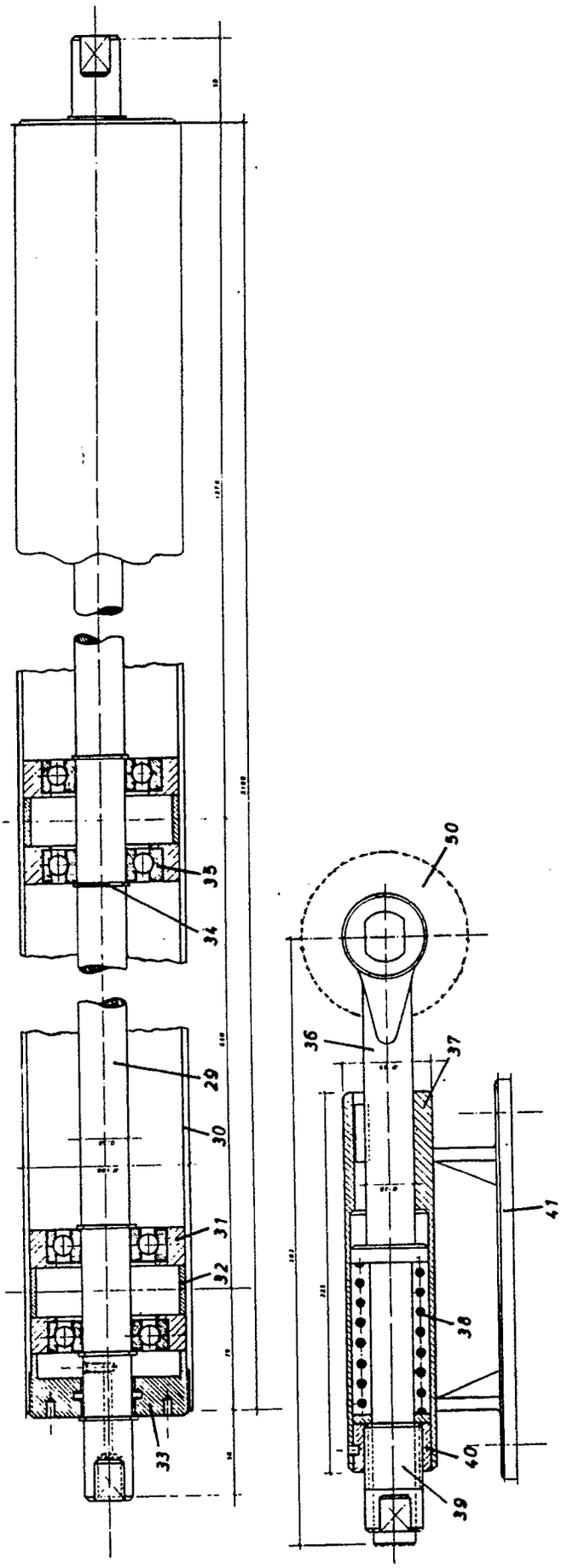



FIG. 4

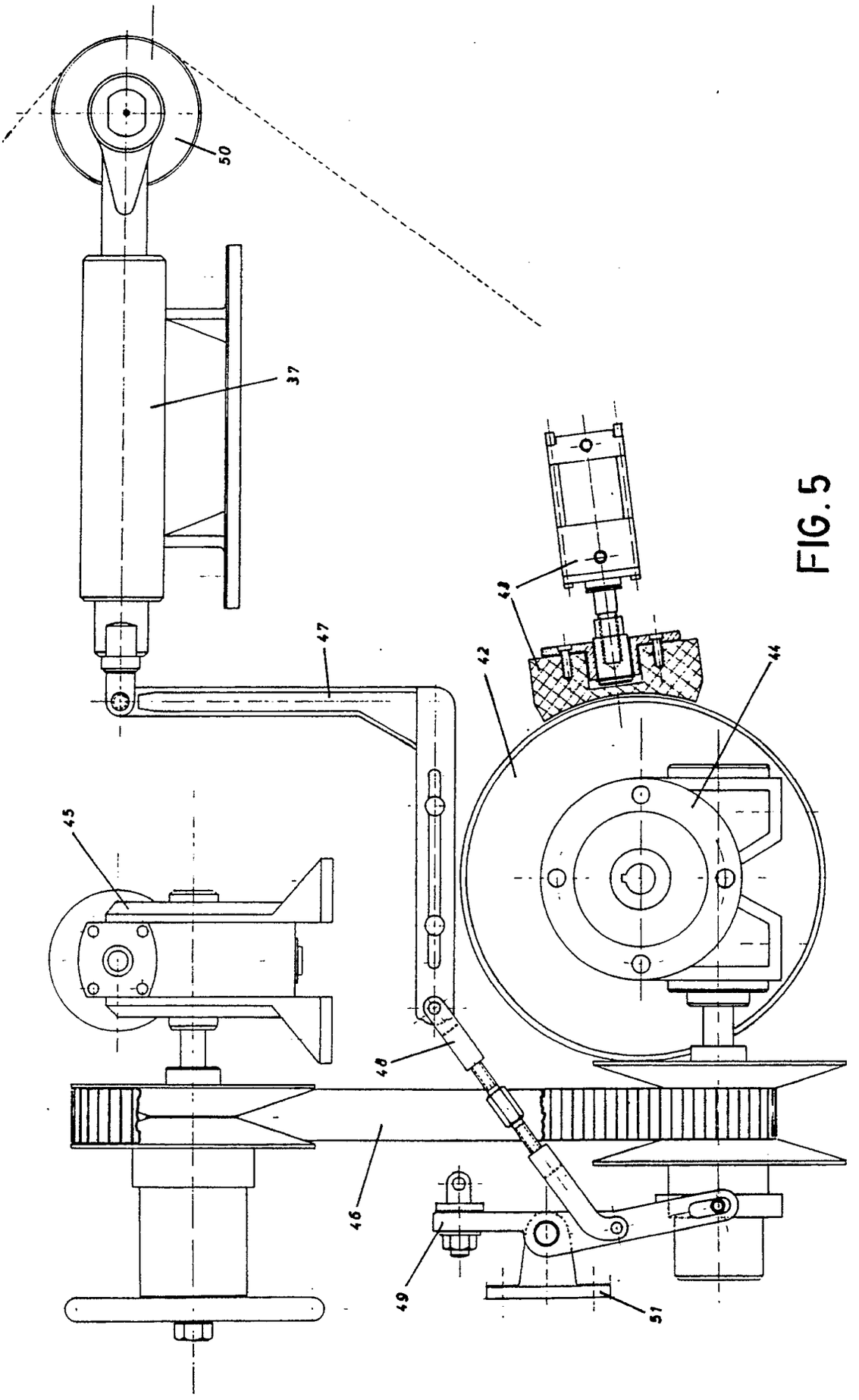



FIG. 5

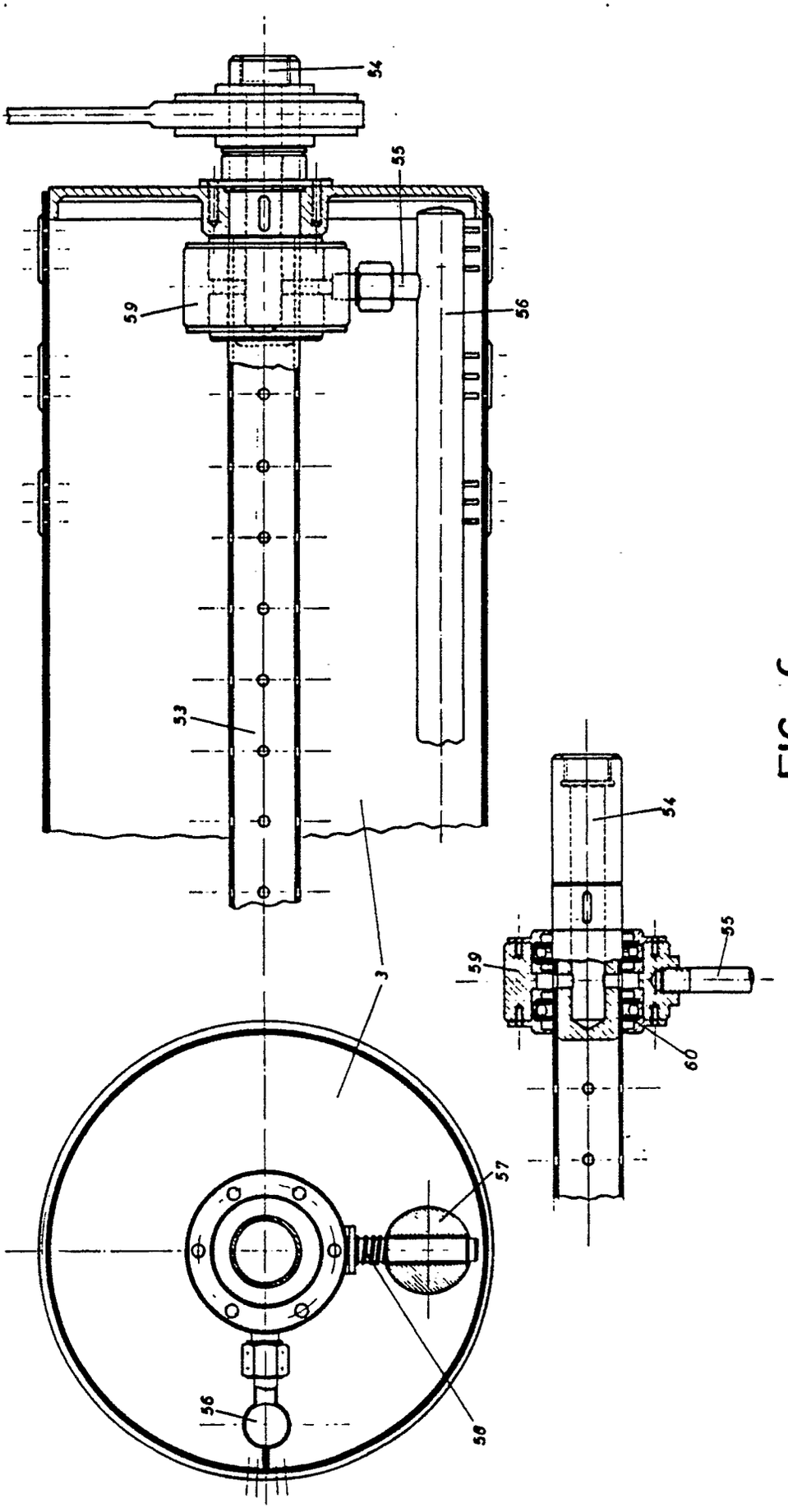



FIG. 6

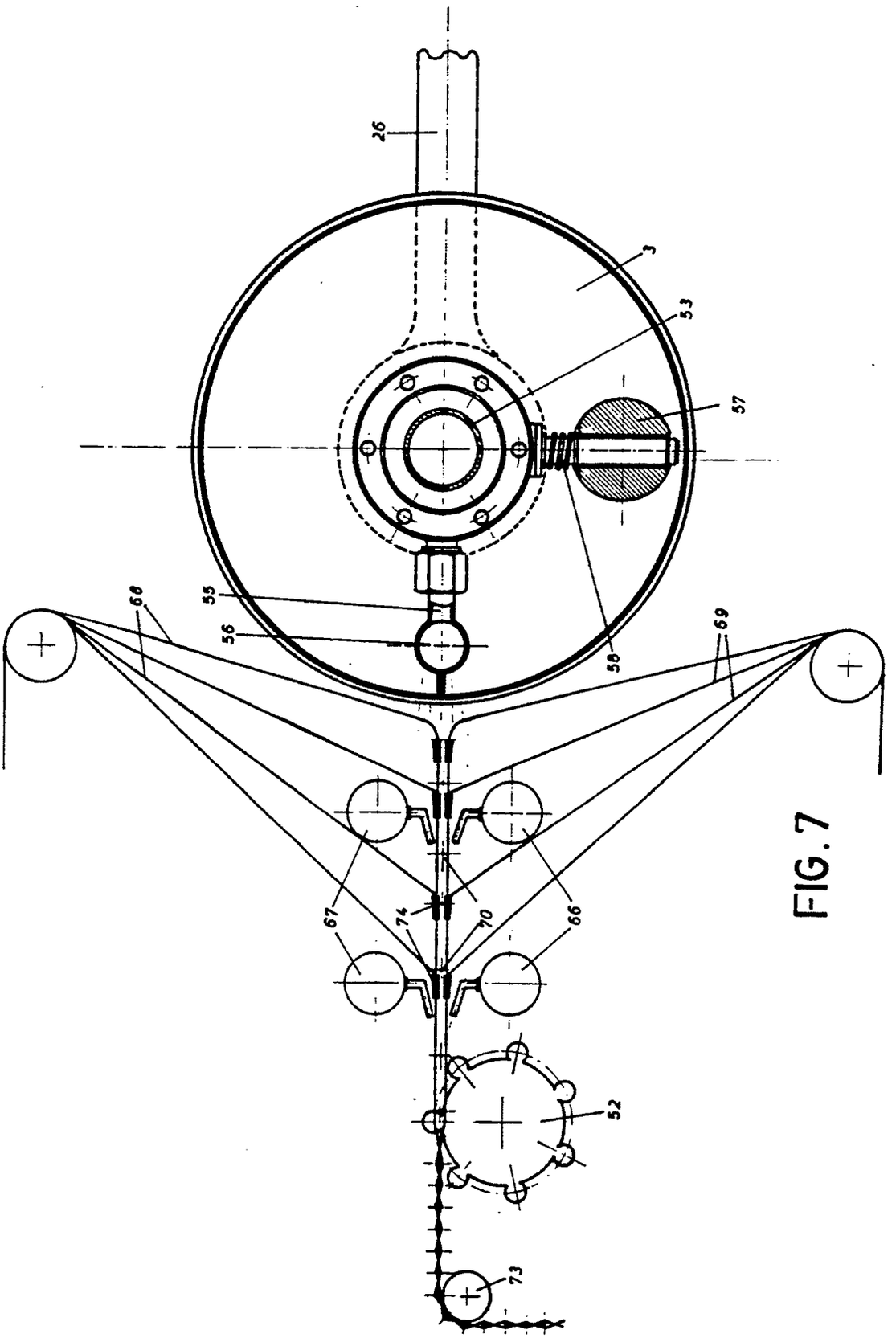



FIG. 7

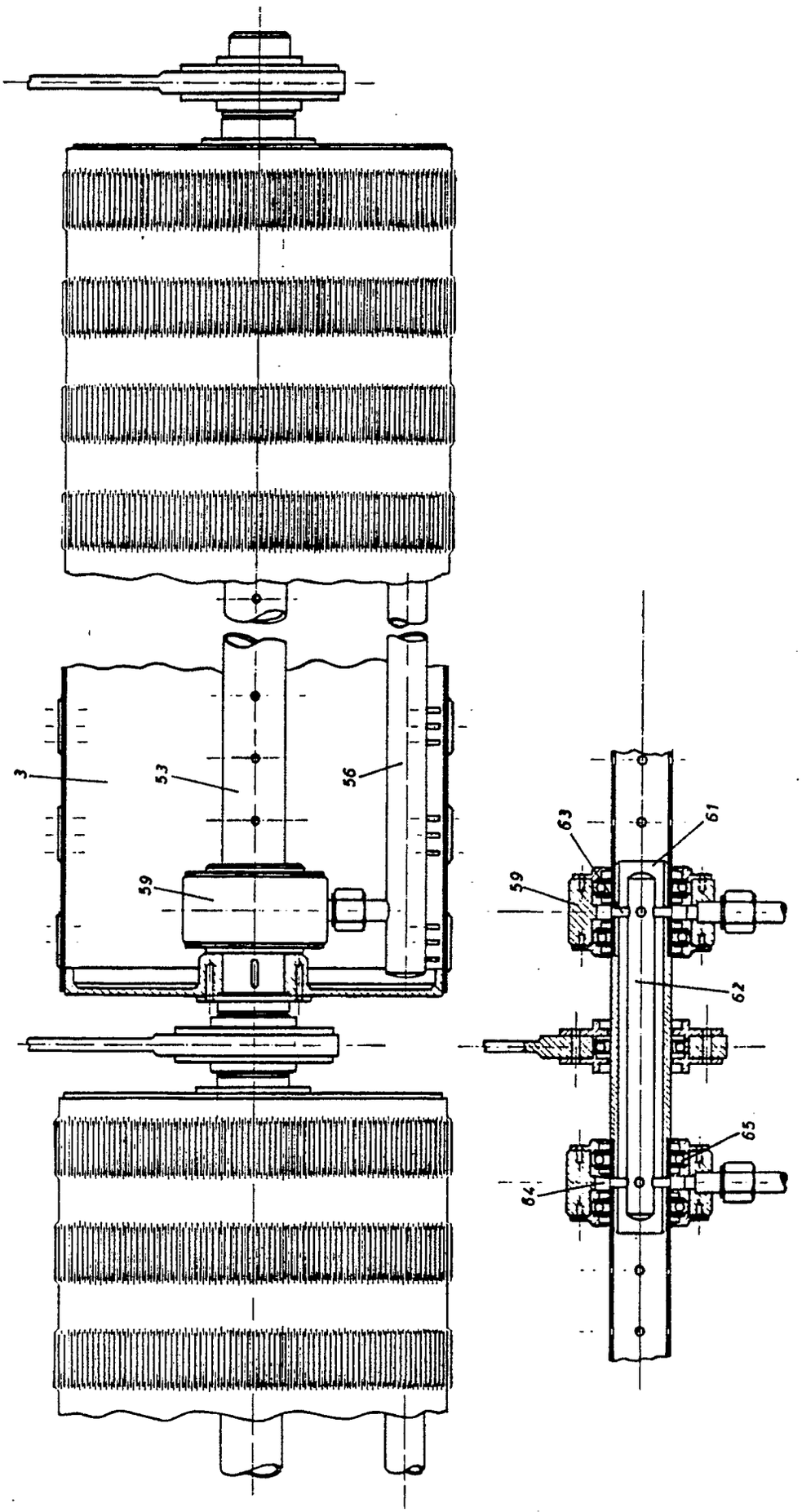
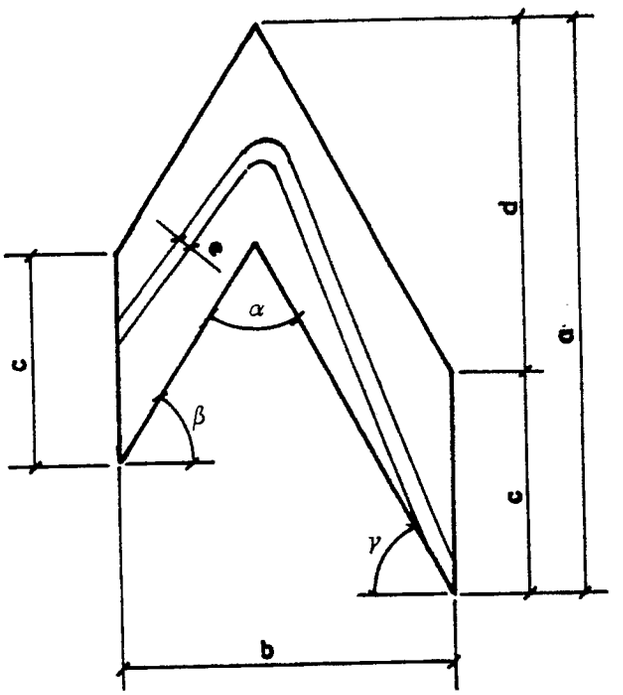
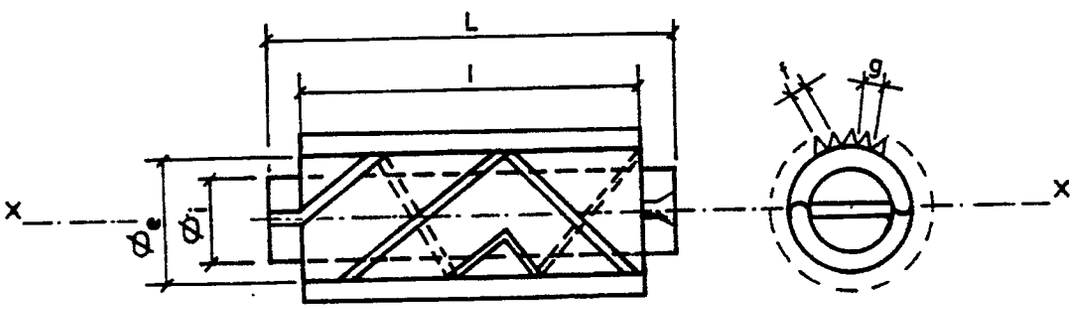



FIG. 8



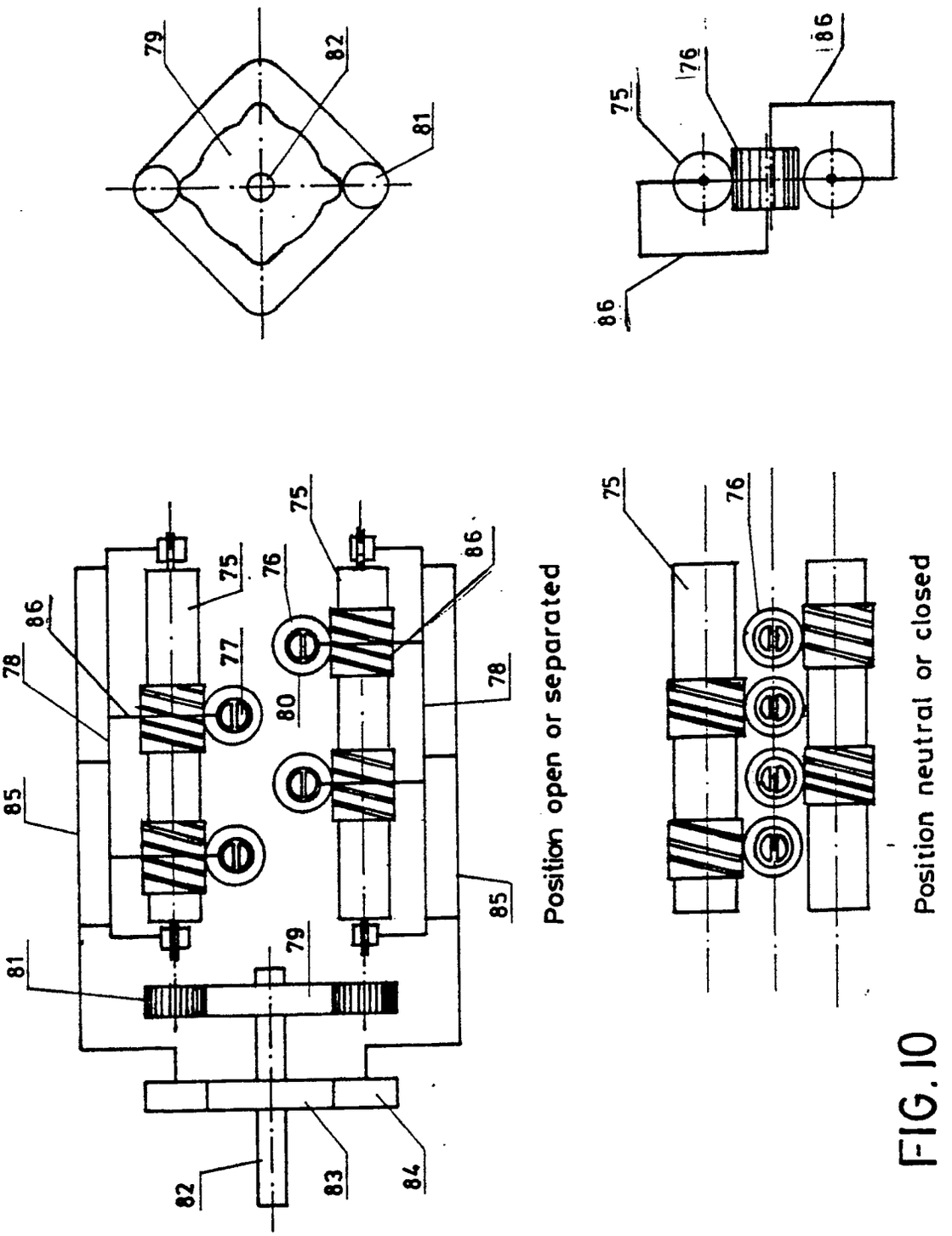

9.1




9.2

9.3

FIG.9


79
82
81
75
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78
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85
81
79
82
83
84
Position open or separated
75
76
Position neutral or closed

FIG. 10

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number

EP 90 11 1349

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5) |
|---|---|---|---|
| A | US-A-3 636 986 (LANGLEY ET AL.)<br>* the whole document * | 2-5 | D 03 D 41/00<br>D 03 C 13/00 |
| A | CH-A-5 436 21 (RÜTI AG) | | |
| A | GB-A-2 115 021 (OSTOYA ET AL.) | | |
| A | US-A-2 392 489 (MARTIN) | | |

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D 03 C
D 03 D

The present search report has been drawn up for all claims

| Place of search | Date of completion of search | Examiner |
|---|---|---|
| The Hague | 24 May 91 | REBIERE J-L. |

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same catagory
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T: theory or principle underlying the invention

E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document