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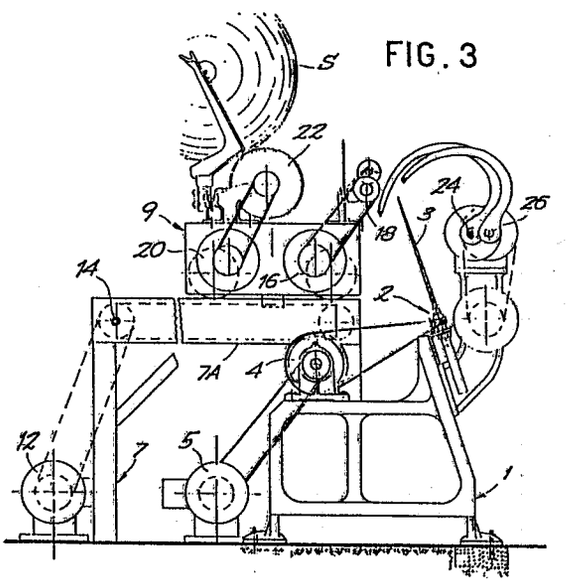
(54) Actuation and control system of an intermittent (selfacting) spinner.

(57) A system for the actuation and control of a selfacting spinner, comprising: a central microprocessor unit (CPU), which receives and processes the information relative to the execution of the process; individual peripheral adjustment modules which hold or not hold single processors, for one or several members provided for: the actuation of the spindles (3); the actuation of the mobile bench (9) of the supply; the actuation of the cylinders (18); the actuation of the rove-feeding drum (23); the actuation of the winding rod; the actuation of the counter-rod.

FIG. 3



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Description

"ACTUATION AND CONTROL SYSTEM OF AN INTERMITTENT (SELFACTING) SPINNER"

With the present-day state of art, the motion of the main members of the spinner is generally effected by means of three electrical motors: a main motor for the actuation of the spindles; a second motor which operates - through mechanical connections - the pirns-holder bench (and/or the spindles-holder bench), the cylinders and the feeding drum, the group for the actuation of the rod and counter-rod; a third electrical motor - possibly double-acting - which drives the rod and the counter-rod rotation, during the subwinding phase at the end of the spindle take-up. The various phases performed by the above mentioned actuation means are synchronized by electronic and electro-mechanical equipment. The positioning of the winding rod at the beginning of the needleful winding is driven, for example, by a pneumatic piston.

Also independent actuation means are known from the prior art, having variable-speed motors, for the shaft of relative displacement between the pirns-holder bench and the spindles-holder bench, and for the shaft which operates the feeding cylinders.

For the most part of the actuation and drive members, connections and transmissions of generally mechanical type are employed, mostly adjustable with the machine being at a standstill.

The present invention refers to a system for the actuation and control of a selfacting spinner, capable of simplfying the mechanics, rationalizing the controls and sequences, reducing dead times and improving the product features.

Substantially, according to the invention, a system is provided for the usage of a central processing unit (CPU), which receives and process the information relative to the process execution and, in particular, controls and co-ordinates a number of motors and/or actuators, to individually obtain all the motions -translations and rotations that may be even partial - needed for carrying out the whole operation cycle, that is:

A - the spindles rotation;
B - The relative displacement between the pirns-holder bench and the spindles-holder bench;
C - the rotation of the cylinders;
D - the rotation of the pirns-unwinding drum for the feeding;
E - the actuation of the winding rod;
F - the actuation of the counter-rod.

The traditional technology of the intermittent spinning - known per se - is not modified, although optimized; in fact the same procedure is carried out by actuating the above mentioned members in a well defined time cycle by motors and mechanicals groups which determine the time sequence of the motions of the spindles, of the mobile bench(es), of the cylinders, and of the drum for the rod or counter-rod feeding.

A simplification and/or replacement of electro-mechanical driving and synchronization members is thus obtained, among other things, by making use of individual actuation means (variable-speed or other kind of electrical motors), each of them being piloted by a microprocessor unit.

The actuation system in question may comprise a central microprocessor unit and individual peripheral adjustment modules for one or more of members: for the actuation of the spindles; for the actuation of the mobile bench (spindles and/or feeding bench); for the actuation of cylinders; for the actuation of the rove feeding, for the actuation of the winding rod; for the actuation of the counter-rod.

Transducers are provided for picking up the information relative to the instantaneous conditions reached by various members.

The actuation system in question may also comprise optical sight or similar controlling means, for the disposition of the bays of material which is fed to the cylinders and for the consequent corrections.

The actuation members are provided with variable speed - mostly step-by-step and/or variable-speed electrical motors like d.c. motors or other -.

All the adjustments can be made even with the machine in operation.

The invention will be better understood by following the description and the attached drawing, which shows a practical non limitative exemplification of the same invention. In the drawing:

Fig. 1 is a side view of a traditional solution;
Fig. 2 shows a plan view of an embodiment according to the invention;
Fig. 3 shows a side view similar to Fig. 1 of the embodiment according to Fig. 2;
Fig. 4 shows a block diagram.

In the drawing, numeral 1 indicates the structure for a bench 2 - stationary in the example - of the spindles 3, arranged in a row with inclined axes; the spindles 3 are suitably driven, for example by a motor 5, via suitable transmissions, or by individual motors. Numeral 7 indicates a fixed structure forming tracks 7A for the to-and-fro movements of a carriage structure 9 forming the pirns-holder bench for the pirns or beams S; numeral 12 indicates a motorization for a shaft 14 for the movement of group 9. Said group 9 carries a motorization 16 which drives the shaft of the cylinders 18 of a set of cylinders as well as a motorization 20 for a cylinder 22 intended to feed the material of the pirns or beams S, which rest on said cylinder 22, to the cylinders 18. On the structure 1 shafts 24 and 26 are also provided, respectively of the winding rod and of the counter-rod, respectively operated by motors 28 and 30.

The present invention provides for the direct actuation of the above defined shafts 4, 14, 18, 22, 24, 26. The individual actuations may be carried out by utilizing, on each shaft, one or several electrical motors or motor reducers at variable speed like the ones above mentioned (step-by-step motors or other kind of actuation means) and like those herein illustrated, driven through suitable adjustment and

control modules by a microprocessor central unit which is interfaced to input/output peripheral units or devices for data entry and control of the system by the operator.

Substantially the motions of the above mentioned shafts perform the spinning cycle steps: feeding; draft; twist; breaking off or snipping; binding and winding and the subwinding phase at the end of the spindle take-up. These motions are imparted, coordinated and controlled by the microprocessor central unit, which may pass certain functions - according to the circumnstances - to other processors.

By way of example, not to be considered in a limitative sense, the structure of the system is shown in Fig. 4 in a block diagram form.

To the central microprocessor unit 52, the cards are connected for setting the motors, the input/output peripheral units (keyboard, video unit, printer, etc.), the store modules and the transducers which detect the shaft movements; store units are indicated by 54, parameter-insertion units by 56, output units (video, printer) by 58.

The system of Fig. 4 may comprise a single microprocessor, in which case the data processing is concentrated on the central unit 52, or a central microprocessor 52 and other processors which lead to adjustment cards or modules 60, 62, 64, 66, 68, 70. In this case the processing tasks are divided between the central unit and the other processors. Each adjustment module is generally able to actuate and/or control one or more shafts and hold one or more processors. For example, an operating version - always with reference to Fig. 4 - may provide that the central unit 52 performs the operations in sequence and the adjustment modules perform the adjustment of the individual actuation means. In particular: module 60 controls motor 5 of spindles; module 62 controls motor 12 of the bench; module 64 controls motor 16 of cylinders; module 66 controls motor 20 of the feeding; module 68 controls motor 28 for the winding rod; and module 70 controls motors 30 for the counter-rod. By 5A, 12A, 16A, 20A, 28A and 30A the transducers are indicated being associated to the individual control motors or members to supply return data to the microprocessor 52 and/or to the pertinent processors. The adjustments of the spindles, bench, cylinders, feeding, winding rod may also be made in terms of speed or position. The actuation of the counter-rod takes place, instead, by regulating the torque.

The accomplishment of the various phases of the spinning cycle, with the motion of various members taking place in a predetermined timing cycle, is obtained through the implementation of a program (software) which is physically located in the system's memory supports. The accomplishment of the phases may be controlled on video devices. Program input parameters allow specific working conditions to be carried out.

The working data and parameters, in digital form, can be entered from a keyboard located on the machine or from a linked remote computer; in any case these data are stored on data supports. The working parameters and the monitoring of the machine may be supplied on the machine video and/or printer, or obtained from a remote computer.

The various phases are summarily reported in the following.

The motion of either the pirns-holder bench or spindles-holder bench or of both these benches simultaneously, during the feeding operation, through the shaft 14, is controlled - via software - to permit the adjustment of the variable speed of the bench and of the breaking and acceleration parameters both upon the feed and draft phase, and upon the winding and the bench re-entry, and the variation of the needleful length possibly through the consequent automatic adjustment of the acceleration and breaking parameters. This allows the working parameters to be optimized with consequent improvement of the yarn quality, with respect to what is provided by the existing machines, wherein mechanical devices are provided which allow discrete and little flexibility adjustments to be made while the length of the needleful, that is, the bench run is generally fixed, or can be varied, through complex mechanical modifications.

The synchronization of the feedings between the drum 22 and the cylinders 18, that is, between the groups driven by motors 16 and 20, may also be optimized. On the machines having mechanical adjustments, the control of the cylinders is derived from the mobile bench movement through a mechanical transmission (chain or the like) which ensures also the perfect synchronism; the feeding drum is actuated by the cylinders shaft, and the peripheral speed thereof, with respect to that of cylinders, is now adjusted by hand through a mechanical variator and, usually, at each change of the lot of material. On the contrary, with this invention it is possible to perform this adjustment through the keyboard, or resist the speed ratios (stored values), utilized in previous workings of similar material, with significant regulation and variation elasticity, even during the working phase.

In a feasible embodiment, an automated control of the synchronization between the drum 22 and the cylinders 18 is realized by means of sights - especially optical sights - by which it is possible to evaluate the arrangement of the mean bay of the roves between the drum 22 and the cylinders 18 in order to control, in one direction or the other, the peripheral speed of the drum in order to correct said arrangement so as to keep it between the two sights.

As far as the draft phase - operated according to the invention by shafts 14 and 18 - is concerned, the prior systems, during the output phase of the bench or benches, allow to obtain step-by-step adjustments among three draft conditions; by operating the two electro-mechanical clutches held in the machine head it is possible to obtain: nul draft, partial draft according to predetermined transmission ratios, and total draft.

According to the invention, the entry of the draft parameters from the keyboard allows determined draft functions to be anyway combined and the values and extension thereof to be adjusted up to cover the whole length of the needleful (draft and

counts data relative to the rove and the yarn). For draft conditions of recurrent usage, several suitably classified configurations may be programmed, that can be recalled through the keyboard by means of codes. Besides, it is possible to program the draft function from the keyboard by supplying draft data in a discrete number of points along the bench run and supplying the work parameters (input and output counts, number of twists inserted, etc.). A correction factor possibly allows to automatically adjust the total draft and the count.

As far as the twist phase is concerned, till now the maximum rotation speed of the spindles causing such twist is reached after a time which is set by the operator. With this invention, it is possible to regulate the rate of the twists insertion in a quite generalized fashion, as well as to compute their number according to different measurement systems. It is also possible to eliminate the present-day device for the twists computation as this parameter is set from the keyboard together with the cycle parameters and is made available in real time on the output units (54 and/or 58 or other).

Upon completion of the twist phase, with the mobile bench(es) being at the position of maximum opening or at the successive one for the winding, it is possible, according to the invention, to resort, in a flexible way, to various expedients which are usually required in the working of yarns having different characteristics such as, for example:

- an auxiliary rove supply, to compensate for the needleful shortening due to the twist, through the actuation of the shaft 18 and the cylinder 22;
- a partial re-entry of the mobile bench(es) through the actuation of the shaft 14 that is through the motor 12, with the bench run and the intervention time being adjustable;
- an auxiliary rove supply during the re-entry of the mobile bench or benches, in the winding phase, in order to avoid a possible excess of twists concentration towards the feeding cylinders, due to the rubbing action of the yarn against the thread-guide, with a synchronized actuation of shafts 14, 18 and 22.

During the breaking off or snipping phase (obtained through the manoeuvres of spindles 3, or rod 24 and counter-rod 26) a perfect synchronization of the rotation reversal of the spindles, as well as of the motion of the rod, is necessary in order to respectively unwind the false-winding turns on the spindle and to position the rod exactly at the starting point of the winding, while the motion of the counter-rod causes the yarn portion released by the spindle to be recovered. Till now, the rotation of the spindles is caused by the same motor which provides for their control upon the twist phase, while the motion of the rod is operated by a mechanical or mechanical-pneumatical system. According to the invention, instead, in the range of the computerized control of the various phases of the machine cycle, both the spindles rotation imparted to the relevant motor, and the rod motion derived, according to this invention, from the proper variable-speed motor 28, are committed to the central unit; the motor 28 is capable of carrying out, in addition to this snipping phase, also the remaining movements of the rod 24 during the successive winding phase, as well as during the subwinding phase.

As far as the winding phase is concerned, the machines now present on the market utilize, in general, mechanical systems which do not permit the spool formation parameters to be varied but through complex modifications. The cone-forming turns are distributed on the spools according to a rod motion which is defined by the profile of a stick (that is pipe) or "core"; the speed of the spindles has to compensate for the radius variation of the spool winding and the speed variations of the mobile bench(es).

The variation of the spindle speed on the machines of present-day is controlled by the so-called sector -mostly electronic or the like - piloted by an encoder located on the counter-rod. Substantially in this invention, substantially, the function of controlling the spindles speed during the winding may be committed to the central unit by detecting the counter-rod position signal.

According to the invention, the flexible, computerized and independent operation of the motion parameters of the spindles, of the bench and of the rod, allows different and thus more suitable shapes of spools to be achieved (conical, cylindrical, and other shapes), and also the multi-layer spool taper and shape to be easily modified. Owing to the re-entry motion law of the mobile benches, the height of the cone, the count of the output yarn, the tension on the yarn and the spool diameter, the system according to the invention permits to determine both the displacement law of the rod (by adjusting the increase of the starting point of the winding during the spindle take-up), and the turns distributing during the winding.

According to the invention, the functions of the counter-rod remain those of adjusting the yarn tension and recovering the same yarn during the breaking off or snipping. In the solution according to the drawing, the counter-rod may be actuated in such a way as to limit and/or compensate also for the torsional deformations. It is a preferential solution that the counter-rod operation is committed to a plurality of variable-speed electrical motors, distributed along the machine front as to limit the torsional deformations and make the spool formation uniform in the various spindles; in this way, the known drawbacks that can be found on the machines of present-day are reduced or eliminated and also the differences in the compactness of the spool between the start and end point of the spindles take-up are, at least in part, narrowed.

The regulation of said motors is made by keeping the torque constant, that is, by continuously regulating -during the spindle take-up - the tension of the yarn.

The winding rod may be operated by one or several motors so as to reduce - also in this case - the torsional deformations and optimize the spool formation.

The re-entry of the bench is achieved, in the example of the drawing, by the shaft 14 and the motor 12. The lightenings of the bench facilitate the

movements thereof while improving the machine performance. Where special yarn quality requirements makes it preferable to lower the re-entry speed of the bench (and thus of the winding) below the values pertinent to maximum productivity, this is achieved by suitably setting the speed-variable motor for the control of the mobile bench.

As for the subwinding phase at the end of the spindles take-up, in the present-day machines one or several electrical motors are utilized for the simultaneous actuation of the rod and counter-rod by means of a mechanical device; the rod is so positioned as to wind the yarn under the tube, while the counter-rod is positioned at middle height. The use of independent actuation means - with the programm operable according to the invention - on said two shafts, allows the actuation means relative to the shafts 24 and 26 to be driven during the subwinding phase by recalling suitable subroutines.

The advantages of the system according to the invention will be apparent to those skilled in the art. In particular, the following advantageous features are of importance:

1) - the broadening of the performance range that can be achieded by the machine owing to the flexibility allowed by the independent computerized drive of the individual shafts, with better quality of the yarn and steadiness of the work parameters;

2) - increase of productivity owing both to the greater potentiality of some phases, and the reduction of the idle times for stops, repairs, adjustments and setting-up;

3) - utmost simplification and lightening of the mechanical part;

4) - possibility of performing a machine monitoring to obtain all the information relative to its working (output, count, speed, twists, draft, etc.) and to its efficiency;

5) - reduction of overall dimensions;

6) - reduction of errors upon the setting of data and the adjustments, and possibility to accomplish them even with the machine in operation;

7) - capability of machine self-diagnosis;

8) - possibility of pre-setting work conditions, already utilized in previous lots of similar materials, in an automated manner (by storing the work parameters into memory);

9) - interfacing the central unit of the machine with a computer able to manage the spinning process being in production.

It is understood that the drawing shows an exemplification given only as a practical demonstration of the invention, as this may vary in the forms and dispositions without nevertheless departing from the scope of the idea on which the same invention is based.

Claims

1. A system for the actuation and control of a selfacting spinner, characterized by the utilization of a central microprocessor unit (CPU), which receives and processes the information relative to the execution of the process and, in particular, controls and coordinates various motors and/or actuators, in order to obtain the motions - displacements and/or rotations that may be even partial - needed for carrying out the whole operating cycle, that is:
the spindles (3) rotation; the relative translation between pirns-holder bench (9) and spindles-holder bench (1); the rotation of the cylinders (18); the rotation of the pirns-unwinding drum (22) for the feeding; the actuation of the winding rod; the actuation of the counter-rod.

2. Actuation system according to claim (1), characterized in that it comprises a microprocessor as a central unit and individual peripheral adjustment modules which hold or not single processors, for one or several members provided for: the actuation of the spindles (3); the actuation of the mobile bench (of the spindles and/or the supply); the actuation of the cylinders (18); the actuation of the rove-feeding drum 22); the actuation of the winding rod; the actuation of the counter-rod.

3. Actuation system according to claims 1 and 2, characterized in that it comprises position, speed and force transducers to transmit information, about the conditions instantly reached by the various members, to the microprocessor.

4. Actuation system according to the preceding claims, characterized in that it comprises means - as optical sights or of similar type - for the control of the bays situation of material which is fed to the cylinders.

5. Actuation system according to claims 1 and 2, characterized in that it comprises actuation members consisting of step-by-step electrical motors and/or variable-speed electrical motors.

6. Actuation system according to the preceding claims, characterized in that it comprises devices able to modify the work parameters even while the machine is in operation.

7. Actuation system according to the preceding claims, characterized in that it comprises independent motions of the pirns-unwinding drum, the rod and the counter-rod.

8. Actuation system according to the preceding claims, characterized in that it comprises programmes that can be inserted for carrying out different types (cylindrical, conical or of other types) of winding.

FIG. 1

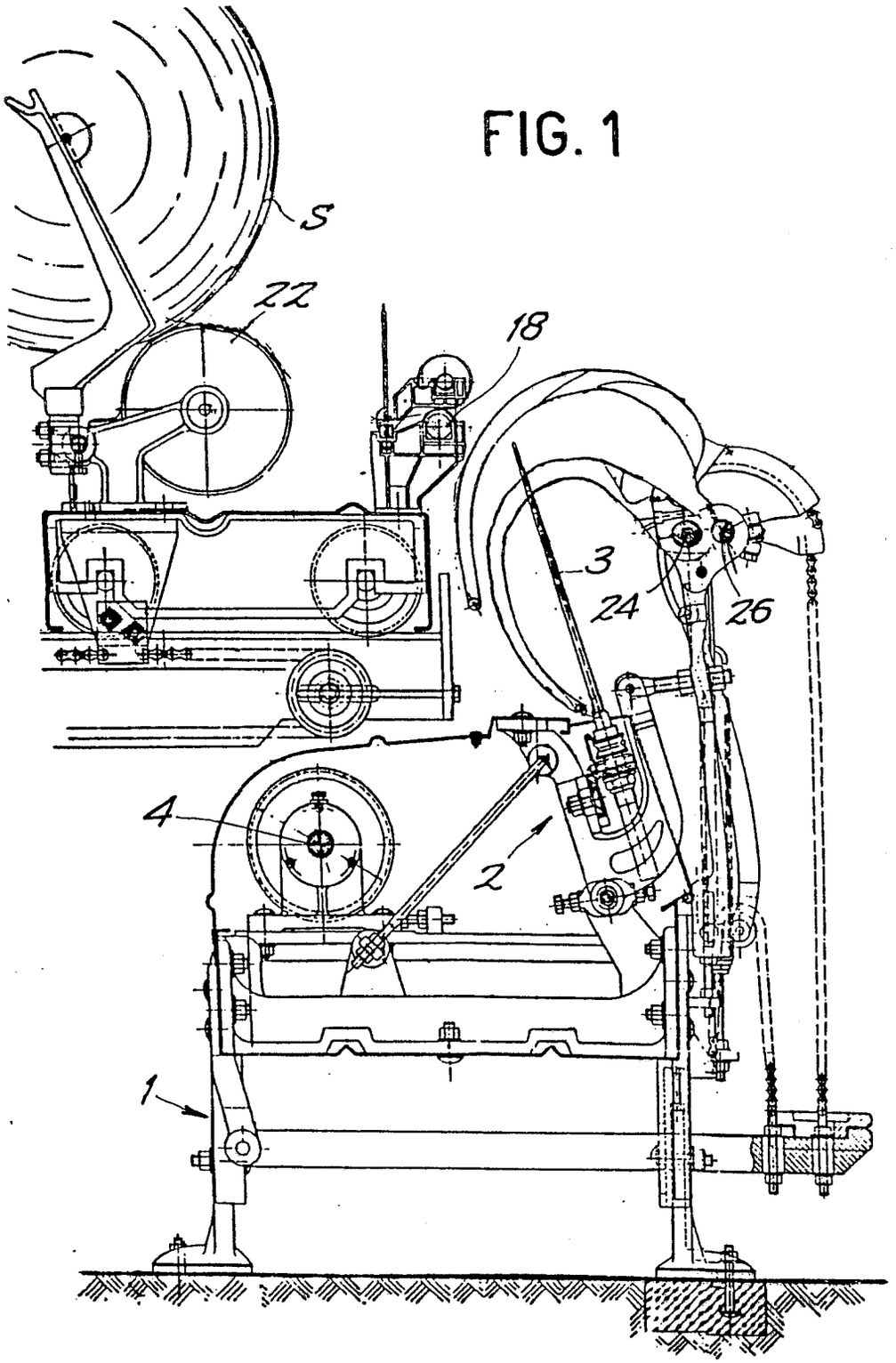

FIG.2

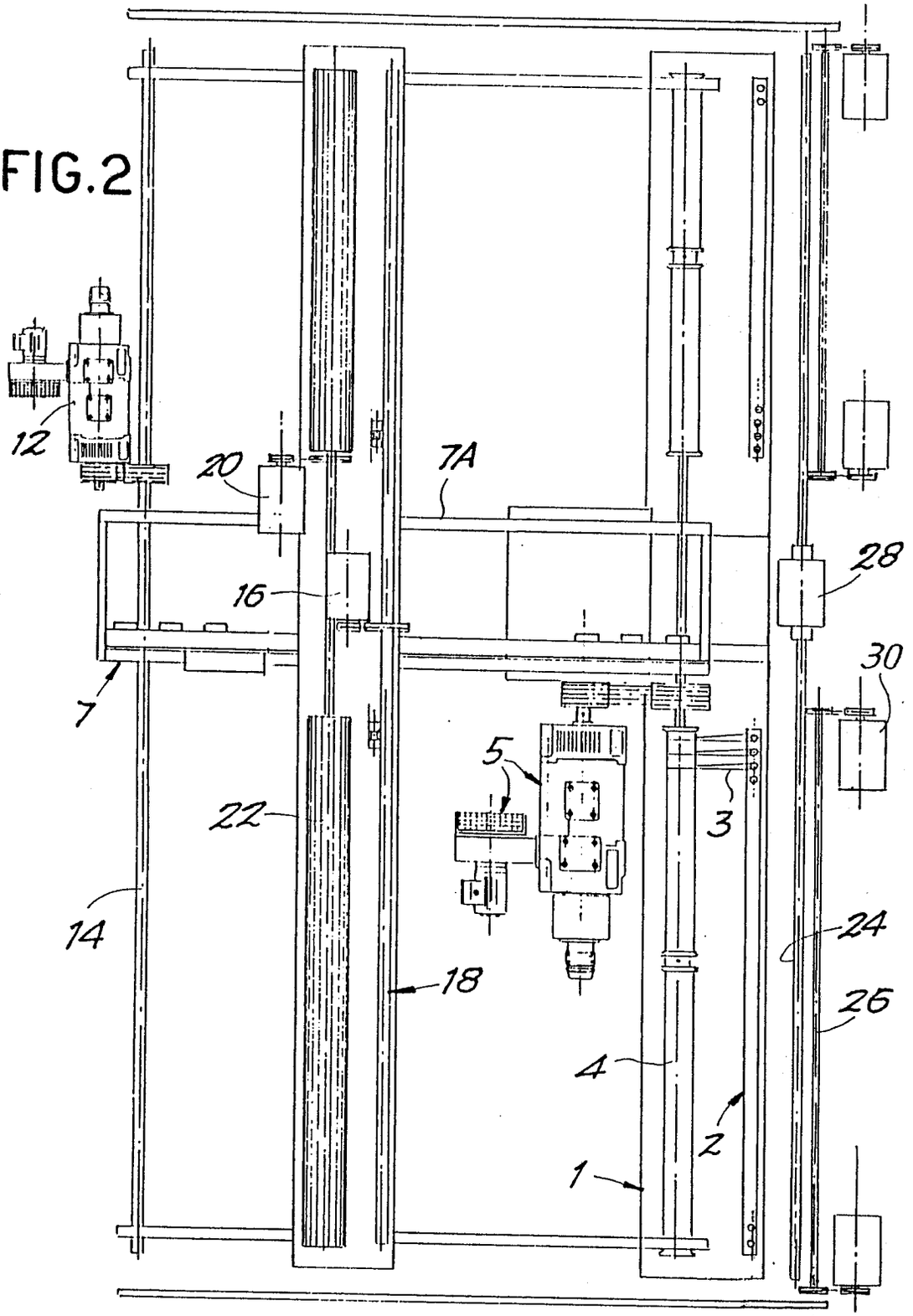

FIG. 3

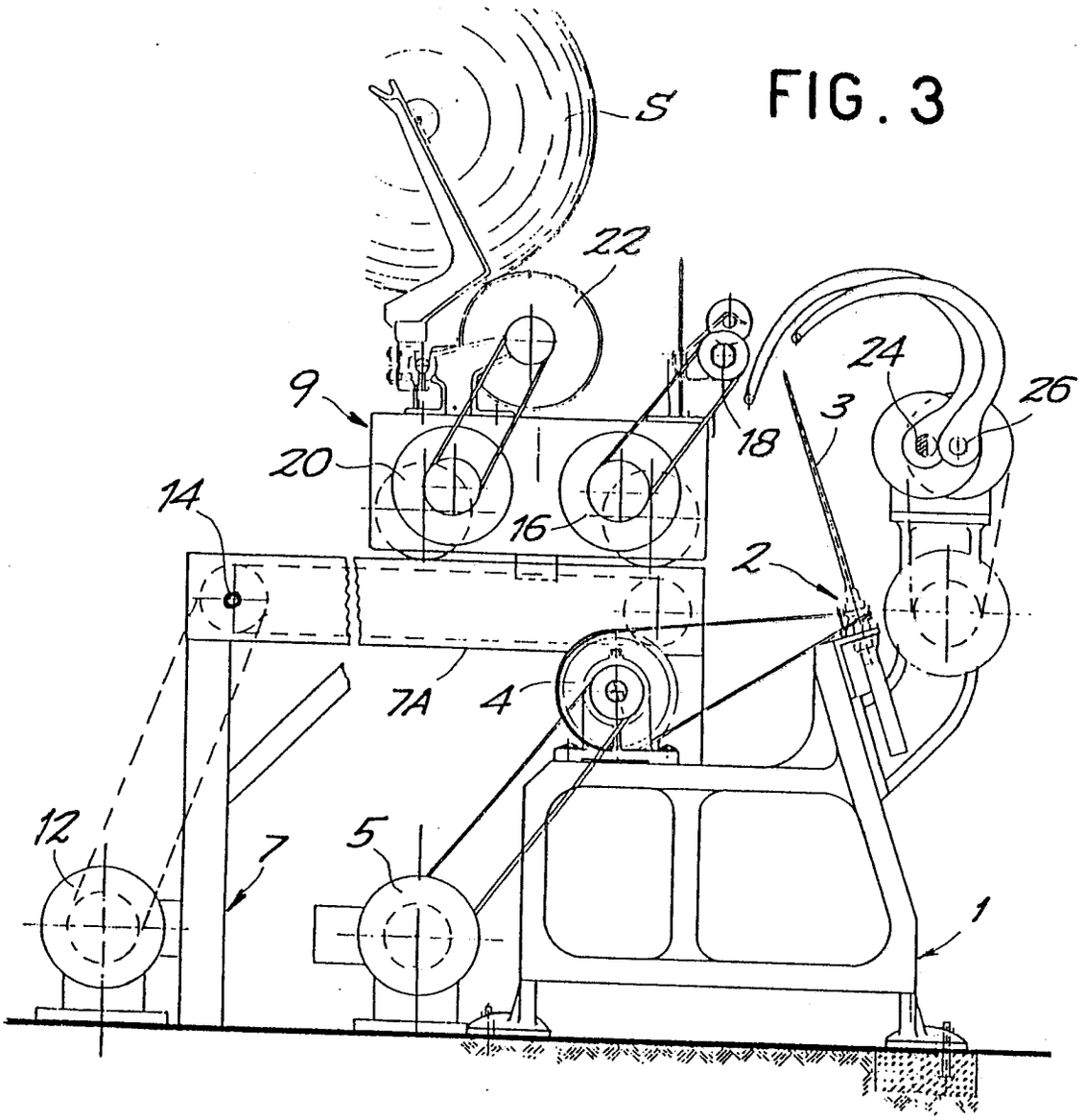

FIG. 4