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(54) COIL UNWINDER

(71) I, ENRICO LAMPERTI, an Italian Citizen, of 4 Via Ercole Ferrario, Gallarate, Varese, Italy, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to coil unwinders.

Driven coil unwinders already exist in the present state of the art, but these known devices are generally fixed and made specially for a single machine or for a single type of machine. Machines which work filaments or wires, strips, and thin sections are many and varied, both in the field of machine-tools for working metals, and in the field of machines for processing plastics materials. Also, one and the same machine can be adapted to handle varieties of materials and dimensions of wires or other strip-form material such as to require the provision of coil unwinders of different specific characteristics to operate therewith. In general, therefore, it is true to say that each type of coil unwinder hitherto in existence has been suited to a single specific use and when used differently therefrom inevitably displays disadvantages.

A first disadvantage arises from the fact that the coil is normally located at a relatively high level with respect to the ground. This can result in uneven paying-off movement of the thread or wire, abnormal stressing of a coil supporting platform of the device and displacement of a base of the device on the floor. To avoid this, previously the base was fixed to the ground or else heavy objects were put on the base in order to increase the stability thereof.

In the known coil unwinding devices the base carries directly a reduction gear unit and this carries, directly, the coil-carrying platform or plate. Structures of this type have the disadvantage that the components of the reduction gear are directly affected by the unbalancing stresses.

Also, the known coil unwinding devices lack mechanisms for straightening the thread or wire; on the contrary such mechanisms are generally arranged as accessory equipment to the subsequent machine-tool for working the thread or wire. This complicates control of the wire downstream of the straightening mechanisms so that the wire has been able to enter the machine in imperfect condition.

Furthermore in the known coil unwinding devices, the suspension members for the portion of the coil just leaving the device and being fed to the subsequent machine, which suspension members also comprised sensors or controls for causing start-up and stoppage of the coil, have disadvantages which make the starting and stopping of the coil-unwinding device untimely and imprecise.

Also, the conventional coil unwinding devices, being static structures, have to be provided with means for connecting them up to the frameworks of the subsequent machines.

According to the invention there is provided a coil unwinder comprising a frame; a support means rotatably mounted to said frame and adapted to carry the coil; means carried by said frame for rotatably driving said support means so as to unwind said coil; guide means carried by said frame for guiding the portion of material being unwound from said coil and leaving the coil unwinder, said guide means comprising a first guide having a slot which extends radially with respect to the axis about which said support means is arranged to rotate, and through which said portion can pass, a second guide engageable with said portion of coil material and movable radially with respect to said axis, and biassing means for causing said second guide to urge the portion in said slot radially outwardly; and ground-engaging means carried by said frame on which the unwinder can be transported.

The coil unwinder of the preferred embodiment described below has a number of additional features which contribute to obviating or reducing at least some of the disadvantages described above, and provides a versatile device suited to a very wide range of different uses. This versatility, combined with the mobility of the coil unwinder of the preferred embodiment, permits the latter to be used in conjunction with any of a number of machines of a plant, and confers on the device itself great adaptability or flexibility.

As regards stability, in the device of the preferred embodiment, the bearing structure is a frame which directly supports substantially all of the components of the device, and the weight and dimensions of the structure are such that, when resting on the floor, it provides the necessary stability for normal operation. To shift the device from one place to the other, there is provided a set of at least three wheels, at least one of which is preferably self-orienting, the set of wheels preferably being retractable. There may be provided a handle capable of assuming two positions in one of which it is disposed close to the frame of the device and in the other of which it juts out in the manner of a tiller, movement of the handle to its jutting-out position causing relative downward movement of an under-carriage carrying the set of wheels, thereby to raise the frame clear of the ground and transform the device into a trolley or carriage which is displaceable manually and which can be steered by the handle.

In the preferred embodiment a speed reducing gear unit is firmly fixed to the wall of the frame, and both a transmission member for transmitting drive, and a coil-carrying plate which receives it are firmly supported by respective supports integral with the frame, whereby each component is subjected only to directly-applied stresses and not also to indirect stresses.

In accordance with the preferred embodiment of the present invention, the coil unwinder comprises means for straightening the wire or strip material leaving the coil, so as to allow better control of the material.

Further, the guide means of the coil unwinder of the present invention is an improvement of those of the prior art. The guides may have rollers to make them more tractable and less subject to wear. Various alternative types of guide means are described below.

The preferred embodiment is provided with an improved servo-mechanism which is arranged such that not only are signals supplied for starting and stopping a motor which drives the coil-supporting means, but these signals are proportional to the extent or magnitude of the displacement of a sensor of the servo-mechanism, and are transmitted to a motor, which may be a direct current motor, and cause timely and gradual adjustment or adaptation of the position of the coil in response to the demand for thread or wire from the user machine, thereby substantially minimising the machine stresses.

The preferred embodiment of the invention is also provided with a wire-winding device which permits selective manual operation of the unwinder.

In the preferred embodiment, the entire transmission between the motor which, as has been described, may be a direct current motor, and the shaft of the coil-supporting plate has been improved. More particularly, the motor transmits drive to the reduction gear preferably by means of a belt, so as not to transmit vibrations to the reduction gear. In its turn the reduction gear transmits its own reduced-speed drive to a vertical shaft, via a coupling, and this latter shaft is coupled to the shaft of the coil-supporting plate by means of an elastic clutch. The motor has a shaft protruding from both of its ends, with one of the shaft ends serving to drive the reduction gear and the other end available to be actuated, when the motor is not being supplied with electrical current, manually by means of a hand-wheel located in a suitable position on the outside of the device.

A preferred embodiment of the invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a perspective overall view of the preferred embodiment of the coil unwinder in accordance with the present invention;

Figure 2 is a schematic elevational view of the transmission members of the unwinder of Figure 1;

Figure 3 is a detailed perspective view of the under-carriage of the unwinder, this having the form of a trolley with a handle installed partly inside and partly outside the frame of the unwinder, the under-carriage and the handle being shown in the positions adopted when the under-carriage has been lowered to enable the unwinder to be moved about;

Figure 4 is a view similar to Figure 3, but showing the under-carriage and the handle in the positions adopted when the under-carriage has been raised;

Figure 5 is a detailed perspective view of a form of guide which can be used in the unwinder of Figures 1 and 4; and

Figure 6 is a detailed perspective view of another form of guide.

With reference to the various Figures of the drawings, a preferred embodiment of the coil unwinder of the present invention comprises a bearing frame 1, a mobility system indicated at 2 for raising the whole device on wheels to permit it to be moved about (Figures 3 and 4), a transmission system 3 (Figure 2), a servo control system 4 (Figure 2), a straightening device 5 (Figure 1), a suspension device 6 for the unwinding wire or other strip material and a cable-winding device 7.

More particularly, the frame 1 comprises a substantially box-like body having a base 11 which is hollow and open at the bottom, and, in the form of a parallelepiped, a column 12 which is also hollow, and an upper shelf or section 13. Secured to the upper shelf 13 is a plate 50 to which a support 51 is fixed, this support 51 being substantially in the form of a "Z" (when viewed in plan) and extending substantially horizontally. Attached to the outer end 51′ of this support 51 are two systems 152 and 153 of straightening rollers, which systems are respectively vertical and horizontal. The base 11 of the frame 1 houses the mobility device 2, a handle 20 of which projects outwardly of the base by way of two slots 12 formed in the base 11 itself. The device 2 is shown retracted or ineffective in Figure 4, and extended or effective in Figure 3. Also in Figure 1 the handle 20 is shown in the ineffective or retracted position, but in this Figure only the handle 20 is visible. Pivot pins 21, 22 and 23 (Figures 3 and 4) emerge from the flank 11′ of the base 11. The pivot pin 21 is fixed horizontally in the base 11 and pivotally mounted thereon are the ends 20′ of the handle 20, which has substantially the shape of an inverted "U", including a handle cross bar 20″. The handle 20 has a pair of upwardly extending arms between which extends the pin 24 to which are pivotally connected the ends of two connecting rods 25 and 25′. These connecting rods 25 and 25′ each have a respective pair of pivot pins 125, 225 and 125′ and 225′, for respective pairs of levers 26, 27 and 26′, 27′, the lever pair 26 and 26′ being pivotally mounted on the pin 22, and the lever pair 27, 27′ being mounted on the pin 23. The middles of the levers 26, 26′, 27, 27′ are fulcrummed on their respective pins 22 and 23, and these levers support, by their other ends, by respective pins 126′, 227′, an under-carriage frame 727, at the four corners of which there are mounted self-orientating wheels 28.

As has been said, the device 2, as shown in Figure 4 is in the position of ineffectiveness with the handle 20 raised, that is to say the handle 20 parallel to the framework 1. By lowering the handle 20, i.e. by moving the handle 20 away from the framework 1, the ends 125 and 125′, 225 and 225′ of the levers 26, 26′, 27, 27′, move in the same direction causing a rotation in the counter-clockwise direction (as viewed in Figures 3 and 4) of these levers 26, 26′, 27 and 27′. More precisely, as is shown in Figures 3 and 4, the levers 26, 26′, 27, 27′ rotate from a position in which they are inclined in one direction (Figure 4) to a position less inclined in the opposite direction beyond the vertical (Figure 3). This produces a substantial force which effects the lowering of the frame 727 and hence the wheels 28 with respect to the base 11 of the frame 1. The reaction force, which occurs at the pins 22 and 23, causes the frame 1 to be raised, and the coil unwinder can then be rolled on the wheels 28 into any position and next to any machine in a plant, simply by pulling on the handle 20. The position of the levers 26, 26′, 27, 27′, as shown in either Figure 3 or 4, is unstable but can nevertheless be made stable by the locking screws 29, 29′.

Describing now the transmission, with reference to Figure 2, a motor 30 is housed inside the column 12 of the frame 1 on a plate 31 which is integral with the frame itself. The motor is powered by a cable 37 connected to a cable winder 70 which carries a coil of windable cable 70′ ending in a plug 77. The motor 30 has a driven shaft 32 projecting from each end of the motor 30. A one end of the shaft while a front clutch 33′ is fixed to pulley 33 is fixed to/the other end. The frontal clutch 33′ faces and is coaxial with a complementary clutch 33″ fixed to the inner end of a pin 34, which can be slid through a wall 18 of a cover 19 which in turn is fixed by means of screws or the like (not shown) to the column 12 of the frame 1. A hand wheel 34′ is secured to the outer end of the pin 34. A compression spring 34″ is mounted around the pin 34 between the wall 18 and the wheel 34′. Normally, and as shown in Figure 2, the frontal clutch 33″ urged away by the spring 34″ and does not engage the frontal teeth of the clutch 33′. However, if desired, the operator can push axially on the hand wheel 34′ in opposition the spring 34″, and cause the teeth of the clutch 33″ to engage with the teeth of the clutch 33′. Naturally this will be done by the operator only with the motor turned off for the purpose of manually rotating the shaft 32 of the motor, by a few fractions of a turn, or by a few turns, in order to synchronise properly the various members of the machine, as is discussed hereinafter.

The pulley 33 of the motor 30 is connected, via a belt 35, to a pulley 35′ of a conventional speed reducer 36 which is mounted on a plate 16 integrally formed with the column 12 of the frame 1. The reducer 36 is of the special type, conventionally known, which rotatably drives a tubular member 36″. The tubular member 36″ is keyed by a member 36′ to a vertical shaft 38 which is rotatably supported on two bearing supports 16′, 16″, secured to the frame 1. The upper end 38′ of the shaft 38 is fixed to a conventional elastic clutch 39 which transmits the rotation from the shaft 38 to a shaft 39′, in a relatively vibration-less manner, that is to say dampening the load stresses and substantially eliminating the vibrations.

The electric cable 37 powers the motor 30 via an electrical connection box 40 which contains a standard electrical circuit on the motor 30. However, the motor 30 is activated only in the presence of a signal which arrives at the box 40 via the conductor 41 from the device 4 which is discussed later on.

The shaft 39′ is journalled in the support 51 and keyed at its top to support means in the form of a coil-carrying plate or platform 52. In the coil-carrying plate 52 there are formed four orthogonal radial slots 52′, from each of which there emerges a pillar 53 (Figure 1) centering the coil 9 of thread or wire 90 to be unwound. Obviously the pillars 53 are each adjustable by a suitable means, not shown, and the pillars 53 rotate integrally with the platform 52. Conversely, all around the revolving plate 52 there is a system of supports 60, substantially fixed, for suspending the leading portion of thread 90 unwound from the coil 9 to be sent to the user machine, not shown. The supports 60 are four in number and their bearing part 61 is substantially "L" shaped with a horizontal side 71′ which is fixed in an adjustable manner relative to the revolving plate 52, via a slot 71″. The threading arrangement of the members which effectively support the portion of thread 90 being taken from the coil 9 depends on the type of thread 90, that is to say on the material and on the shape and dimensions of its cross section, in addition to the removal speed of the thread 90 and the acceptable wear and tear on the members themselves. In consideration of this, the invention has envisaged various solutions designed to conform the machine to any possible use. Thus the support 60 in the position A (Figure 1) has an arrangement suitable for threading threads having a round cross sectional shape and made of soft and elastic material and in which the feeding speeds of the plant machines are relatively slow. Thus the support 60 in a position A is equipped with the simplest threading members.

The support at position B is equipped with threading members so as to minimise the wear on the horiziontal guide member for the thread 90. The support in position C is equipped so as to minimise the wear on the vertical guide member. Naturally the same support can be equipped both with the threading members of position B and with the threading members of position C to minimize the friction and the wear. The support in position D is equipped with a device of the type shown in detail in Figure 5.

Describing now in detail the members which equip the supports A, B, C and D it is observed that as regards the first three they have in common a horizontal radial, loop 62A, 62B and 62C forming a thread-guide and pivotally mounted at one end at 62A′, 62B′ and 62C′. Also in common the supports are equipped with a vertical thread-guide 63A, 63B, 63C, substantially formed by two parallel uprights fulcrumed for radial movement to the tops 63A′, 63B′ and 63C′ of the supports 60. The lower ends 63A″, 63B″ and 63C″ of each vertical thread-guide is coupled to one end of a spring 64A, 64B and 64C whose other end is coupled up to one end of a screw 65A, 65B, 65C loosely and horizontally housed in a hole in the supports 60. Each spring urges the respective vertical thread-guide radially outwardly. Two nuts regulate and engage the screws 65A, 65B, 65C for setting the optimum position of the vertical thread-guide. The thread-guide 62B has two longitudinal rollers 162B which are rotatably coupled around runners for the horizontal thread-guide 62B. In special cases ball bearings can be mounted between the rollers and the runners of the thread-guide 62B. The thread-guide 63C has two vertical longitudinal rollers 163C.

The thread-guide at position D is shown in Figure 5. A support 161 is secured to the support 71 and includes a bearing 261 which loosely bears on a pin 261′ integral with a guide beam 361 jutting out in cantilever manner from the pin 261′. The beam 361 is formed by two guides 361′ and 361″ of substantially triangular cross sectional shape defining a radial slot in which a thread-guide carriage 461 can longitudinally slide. The carriage 461 has substantially an "H" shaped cross section, and is urged towards the support 161 by a compression spring 561 which abuts at its other end against a plate 661 which joins and acts as a closure for the guides 361′ and 361″. The surface of the carriage 461 facing the support 161 has a groove 461′ in order better to guide the thread. Alternatively a rolling member or bearing can be positioned inside this groove 461′.

In the case where the thread 90 is to be unwound from the coil 9 is a strip or ribbon it is expedient to use a thread-guide device of the type shown in Figure 6. This device provides for an adjustable height by means of a support 161 which has a slot 161′ through which a screw 161″ passes. Four guides 662, 662′, 663, 663′ jut out horizontally from the support 161, in the radial direction with respect to the machine. The four guides have substantially an "L" shaped cross section such as to support two sliding seats 664, 665 which carry two coaxial bearings 664′ and 665′. A shaft 666 passes through the two bearings 664′ and 665′ so that a portion of the shaft extends outwardly from each bearing. A spring 667, 667′ is coupled to each end of the shaft 666 and at the other end to a support 668, 668′ which extends on the opposite side of the plate 161 from the thread-guide. At the centre of the shaft 666 there is housed a roller 669 mounted on two bearings which is the member which abuts against and guides the ribbon.

Proceedings now to describe the servo control 4 with reference to Figures 1 and 2, it is seen that it comprises an eyelet 40′ mounted at the top of a rod 41′ which, in turn, is screwed to the upper end of a spring 42 whose lower end is screwed on the upper end of a rod 43. The rod 43 is attached at its lower end to a head 44 which is adjustably mounted by means of a screw on a rod 45 which in turn is slidably mounted in a pair of supports 46, 46′. An orthogonal arm 47 is attached to the end of the rod 45 and includes a pin 47′ at its own lower end to which there is attached the end of a connecting rod 48 in turn attached at 48′ to the end of a lever 48″. The other end of the lever 48″ actuates a pin 49 that acts on a photosensing system 49′ which, through the conductor 41, transmits a signal proportional to the magnitude of the radial displacement of the eyelet 40′ to the electronic circuit 40 which controls the motor 30 actuation.

In order to feed the thread 90 unwound from the coil 9 to a machine (not shown) one lowers the handle 20 and positions the unwinding machine in position next to the user plant machine. Then, by raising the handle 20, one stabilizes the coil unwinder in that position. Then by acting on the handwheel 34′, i.e. by pushing it axially and rotating it the motor shaft 32 can be rotated by small fractions of a turn to rotatably position the platform 52 which carries the coil 9 which is centered thereon by the pillars 53. This manual rotation of the plate 52 makes it possible to thread the end of the thread incrementally through the slotted holes 62A, 62B, 40′, 62C, 461′ and from there between the rollers 152 and 153, thus sending the thread towards the user machine. All the supporting members for the thread and in particular the springs 64A, 64B, 64C and 561 are adjusted so that the thread has to complete the widest possible path. The eyelet 40′ is adjusted so that it supplies the required control signal to the motor box 40 only when the radius of curvature of the leading thread portion is reduced substantially to a minimum. In other words it is desired to maximize the difference between the diameter of the coil of thread when widest which occurs at the end of each unwinding operation and the diameter of the coil of thread when narrowest, which occurs at the start of each unwinding operation. Obviously the maximisation of the coil thread supplied in each unwinding operation decreases the number of unwinding operations required. The special stabilization of the support members of the thread allows the exploitation of the user machines at maximum levels of production.

When all the members are adjusted as said, one supplies current to the motor 30 from the plug 77 which drives the motor 30 during receipt of the position signal from the eyelet 40′ corresponding to a minimum amount of thread 90 available for use.

In practice, it is also possible to arrange for the rotational axis of the machine to be horizontal. This does not entail substantial variations to the construction of the unwinder.

WHAT I CLAIM IS:

1. A coil unwinder comprising: a frame; a support means rotatably mounted to said frame and adapted to carry the coil; means carried by said frame for rotably driving said support means so as to unwind said coil; guide means carried by said frame for guiding the portion of material being unwound from said coil and leaving the coil unwinder, said guide means comprising a first guide having a slot which extends radially with respect to the axis about which said support means is arranged to rotate, and through which said portion can pass, a second guide engageable with said portion of coil material and movable radially with respect to said axis, and biassing means for causing said second guide to urge the portion in said slot radially outwardly; and ground-engaging means carried by said frame on which the unwinder can be transported.

2. A coil unwinder as claimed in claim 1, wherein said ground-engaging means comprises a set of wheels, at least one of which is self-orienting, and means for moving the wheels between first and second positions, in one of which the frame is supported on the wheels and in the other of which the wheels are retracted.

3. A coil unwinder as claimed in claim 2, wherein the means for moving the wheels comprises a lever which, when the frame is supported on the wheels, can be used to steer the unwinder during transportation thereof.

4. A coil unwinder as claimed in any preceding claim, including means for manually rotating said support means.

5. A coil unwinder as claimed in any preceding claim, comprising a sensor responsive to the radial position of said portion of coil material for providing a signal operable to control said driving means.

6. A coil unwinder as claimed in any preceding claim, wherein said first guide comprises a pair of arms defining therebetween said slot, and is pivotally mounted about an axis extending radially with respect to said axis about which said support means is arranged to rotate.

7. A coil unwinder as claimed in claim 6, wherein said second guide comprises a lever having a pair of arms disposed one on each side of said first guide.

8. A coil unwinder as claimed in any one of claims 1 to 6, wherein the second guide comprises a carriage arranged to slide in said slot.

9. A coil unwinder as claimed in any preceding claim, in which the guide means

includes rollers against which the portion of coil material is arranged to engage.

10. A coil unwinder as claimed in any preceding claim, including a plurality of said guide means disposed around the axis about which the support means is arranged to rotate.

11. A coil unwinder as claimed in any preceding claim, including means for straightening said portion of coil material.

12. A coil unwinder substantially as herein described with reference to and as illustrated in the accompanying drawings.

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1578860 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

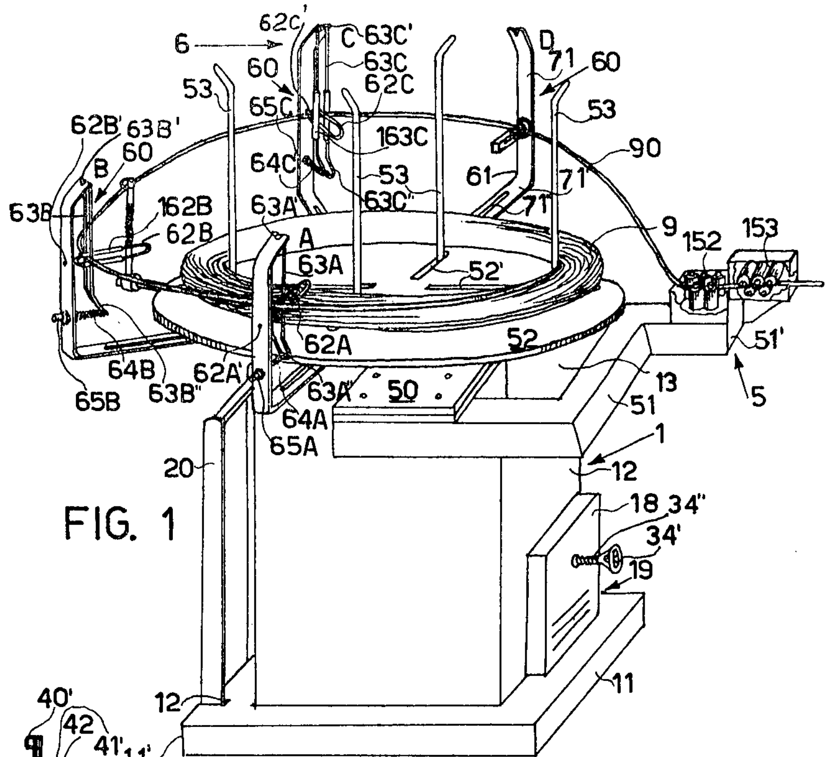

FIG. 1

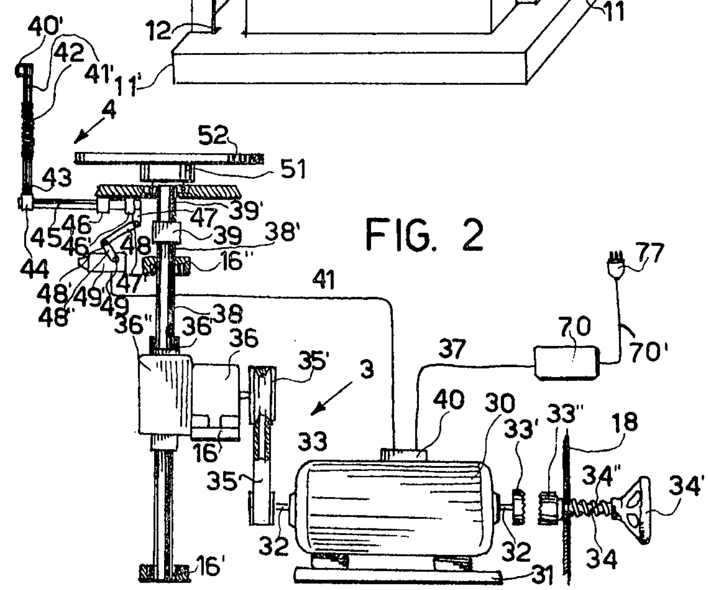

FIG. 2

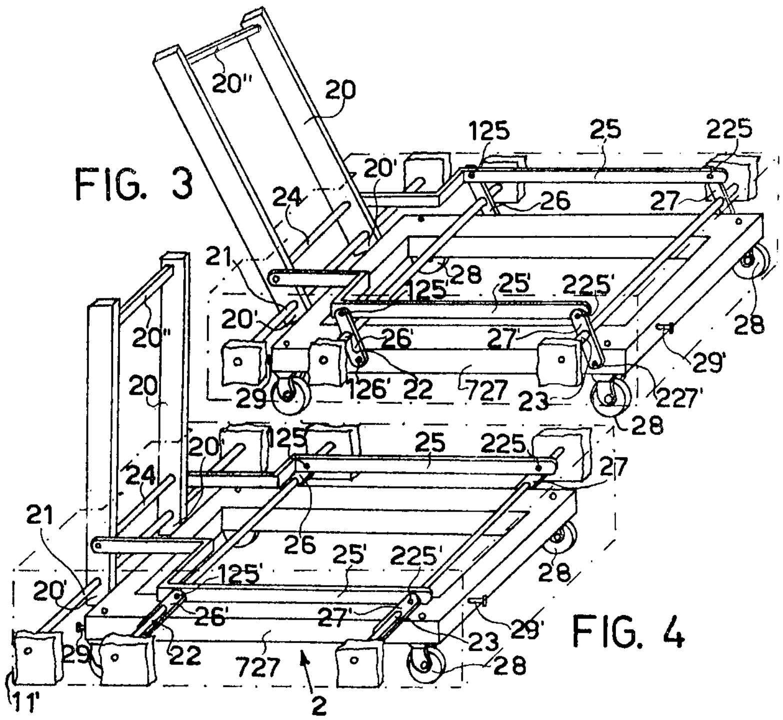

FIG. 3

FIG. 4

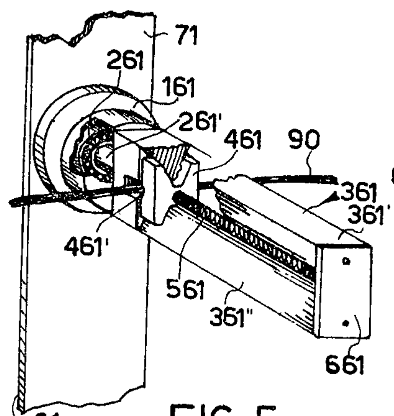

FIG. 5

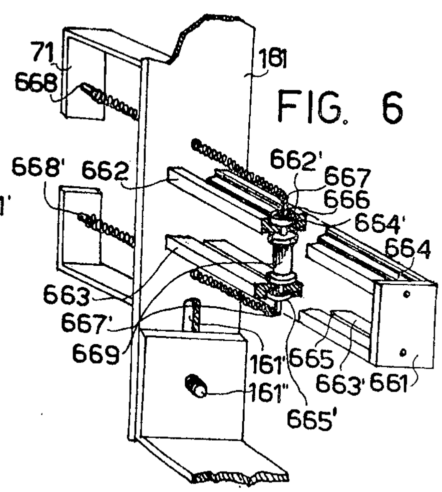

FIG. 6