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54 **Skeining apparatus.**

57 A skeining device has a dedicated computer for monitoring the operation of all its components to provide continual automatic adjustments during operation of the device as well as being pre-programmable to produce different types of skein as required. An angled retainer hook 14 is solenoid operated and controlled by the computer to withdraw when required as well as move towards a rotatable retainer hook 13 during skeining.

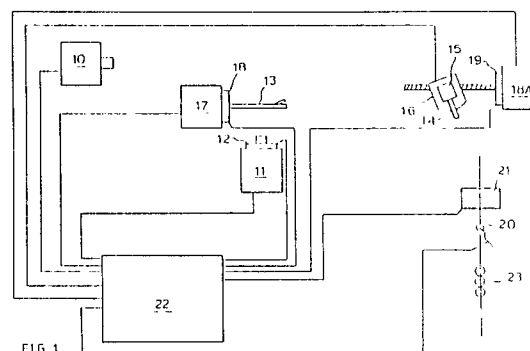


FIG 1.

Description

SKEINING APPARATUS

This invention relates to skeining devices.

The leads to electrical coils, such as solenoid and relay coils, are normally reinforced by being skeined, i.e. multiplexed and then twisted. This procedure is frequently and normally carried out by hand, which is a slow, labour-intensive, unreliable and expensive practice. It may also reduce the efficiency of coil winding which has to be stopped while the leads are skeined.

Automatic and semi-automatic skeining devices are already in use such as those described in UK Patent Specification 2049748B. The present invention relates more particularly to improvements in such automatic machines.

According to one aspect of the invention a skeining device includes a means for controllably feeding wire through the machine, means for multiplexing the wire by wrapping the wire a number of times between retaining members in the apparatus, means for twisting the wrapped wires a number of times to form a skein, and a computer arranged to receive signals corresponding to the passage of wire through machine, signals corresponding to the number of wraps of the wire, and signals corresponding to the number of twists formed in the wrapped wire, the computer being arranged to provide output signals to control the machine drive mechanisms and programmed to control the operation of the device automatically by continually monitoring its received signals and the output signals.

Preferably, the computer is programmed to alter the operation of the skeining device in accordance with the gauge of the wire, and provide output signals which cause different numbers of wraps and twists to be applied in accordance therewith.

In a practical configuration, the skeining device is normally provided as an add-on or as an attachment to a winding machine. Such winding machines can be computer-controlled in which case the computer of the skeining device is programmed to respond to signals from the winding machine computer to vary the operation of the skeining device. As such the operation of the skeining device is controlled to suit what the winding machine is forming automatically. For example, where the size of bobbin coil is changed, the skeining device can be controlled by the computer to respond to a different length of coil winding required as well as the form and strength of skein required for that coil.

Further, based on experience and/or formal design parameters, the computer of the skeining device can be programmed simply to respond to, say, a product identifying code, transmitted by the winding machine, and thereafter form skeins appropriate and best suited to such different products as identified by their codes. This can be carried out as products being formed by the winding machines are changed by the operator of the winding machine without the operator having to give the skeining device any instructions as such.

One of the retaining members may comprise a hook (or spike) mounted on a solenoid plunger which is operable to withdraw the hook to or within the surface of a stripper plate on the underside of a carriage to release a skein after it has been formed while being retained on the hook.

The longitudinal axis of such a hook is usually at right angles to the long axis of the skein but, in accordance with this application, the needle is angled at 10° to 15° in a direction away from the other retaining member and/or at 5° to 8° in a lateral direction to the long axis of the skein.

In some arrangements a number of skeins may be formed on the same skeining device. In that case pairs of retaining members are arranged so that a number of parallel skeins can be formed side by side. Each hook is arranged to be withdrawn by operation of a solenoid plunger and individually operable under the control of the computer. This enables two particular practical functions to be readily carried out. When setting up the skeining machine for multiple skeining only one skeining track can be threaded up and the machine adjusted and run until satisfactory skeining is achieved using automatic computer control of the skeining device and a selected one of the solenoid controls. When this is working satisfactorily the other tracks can be simply set up with the same conditions of feed speeds and wire tensions. Secondly, where bifilar windings are being formed the associated coil winding machine can be arrested so that a single wire, or some but say not all of the wires can be skeined selectively as desired. Such operation can be automatically programmed and carried out for each complete bifilar winding required.

The other retaining member is advantageously itself rotatable to apply the aforementioned twisting to form the skein, as for example described in UK Patent Specification No. 2049748B. In such an arrangement, in accordance with this application, the undersurface of the stripper plate is preferably cut-away from the region around the hook at least to some extent on at least the skein forming side thereof. With such an arrangement the skein can be twisted without the skein contacting the undersurface of the stripper plate or carriage while the wire is twisted right up to the hook where desired.

One of the retaining members is preferably mounted on a movable support which is controlled to positively move the members towards each other as the wires are twisted to form the skein.

A counter may be provided to monitor the rotations of the twists applied to the multiplexed wires and an output thereof used to control in correspondance therewith the relative movement of the retaining members towards one another. This correspondance may be varied according to the gauge of the wire and the number of wraps as required, and the skeining device computer programmed to make such appropriate adjustments automatically.

The movable support may be arranged to reduce the distance between the retaining members after each skein forming operation is completed to facilitate removal of the skein and/or release of the skein from the retaining members as and when required.

A flyer or moving guide is mounted adjacent the wire inlet end of the skeining device with its aperture axis generally at 90° or significantly angled to the general direction of travel of the wire. During simple through-feeding of the wire, that is whenever the skeins are not being formed, the flyer is preferably arranged to be twisted, through say 30° to 40° or more or at least to a position where the wire passes through the aperture without making any or very little fictional contact with the sides of the aperture of the flyer.

The skeining device may have a number, say two to five, tensioning devices for the wire adjacent the wire inlet of the device. Conveniently these tensioning devices comprise one or more discs between pairs of which the wire passes to be tensioned by contact with the surfaces of the discs. The discs are held biased together by respective springs or if suitably orientated biased together as a result of gravity. For such an arrangement, a lever mechanism may be provided which has upstanding wire guides movable in and out from between respective of the tensioning devices in a manner to urge the wire into the spaces between the discs. The guides allow, only when the mechanism is operated, the wire to pass beyond the periphery of respective discs. The lever mechanism facilitates threading of the tensioning devices by enabling threading to be carried out in one operation instead of having to individually thread each of the tensioning devices one at a time.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:-

Fig.1 is a schematic diagram of a skeining device;

Fig.2 is a part-sectioned elevation of a motor and twisting needle;

Fig.3 is a sectioned side view of a rear hook assembly;

Fig.4 is an end view of the rear hook assembly;

Fig.5 is a sectioned side view of a flyer in one operative position;

Fig.6 is a sectioned side view of the flyer in another operative position.

Fig.7 is a plan view of a multiple wire tensioning device; and

Fig.8 is a side view of the tensioning device;

Referring to the drawings, in Fig.1 a skeining device has a wire feed-through motor 10, a multiplexing drive motor 11 having a tachometer 12, two retaining members in the form of a rotatable needle 13 and a rear hook 14 mounted on the plunger of a solenoid 15 carried by a carriage 16. The needle 13 is driven in use by a motor 17 and the rotation of the needle is monitored for relative position and number of revolutions by a counter 18. A carriage drive motor 18A, monitored by a tachometer 19, moves the carriage 16 as required (and explained below)

towards and away from the needle 13. A flyer 20 is positioned adjacent an input for the wire into the skeining device and has two operative positions, see below. A wire gauge monitor 21 and wire tensioner 23 are also provided.

A microcomputer 22 is programmed to control and monitor the operation of the skeining device. The computer 22 receives inputs from the tachometer 12, the counter 18, the tachometer 19, the wire gauge monitor 21 and a wire through-put monitor (not shown). The computer also receives instructions and command signals from another computer (not shown) supplied in use to control the operation of an associated coil winding machine. The computer 22 provides output signals to control the motors 11, 17 and 18A and to move the guide 20. The motor 10 in practice would normally be the coil winding motor, in which case it would not be controlled by the microcomputer 22 as a rule. The computer 22 is programmed to control the skeining device to form skeins as and when required along the length of wire being fed through the device in an otherwise conventional fashion. However, by continually monitoring the operation of each of the device components, running adjustments and compensations are made automatically to maintain satisfactory skeining operations to take place. For example, the number of twists required to form the skein is predetermined by design requirements and as twisting occurs the natural length of the skein shortens. The carriage 16 is driven in use towards the needle 13 to compensate for this shortening. The computer 22 however monitors the twists as they occur via signals from the counter 18 and controls the shortening throughout the twisting by controlling the motor 18A. Further, the computer 22 is programmed to alter the ratio of twists to movement of the carriage according to the gauge of the wire being used to form the skeins and/or according to design parameters as appropriate.

The described computerised skeining machine with its dedicated computer 22 has the ability to preprogram the number of twists, the number of strands, the retraction rate of the carriage 16, the lengths of skeins and to give each different skeining a number. The number enables the user to recall a chosen program by calling up this number. The computer 22 also has the facility of advising the user the preferred program for any given wire gauge. This information is factory programmed and stored in the memory of the computer 22. The described skeining device enables a computer of an associated winding machine to program not only the winding machine but also to give instructions to the skinner computer as and when required. The biggest advantage is that once the winding machine and skeining device have been programmed they act as one and the entry of a single identity or code sets both machines in milliseconds. This is a task which in the past would have taken 4-5 hours.

When more than one computer controlled skeining machine is used, each skeining device may be programmed with different information and operate in a different mode even though working on one winding machine. This is particularly useful when the

skeining devices are mounted on a twelve spindle rotary carousel winding machine where each spindle of the winding machine operates independently. The addition of the computerised skeining device now allows the device not only to operate independently, but to operate independently performing different tasks. It is often the case that multiple skeining devices are used with multiple spindle winding machines where all winding spindles and skeining devices operate in unison. Those winding machines without computers are unable to program the skeining devices. However one skeining device may be programmed and this information transferred to the others thus obviating the need to program each one independently.

In Fig.2, the rotor of the motor 17 is coupled to the needle 13 and the counter and sensor 18 consists of a disc mounted on the rotor and a sensor mounted on the casing of the motor 17.

In Figs.3 and 4, the carriage 16 is supported on a slide 301 and connected via a trapped nut 302 to a leadscrew 303. The leadscrew 303 is connected to the motor 18A (see Figure 1). The rear hook 14 is mounted in the end of the solenoid plunger 15. An electrical coil 304 forming part of the solenoid is connected by a flexible lead (not shown) to the computer 22. Thus, when it is desired to release the skein the solenoid coil is energised and the hook 14 is withdrawn up within the carriage 16.

It will be noted that the longitudinal axis of the hook 14 lies at about 15° to the vertical and rearwards, that is away from the needle 13 in use. Further, the longitudinal axis of the hook 14 is at about 7° to the vertical in a lateral direction (see Figure 4) to the long axis of any skein being formed in practice. The rearward configuration enhances the operation of the skeining device during multiplexing tending to urge the wraps of wire to move to and be concentrated at the crotch formed between the hook 14 and the undersurface of the carriage 16. The lateral configuration assists in this and in particular aids the catching efficiency of the hook 14 as the wraps are laid down during multiplexing, the wire arriving from right to left as seen in Figure 4.

The underside of the carriage 16 is cut-away to some extent to the left side (Figure 3) of the hook 14. As the skein is formed by the twisting the multiplexed wires, the twists can then extend, without interference of the undersurface of the carriage, right up to the hook 14.

In Figures 5 and 6, a flyer or guide 20 is shown in more detail. The flyer 20 is made of ceramic material and is mounted on a pivotable frame (not shown) controlled by output signals provided by the computer 22. Figure 5 shows the relative position of the flyer 20 during each skeining operation. Fig.6 shows the position of the flyer 20 when wire is passing straight through the skeining device for coil forming in an associated adjacent winding machine (not shown). In the position shown in Fig.6 the flyer 20 allows passage of the wire with little or no resistance to its through movement.

In Figs.7 and 8, the wire tensioner 23 consists of three pairs of discs between which pairs the wire passes. The wire is kept between the discs in a

lateral direction by four guide posts 71 to 73 and central posts of each pair of discs. The guide posts are fixed on a bar which is pivotably mounted below the discs and extends along underneath the discs. An operating level (not shown) is provided to rotate the bar and swing the guide posts to the position shown dotted in the Figures 7 and 8. Thus, the guide posts can be swung out of the way of the path of the wire to allow the wire to be threaded between each pair of discs simultaneously. The discs are held together by gravitational forces and additional discs or weights can be added where required to urge the discs together. Biasing springs and the like can be added where required or preferred.

Claims

1. A skeining device including a means for controllably feeding wire through the machine, means for multiplexing the wire by wrapping the wire a number of times between retaining members in the apparatus, means for twisting the wrapped wires a number of times to form a skein, and a computer arranged to receive signals corresponding to the passage of wire through machine, signals corresponding to the number of wraps of the wire, and signals corresponding to the number of twists formed in the wrapped wire, the computer being arranged to provide output signals to control the machine drive mechanisms and programmed to control the operation of the device automatically by continually monitoring its received signals and the output signals.

2. A skeining device according to Claim 1, in which the computer is programmed to alter the operation of the skeining device in accordance with the gauge of the wire and to cause different numbers of wraps and twists to be applied in accordance therewith.

3. A skeining device according to Claim 1 or 2, including a retaining member comprising a hook mounted on a solenoid plunger which is operable to withdraw the hook to or within the surface of a stripper plate on the underside of a carriage to release a skein after it has been formed while being retained on the hook, in which the solenoid is operable under the control of an output signal of the computer.

4. A skeining device according to Claim 3, including a plurality of hook retaining members each having an associated solenoid and each associated with a respective rotatable retaining member for forming a number of separate skeins in the one skeining device, in which each of the solenoids is operable under the control of respective output signal of the computer.

5. A skeining device according to Claim 3 or 4, in which each hook is angled at 10° to 15° in a direction away from the other associated retaining member and at 5° to 8° in a direction lateral to the long axis of the path of a skein.

6. A skeining device according to Claim 3 or 4, in which the underside of each skipper plate is cut-away in a region around the hook on the skein forming side thereof.

7. A skeining device according to any of Claims 1 to 6 in which one of each skeining pair of retaining members is mounted on a movable carriage controlled to move by output signals of the computer during skein forming operations.

8. A skeining device according to Claim 7, in which the carriage is arranged to be moved under the control of the computer at the end of a skeining operation towards the skein to facilitate removal of the skein.

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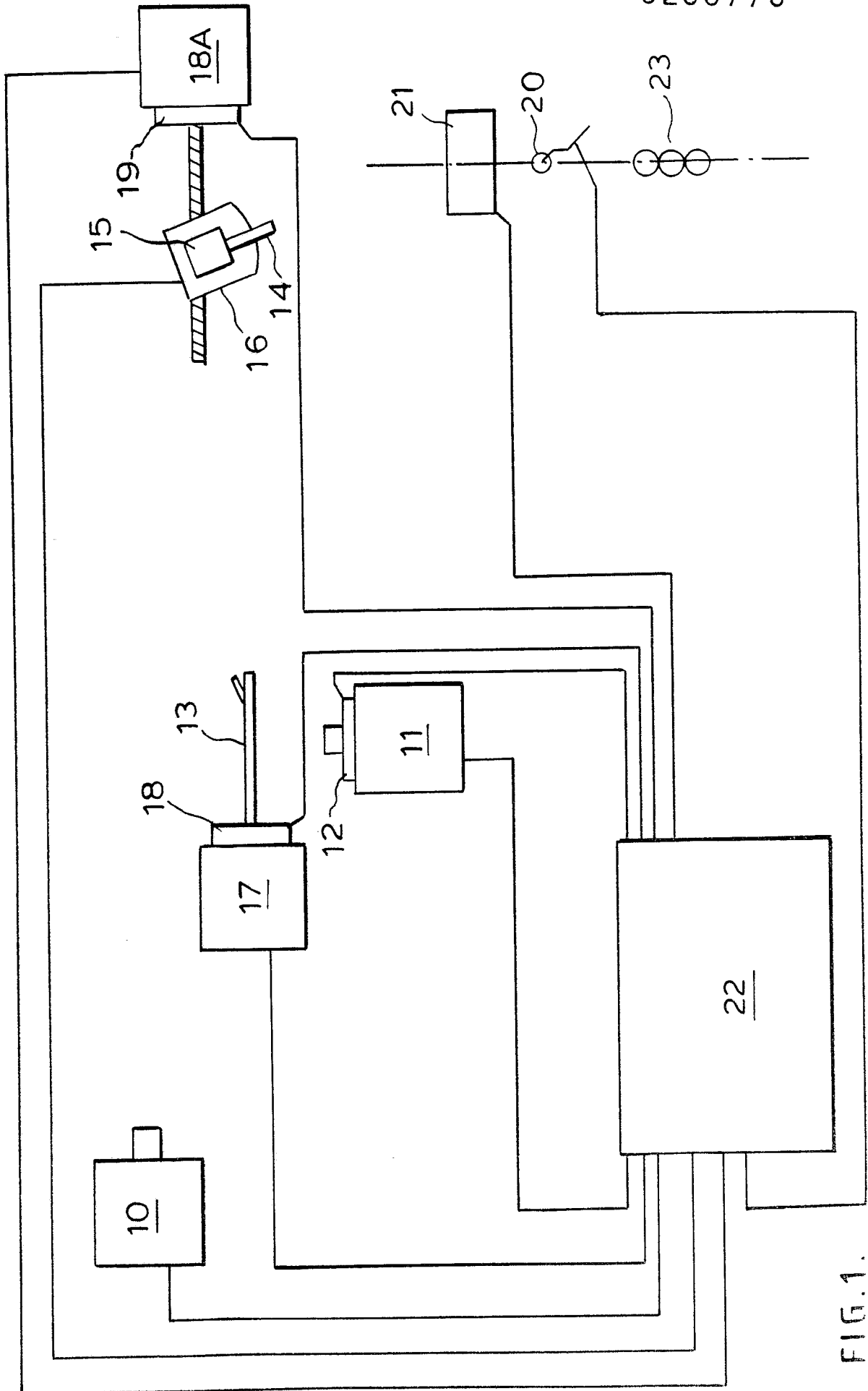
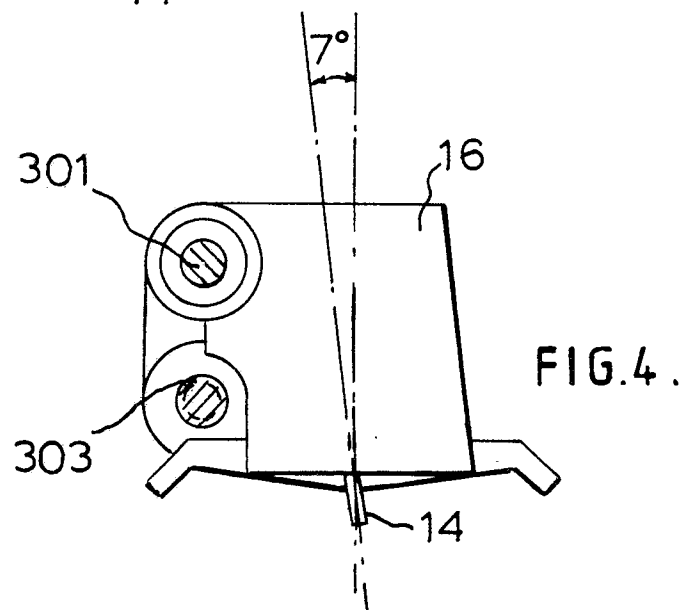
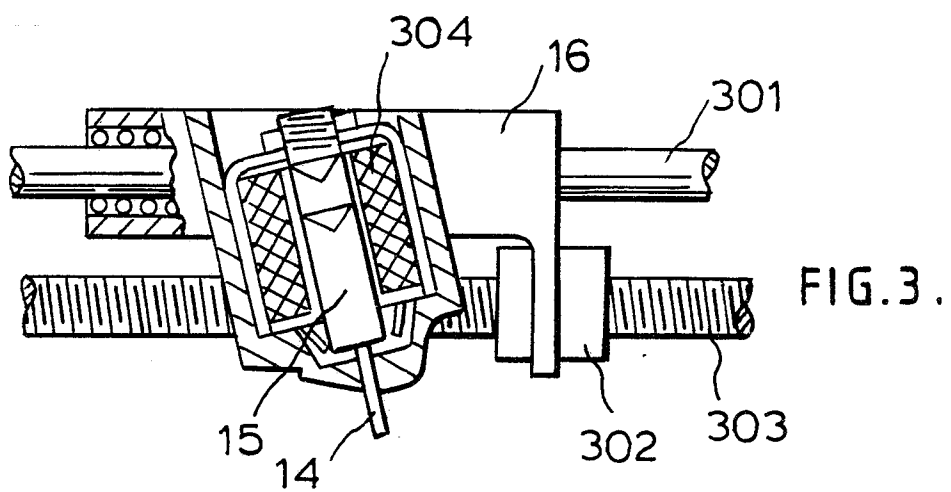
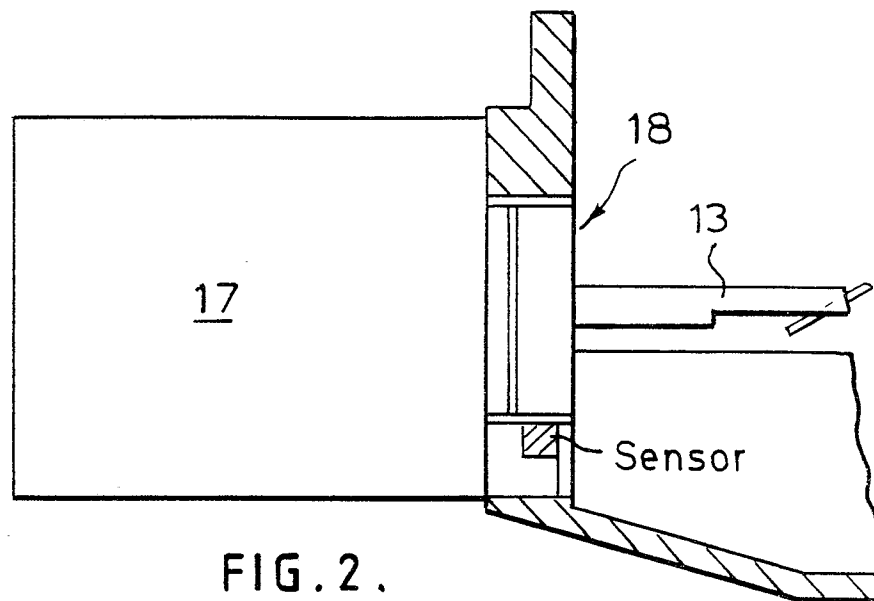


FIG. 1.



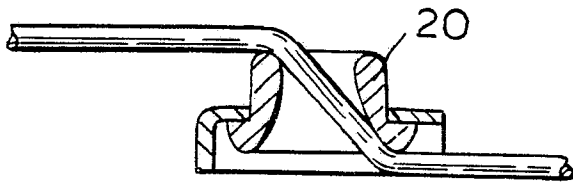


FIG. 5.

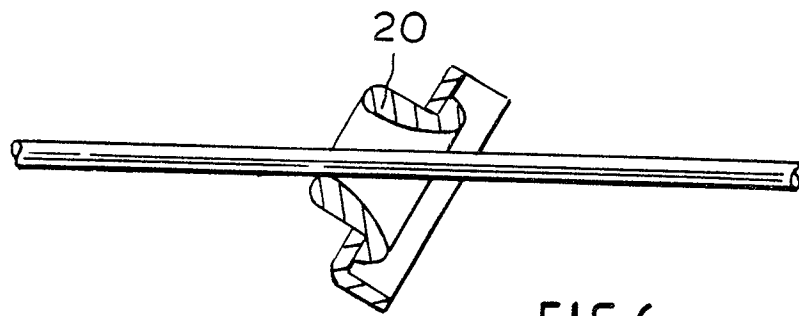


FIG. 6.

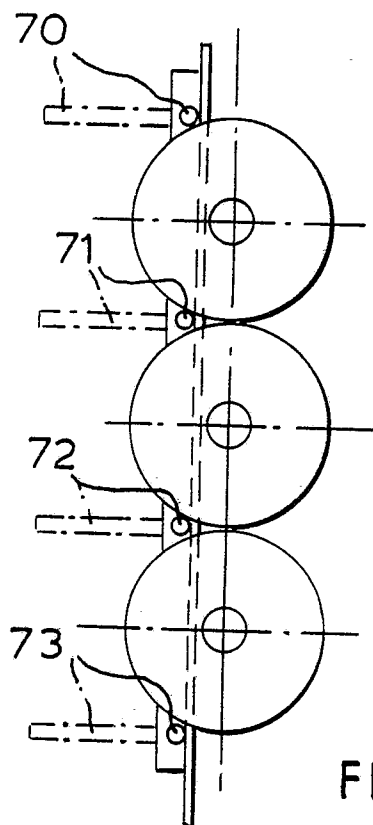


FIG. 7.

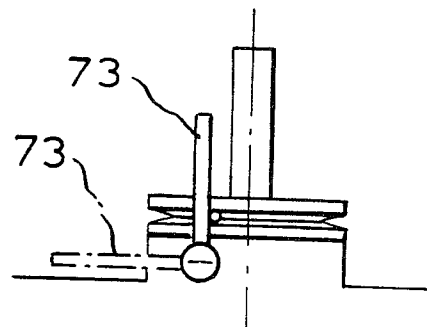


FIG. 8.



DOCUMENTS CONSIDERED TO BE RELEVANT			EP 88306275.4
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
A	EP - A2 - 0 223 226 (ROBERTS INDUSTRIES, INC.) * Totality * --	1,2,3, 4,5,7	B 65 H 54/56
A	US - A - 4 620 571 (G.E. WHELLAMS) * Totality * --	1,2,7	
Y	GB - A - 2 184 465 (EVENOAK LTD.) * Totality * --	3,4 1,2,5, 7	
A			
Y	DE - A1 - 3 110 867 (EKS ELEKTROM. DR. SCHEUERER) * Fig. 1 * --	3,4	
D,A	GB - A - 2 049 748 (D.L. FOULKES) * Totality * ----	1,2,5, 7	TECHNICAL FIELDS SEARCHED (Int. Cl. 4) B 65 H 54/00 H 01 F 7/00 B 21 F 7/00 B 21 F 15/00 H 02 G 1/00
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 30-09-1988	Examiner JASICEK
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document 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			