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Apparatus for stranding wires

This invention relates to the stranding of wires.

It is known that the twisting of wires together during their assembly together offers physical and electrical advantages when used in communications or other electrical systems. For example, twisting of pairs of wires as used in telephone systems improves electrical characteristics, such as reducing crosstalk.

Conventionally, to continually twist wires together in the same direction requires a heavy movable construction as the wire spools for feeding wire into the apparatus must also revolve about the machine axis. The heavy construction limits the operational speed. To avoid the rotation of the spools, a periodically reversing twist is given to the wires and as it is desirable to twist long lengths of wires, accumulators become necessary.

In order to overcome problems with known twisting apparatus, simplified apparatus has been devised to give a periodic reverse twisting operation. This simplified apparatus, as described in U.S. Patent No. 3,910,022 in the name of Phillip John Reed, assignee, Northern Electric Company Limited, involves the use of a tubular member one end of which is held stationary and the other twisted first in one direction and then the other. Dividers positioned along the tube form separate paths for wires passing down the tube and a twisting means at a tube outlet places the reverse twist in the wires.

The invention described in the above patent is effective in creating reverse twist. It has certain disadvantages, however, namely that because it is long, i.e. about 37 feet long (11.27 meters) with 0.5 inch (1.27 cms) inside diameter, it is difficult to thread or pass wires in their correct positions down the tube and this procedure is a tedious and time consuming operation. If the tube is formed of transparent plastic to give visual aid to wire threading, the transparency is lost after a short period of use due to impurities deposited upon the tube surface and due to changes in the plastic itself. Also, the friction between the wires and the inside wall of the tube may be sufficiently high to result in some stretch.

From DE—OS 2,140,697 and Swiss Patent No. 468,517 it is known to provide apparatus for twisting wires, the apparatus comprising a rigid elongate central support and discs provided with holes around their circumference for receiving individual strands of wires. Twisting is effected by rotating the discs about the rigid central support. This requires the discs to be rotatably mounted on the support and for each disc to be capable of being rotated separately by respective rotating means. While such apparatus is more convenient from the threading point of view, it is expensive and complex.

The present invention provides an apparatus for stranding wires comprising an elongate member having a longitudinal axis and being rotationally flexible about said axis, wire guiding means comprising a plurality of wire guiding elements longitudinally spaced apart along the elongate member wire twisting means at the downstream end of the member in the sense of the direction of wire movement, said wire twisting means extending radially outwardly of and non-rotatably secured to the elongate member holding means for holding the member stationary at a position upstream of the wire guiding means, and rotating means for rotating the downstream end of the member and the twisting means for a predetermined number of revolutions about the axis alternately in one direction and then the other, characterised in that the wire guiding elements are non-rotatably secured to and extend radially outwardly from the elongate member and have holes angularly spaced around the longitudinal axis with each hole corresponding with other holes to define a single guide path for wires along the exterior of the member and in that the wire twisting means extends in a direction parallel to the axis of the elongate member and defines a plurality of longitudinally extending holes corresponding to the holes in the wire guiding elements, said wire twisting means being drivably secured to the rotating means whereby to impart rotational forces on the elongate member.

In a preferred arrangement, each of the guiding elements in a disc through which the elongate member extends with the disc secured to the member. Each disc is formed with a plurality of angularly spaced holes, one for each guide path. Alternatively, each guide element is a plate extending outwardly from the elongate member and extending around predetermined degrees of arc. The plates would each be provided with holes for some, but not all, of the paths and plates would be angularly as well as longitudinally spaced to provide holes for all of the paths.

The elongate member may comprise a single tube, rod or wire or may comprise a plurality of tubes, rods or wires suitably joined end-to-end to transmit angular twisting motion from the downstream end along the member. Alternatively, the elongate member is of composite construction designed to give small inertial resistance to change in direction of rotational movement. Composite constructions useful in this regard are formed from plastic. One particular construction has a core of plastic rope with a braided cover jacketed by a covering layer which may be nylon. Low inertial resistance allows the apparatus to be operated at higher speeds of oscillation than is possible with apparatus described in Canadian patent

996,824 and with less driving power requirements.

It is preferable that the means for rotating the downstream end of the elongate member and the twisting means is drivably connected directly to the twisting means which in itself drives the elongate member. Advantageously, the twisting means is drivably secured to the elongate member by the downstream end of the member having a mechanically secure connection in the twisting means. To distribute torsional stresses along the elongate member, the twisting means is secured to an axially extending movement transmission tube which is disposed within it and extends further along the elongate member than the twisting means, the tube being securely and non-rotationally held onto the elongate member, for instance by epoxy resin poured into the tube and allowed to set.

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

Figure 1 is a side elevational view showing the basic concept of the invention;

Figure 2 is a cross-sectional view taken along line II—II in Figure 1;

Figure 3 is a side elevational view of apparatus forming one embodiment;

Figure 4 is a detail of the first embodiment in longitudinal cross-section and on a larger scale;

Figure 5 is an end view in the direction of arrow "V" in Figure 4.

Figure 6 is a side elevational view of apparatus forming a second embodiment;

Figure 7 is a side elevational view of part of an elongate member forming part of a third embodiment;

Figure 8 is a side elevational view of an elongate member with guiding elements attached and forming a part of a fourth embodiment.

As shown in Figure 1, the invention is basically concerned with stranding wire by the use of apparatus which comprises an elongate member 10 having a longitudinal axis and having a plurality of wire guiding elements 12 spaced apart along the member 10. The guiding elements 12 are secured to the elongate member and as shown may be discs (see also Figure 2) with the member 10 passing through a concentric hole in each disc.

To guide wires to be stranded as they are passed longitudinally of the member 10, each guiding element 12 is formed with angularly spaced-apart wire guiding holes 14 (Figure 2), one hole in each guiding element for each wire. In the example of Figures 1 and 2, four holes are provided but the number may vary and is dependent upon the number of wires to be stranded. Guide paths for the wire are provided by the holes 14 with each wire passing between elements and through corresponding holes in the elements. In Figure 1, wires 16 are shown passing between elements 12.

The elongate member 10 is rotationally flexible about its longitudinal axis. The member 10 is held stationary in a frame (shown diagrammatically at 18) at the upstream end, when considered in the sense of direction of wire movement, by holding means which may be a wire guide block 20 secured to the frame. In end view, the block is similar to Figure 2 in having four holes 14 corresponding to those in the guiding elements 12. The upstream end of the elongate member is secured into the guide block to prevent their relative rotation.

At the downstream end of member 10 is provided a twisting means which is conveniently a short solid cylinder 22 having holes 14 again corresponding to the number of holes in the guiding elements 12. The member 10 is non-rotatably secured to the twisting means.

In use of the invention, the wires 16 are fed along their paths through the discs and through the twisting means 22. The twisting means and downstream end of member 10 are then rotated for a predetermined number of revolutions in one direction and then the other alternately in each direction from a normal untwisted position of member 10 in which all wire paths through the holes 14 are substantially straight. The number of revolutions on each side of the normal untwisted position may be as desired and may, for instance, be 20 revolutions. Rotation at the downstream end clearly twists the member 10 in each direction as the upstream end is fixed at 18 and the wire paths take on helical configurations to guide the wires through the rotating twisting means 22.

The wires are fed continuously through the holes and along the member 10. The rotation of the twisting means and its directional change causes the wires to be stranded together, as they issue from the twisting means, in opposite directions of twists which alternate with one another. By holding the twisted wires by some means (not shown), after they emerge from the twisting means, any tendency for the wires to become untwisted is avoided.

In a first embodiment shown in Figure 3, in which parts similar to those already described bear the same reference numerals, apparatus is provided for stranding four wires 16. The four wires are shown entering the guide block 20 and emerging from the cylinder 22 but are omitted in between for clarity.

The elongate member in this embodiment is steel rod which is high strength music wire but some alternative may be used such as steel wire. The diameter of the rod is small being around 1.5 mm (0.06″) and is capable of transmitting sufficient torque to rotate the discs 12 with it. As shown in Figure 4, the twisting means or cylinder 22 is about 16 mm (0.625″) diameter and is securely attached to a concentric stainless steel transmission tube 24 of greater axial length than the cylinder. This tube has the downstream end of the elongate member 10 extended through it and secured within it by epoxy resin 26 which fills the tube

and completely embeds the part of the member 10 within the tube. Because of the extra axial length of the tube 24 over member 10, torsional stresses are more evenly distributed over its downstream end than would be the case if the member 10 has directly connected to the cylinder 22.

The end of member 10 is also non-rotatably attached directly to the cylinder 22 by providing the end with a radially extending element in the form of a closed eye 28 which is received within a diametral slot 30 in the cylinder (see Figure 5). The slot is filled with solder.

Rotating means 32, shown generally in Figure 3, is provided for rotating the downstream end of the elongate member 10 and the cylinder 22, this means comprises two clutches 34, 36 mounted in axial alignment upon a hollow shaft 38 which is secured around the upstream end of the cylinder 22 as is clearly shown in Figure 4. Each clutch has a stub shaft 40 freely carried upon shaft 38 and a pulley wheel 42 on each stub shaft is drivable by a belt 44. The pulley wheels are driven in opposite directions by separate motors. Alternatively, the two belts 44 are replaced by a single pulley belt which passes around one pulley wheel in the opposite direction to the other pulley wheel. A single motor is then used to drive the belt which passes around conveniently positioned idler gears. The clutches are electromagnetically operated through leads 46. Each clutch has a driving portion drivably connected to its pulley wheel and a driven portion connected to the shaft 38.

The clutches are actuated sequentially to drive the cylinder 22 in opposite directions. It is important that at the high speeds of operation possible with this apparatus, that the clutches are actuated precisely as required to prevent build-up of cummulative errors. An error of a fraction of a rotation in one direction if left uncorrected in the other direction could result in wire damage.

In this embodiment, the clutches are controlled by microswitches 48, 50 actuated by a finger 52 held by a nut 54. The nut is non-rotatably and axially slidably held in the frame in a manner not shown and is axially moveable along a screw thread 56 provided upon the shaft 38 between the clutches. Upon the finger 52 reaching a microswitch during rotation of the shaft 38 and cylinder 22 in one direction, the switch is actuated to de-energize one clutch and energize the other so that rotation is immediately reversed. With this arrangement, an accumulation of errors cannot occur. Leads 58 connect from the microswitches to a switch box (not shown) to which leads 46 of the clutches also connect.

In use, the wires 16 are fed from spools 60 through the block 20, guiding elements 12 and cylinder 22. Because of the exterior positioning of the holes 14, it is a simple matter to thread the wires through the holes and involves a small amount of time. This is especially important when a wire breakage occurs during manufacture. As the wires are visible during the whole of their passage, they are easily checked to see whether they are threaded correctly and their colour sequence around the elongate member is easily controlled.

The structure has a smaller mass than is provided by apparatus described in the aforementioned patent and smaller inertia forces are involved as less mass acts at rotational distances away from the longitudinal axis of the member 10. As a result, the rotatable structure is rotatable at much higher speeds than the structure described in the earlier patent and the power required to rotate it and reverse its rotation is thus reduced. With the apparatus of this embodiment, speeds of the order of 3800 r.p.m. should be attainable.

The twist in the wires exiting from the cylinder 22 may be provided by physical holding means which has to operate against tension in the wires. Alternatively, the wires may be relieved of their tension immediately after twisting. One way of relieving tension and locking in the twist is to heat the wires rapidly as they emerge from cylinder 22. If there is any insulation on the wires, as with electrical or telecommunications wires, it is heated for a very short period, e.g. 10—15 milliseconds and slight fusing occurs between the insulating coatings on adjacent wires. The heating and cooling is so quick that no damage occurs to the conductors nor any detrimetal change to the insulating layer.

Another way of physically locking in the twist is to arrange for the twisted wires to be fed directly into a coating extruder. It can be arranged that the exit from the cylinder 22 is very close to the extruder inlet. Alternatively, a short length of flexible tube can be positioned between the cylinder and the inlet of the extruder. The wires are contacted by the extruding material, for example PVC, as soon as the wires enter the extruder and are then locked in their twisted state.

The wires can be relieved of the tension by passing over a capstan. The twisted wires pass a number of times round the capstan and the capstan can be overdriven slightly so that tension is applied to the wires passing through the apparatus but the wires pass from the capstan, for example to a take-up spool, under little or no tension. Alternatively a caterpillar capstan can be used.

Another alternative is to bring several groups of twisted wires together and twisting or forming into a cable. Physical contact between the wires would then prevent untwisting even if tension were applied.

The music wire of the elongate member has a useful life at least as good as, and possibly better than that provided by the tubular member of the aforementioned patent.

In a second embodiment shown in Figure 6, apparatus for stranding wire comprises an elongate member 62 having a plurality of wire guiding elements 12 as described for member 10 in the first embodiment. Means 32 is provided for rotating the downstream end of the member. Only an outline of means 32 is shown in Figure 6 but is of the same construction and operates in a similar manner to the means 32 described in the first embodiment. Four wires to be stranded are fed from wire give-up devices 64 (only one being shown), the wires passing over driven pulley wheels 66 to the guiding elements 12.

The apparatus of the second embodiment differs from that of the first embodiment in the holding means for holding the upstream end of the member 62 stationary. In Figure 6 the holding means comprises a counterweight 68 attached to the upstream end of the member 62, the end portion of the member extending around at least one pulley wheel 70 to be held downwardly by the counterweight. The use of the counterweight reduces residual tension.

In a third embodiment shown by Figure 7, apparatus for stranding wire is substantially as described for the first embodiment. It is different however in that an elongate member 72 is of composite construction and is made from plastic. The member 72 has a core 74 of rope formed from plastic monafilaments (KEVLAR or some other suitable high strength type) which is covered with a braided layer 76 of plastic wires such as Nylon. This composite is then coated with a layer of high strength plastic 78. This design is particularly light in weight and offers low inertia forces while being rotationally flexible to allow for high rotating speeds. The member 72 is held within the cylinder 22 in the manner described for member 10 in the first embodiment. The plastic material of member 62 may even be formed at its end into a radially extending element mounted within a slot of the cylinder in a manner similar to that in the first embodiment so as to assist in transmitting the driving force to the member.

In a fourth embodiment (Figure 8) which is also basically similar to the first embodiment, the apparatus includes an elongate member 80 made from a plurality of rods 82 joined end-to-end. Each rod is joined to an adjacent rod or rods by a means which allows for a twisting movement along the member without each rod being individually rotatably flexible. In fact each rod may be substantially rigid rotationally. The rods are joined together by interconnected eyes 84 formed at their ends. The eyes allow for a predetermined angular movement between rods. This angle may be anything desirable and could for instance be around 40° of movement. Hence, with a sufficient number the rods joined end-to-end, a large number of revolutions of the downstream end of the member and of cylinder 22 is possible while the upstream end is held stationary. It follows that where each rod carries one disc 12 as shown in Figure 7, the end disc has a limited angular movement relative to other discs to enable the wires to follow helical paths and out through the cylinder 22. The interconnected eye couplings used in this embodiment will either eliminate or reduce residual stresses caused by oscillation.

Claims

1. An apparatus for stranding wires comprising an elongate member (10, 72, 80) having a longitudinal axis and being rotationally flexible about said axis, wire guiding means comprising a plurality of wire guiding elements (12) longitudinally spaced-apart along the elongate member (10, 72, 80) wire twisting means (22) at the downstream end of the member (10, 72, 80) in the sense of the direction of wire movement, said wire testing means (22) extending radially outwardly of and non-rotatably secured to the elongate member (10, 72, 80), holding means (20) for holding the member (10, 72, 80) stationary at a position upstream of the wire guiding means, and rotating means (32) for rotating the downstream end of the member (10, 72, 80) and the twisting means (22) for a predetermined number of revolutions about the axis alternately in one direction and then the other, characterised in that the wire guiding elements (12) are non-rotatably secured to and extend radially outwardly from the elongate member (10, 72, 80) and have holes (14) angularly spaced around the longitudinal axis with each hole (14) corresponding with other holes to define a single guide path for wires along the exterior of the member and in that the wire twisting means (22) extends in a direction parallel to the axis of the elongate member (10, 72, 80) and defines a plurality of longitudinally extending holes (14) corresponding to the holes in the wire guiding elements (12), said wire twisting means (22) being drivably secured to the rotating means (32) whereby to impart rotational forces on the elongate member (10, 72, 80).

2. Apparatus according to claim 1 characterised in that each of the guiding elements is a disc (12) through which the elongate member extends with each disc formed with a plurality of angularly spaced holes, one for each guide path.

3. Apparatus according to claim 1 characterised in that the elongate member is a single rod or wire (10) having the guiding elements secured to its outer circumference

4. Apparatus according to claim 1 characterised in that the elongate member comprises a plurality of rods (82) joined end-to-end to transmit twisting motion from the downstream end along the member.

5. Apparatus according to claim 4 characterised in that adjacent rods are formed at their adjacent ends with interconnected eyes (84) which transmit the rotational motion from one

rod to another while permitting relative rotational movement between rods.

6. Apparatus according to claim 5 characterised in that each rod is capable of rotational movement through a limited angle relative to an adjacent rod because one eye is freely movable relative to its interconnected eye, whereby a guiding element on one rod is rotatable through said limited angle relative to a guiding element on the other rod.

7. Apparatus according to claim 1 characterised in that the elongate member comprises a core (74) of plastic rope with a braided cover (76) in a jacket comprising a covering layer of plastics (78).

8. Apparatus according to claim 1 characterised in that the rotating means (32) for rotating the downstream end of the elongate member is drivably connected to the twisting means (22) which surrounds and is secured to a transmission tube (24), the transmission tube extending axially further along the elongate member then the twisting means and being securely and non-rotationally held around the elongate member.

9. Apparatus according to claim 8 characterised in that the transmission tube is held around the elongate member by epoxy resin (26) inside the tube and within which the part of the elongate member is embedded.

10. Apparatus according to claim 8 characterised in that the downstream end of the elongate member is in the form of a radially extending element (28) which is non-rotatably held within a diametral slot (30) in the twisting means.

11. Apparatus according to claim 1 characterised in that the holding means comprises a block (20) to which the upstream end of the elongate member is secured, the block being secured to a frame (18).

12. Apparatus according to claim 1 characterised in that the upstream end of the elongate member extends around a pulley wheel (70) and hangs downwardly to the upstream end, and the holding means comprises a weight (68) secured to the upstream end of the member.

Patentansprüche

1. Apparat zum Verseilen von Drähten mit einem länglichen Teil (10, 72, 80), das eine Längsachse besitzt und um diese Achse in Drehrichtung flexibel ist, mit Drahtleitmitteln, welche eine Vielzahl in Längsrichtung längs des länglichen Teiles (10, 72, 80) mit Abstand angeordnete Drahtleitelemente (12) enthalten und mit Drahtverdrallmitteln (22) am in Drahtlaufrichtung hinteren Ende des Teiles (10, 72, 80), welche Drahtverdrallmittel (22) radial von dem länglichen Teil (10, 72, 80) nach außen abstehen und nicht drehbar an ihm befestigt sind, mit Haltemitteln (20) für die Stationärhaltung des Teiles (10, 72, 80) in einer in Drahtlaufrichtung vor den Drahtleitmitteln befindlichen Lage und mit Drehmitteln (32) zum Drehen des in Drahtlaufrichtung hinteren Endes des Teiles (10, 72, 80) und der Verdrallmittel (22) um eine vorbestimmte Anzahl von Umdrehungen um die Achse alternativ zuerst in einer Richtung und dann in der entgegengesetzten Richtung, dadurch gekennzeichnet, daß die Drahtleitelemente (12) nichtdrehbar an dem länglichen Teil (10, 72, 80) befestigt sind und radial nach außen von diesem abstehen und in Winkelrichtung um die Längsachse mit Abstand angeordnete Öffnungen (14) besitzen, wobei jede Öffnung (14) anderen Öffnungen entspricht, um einen einzelnen Leitweg für Drähte längs der Außenseite des Teiles zu bestimmen, und daß die Drahtverdrallmittel (22) sich in einer Richtung parallel zu Achse des länglichen Teiles (10, 72, 80) erstrecken und eine Vielzahl von sich in Längsrichtung erstreckenden und den Öffnungen in den Drahtleitelementen (12) entsprechenden Öffnungen (14) bestimmen, wobei die Drahtverdrallmittel (22) antreibbar mit den Drehmitteln (32) verbunden sind, um dadurch Drehkräfte auf das längliche Teil (10, 72, 80) auszuüben.

2. Apparat nach Anspruch 1, dadurch gekennzeichnet, daß jedes Leitelement eine Scheibe (12) ist, durch die sich das längliche Teil hindurcherstreckt, wobei jede Scheibe mit einer Vielzahl von in Winkelrichtung mit Abstand angeordneten Öffnungen ausgebildet ist, und zwar mit jeweils einer Öffnung für jeden Leitweg.

3. Apparat nach Anspruch 1, dadurch gekennzeichnet, daß das längliche Element ein einzelner Stab oder Draht (10) ist, an dessen Außenumfang die Leitelemente befestigt sind.

4. Apparat nach Anspruch 1, dadurch gekennzeichnet, daß das längliche Teil eine Vielzahl von an ihren jeweiligen Enden miteinander verbundenen Stäben (82) enthält, um eine Verdrallbewegung von dem in Drahtlaufrichtung hinteren Ende längs des Teiles zu übertragen.

5. Apparat nach Anspruch 4, dadurch gekennzeichnet, daß benachbarte Stäbe an ihren benachbarten Enden miteinander verbundene Ösen (84) ausgebildet enthalten, welche die Drehbewegung von einem Stab zu dem nächsten übertragen, jedoch eine relative Drehbewegung der Stäbe gegeneinander zulassen.

6. Apparat nach Anspruch 5, dadurch gekennzeichnet, daß jeder Stab relativ zu einem benachbarten Stab eine Drehbewegung in einem begrenzten Drehwinkel ausführen kann, da eine Öse relativ zu der mit ihr verbundenen Öse frei bewegbar ist, wodurch ein Leitelement an einem Stab in dem begrenzten Drehwinkel relativ zu einem Leitelement an dem anderen Stab drehbar ist.

7. Apparat nach Anspruch 1, dadurch gekennzeichnet, daß das längliche Teil einen Kern (74) aus Kunststoffseil mit einer gefloch-

tenen Hülle (76) in einem eine Deckschicht aus Kunststoff (78) enthaltendem Mantel umfaßt.

8. Apparat nach Anspruch 1, dadurch gekennzeichnet, daß die Drehmittel (32) zum Drehen des in Drahtlaufrichtung hinteren Endes des länglichen Teils mit den Verdrallmitteln (22) in Antriebsverbindung stehen, wobei die Verdrallmittel (22) ein Übertragungsrohr (24) umgeben und damit verbunden sind, und wobei sich das Übertragungsrohr in Axialrichtung weiter als die Verdralleinrichtung längs des länglichen Teiles erstreckt und sicher und nichtdrehend um das längliche Teil gehalten ist.

9. Apparat nach Anspruch 8, dadurch gekennzeichnet, daß das Übertragungsrohr um das längliche Teil durch in dem Rohr befindlichen Epoxidharz (26) gehalten ist, in welchem der Abschnitt des länglichen Teiles eingebettet ist.

10. Apparat nach Anspruch 8, dadurch gekennzeichnet, daß das in Drahtlaufrichtung hintere Ende des länglichen Teiles als ein sich radial erstreckendes Element (28) ausgebildet ist, welches in einem diametralen Schlitz (30) in den Verdrallmitteln drehfest gehalten ist.

11. Apparat nach Anspruch 1, dadurch gekennzeichnet, daß die Halteeinrichtung einen Block (20) umfaßt, an welchem das vordere Ende des länglichen Teiles befestigt ist, und daß der Block an einem Rahmen (18) befestigt ist.

12. Apparat nach Anspruch 1, dadurch gekennzeichnet, daß das in Drahtlaufrichtung vordere Ende des länglichen Teils um eine Umlenkrolle (70) reicht und zu dem vorderen Ende hin nach unten hängt, und daß die Halteeinrichtung ein an dem in Drahtlaufrichtung vorderen Ende des Teiles befestigtes Gewicht (68) umfaßt.

Revendications

1. Appareil de torsadage de fil comprenant un élément allongé (10, 72, 80) ayant un axe longitudinal et étant flexible en rotation autour de cet axe, un moyen de guidage de fil comprenant une pluralité d'éléments de guidage de fil (12) espacés longitudinalement sur la longueur de l'élément allongé (10, 72, 80), un moyen de torsadage de fil (22) à l'extrémité aval de l'élément (10, 72, 80) dans le sens du mouvement des fils, le moyen de torsadage de fil (22) s'étendant radialement vers l'extérieur de l'élément allongé et étant fixé à celui-ci de manière non rotatoire (10, 72, 80), un moyen de maintien (20) pour le maintien à l'état fixe de l'élément (10, 72, 80) en une position en amont du moyen de guidage de fil, et un moyen tournant (32) pour la mise en rotation de l'extrémité aval de l'élément (10, 72, 80) et du moyen de torsadage (22) pendant un nombre prédéterminé de tours autour de l'axe, alternativement dans un sens puis dans l'autre, caractérisé en ce que les éléments de guidage de fil (12) sont fixés de manière non rotatoire et s'étendent radialement vers l'extérieur à partir de l'élément allongé (10, 72, 80) et comportent des trous (14) espacés angulairement autour de l'axe longitudinal avec chaque trou (14) correspondant à d'autres trous de manière à définir un trajet unique de guidage pour les fils le long de l'extérieur de l'élément, et en ce que le moyen de torsadage de fil (22) s'étend dans une direction parallèle à l'axe de l'élément allongé (10, 72, 80) et définit une pluralité de trous s'étendant longitudinalement (14) qui correspondent aux trous pratiqués dans les éléments de guidage de fil (12), le moyen de torsadage de fil (22) pouvant être fixé de manière motrice à l'élément de mise en rotation (32) d'où il résulte que des forces de rotation sont conférées à l'élément allongé (10, 72, 80).

2. Appareil selon la revendication 1, caractérisé en ce que chacun des éléments de guidage est un disque (12) à travers lequel s'étend l'élément allongé, avec chaque disque comportant une pluralité de trous espacés angulairement, avec un trou pour chaque trajet de guidage.

3. Appareil selon la revendication 1, caractérisé en ce que l'élément allongé est une tige ou un fil uniques (10), à la circonférence extérieure duquel sont fixés les éléments de guidage.

4. Appareil selon la revendication 1, caractérisé en ce que l'élément allongé comprend une pluralité de tiges (82) reliées bout à bout de manière à transmettre le mouvement de torsadage le long de l'élément à partir de l'extrémité aval.

5. Appareil selon la revendication 4, caractérisé en ce que les tiges contiguës comportent à leurs extrémités contiguës des anneaux interconnectés (84) qui transmettent le mouvement de rotation d'une tige à l'autre tout en permettant un mouvement rotatoire relatif entre tiges.

6. Appareil selon la revendication 5, caractérisé en ce que chaque tige est capable d'un mouvement rotatoire suivant un angle limité par rapport à une tige contiguë, car un anneau est mobile librement par rapport à son anneau interconnecté, d'où il résulte qu'un élément de guidage sur une tige peut tourner suivant un angle limité par rapport à un élément de guidage de l'autre tige.

7. Appareil selon la revendication 1, caractérisé en ce que l'élément allongé comprend une âme (74) en matériau plastique avec une couverture tressée (76) dans un gaine comprenant une couche de couverture en matériau plastique (78).

8. Appareil selon la revendication 1, caractérisé en ce que le moyen de mise en rotation (32) pour la mise en rotation de l'extrémité aval de l'élément allongé peut être relié de manière motrice au moyen de torsadage (22) qui entoure et est fixé à un tube de transmission (24), ce tube de transmission s'étendant axialement le long de l'élément allongé sur une distance plus grande que le moyen de torsion et

étant fixé et maintenu de façon à ne pas tourner autour de l'élément allongé.

9. Appareil selon la revendication 8, caractérisé en ce que le tube de transmission est maintenu autour de l'élément allongé par de la résine époxyde (26) placée à l'intérieur du tube et dans lequel est noyée la partie de l'élément allongé.

10. Appareil selon la revendication 8, caractérisé en ce que l'extrémité aval de l'élément allongé a la formde d'un élément s'étendant radialement (28) qui est maintenu de manière à ne pouvoir tourner à l'intérieur d'une fente diamètrale (30) pratiquée dans le moyen de torsadage.

11. Appareil selon la revendication 1, caractérisé en ce que le moyen de maintien comprend un bloc (20) auquel est fixée l'extrémité amont de l'élément allongé, le bloc étant fixé à un châssis (18).

12. Appareil selon la revendication 1, caractérisé en ce que l'extrémite amont de l'élément allongé s'étend autour d'une poulie (70) et pend vers le bas dans la direction de l'extrémité amont, et le moyen de maintien comprend un poids (68) fixé à l'extrémité amont de l'élément.

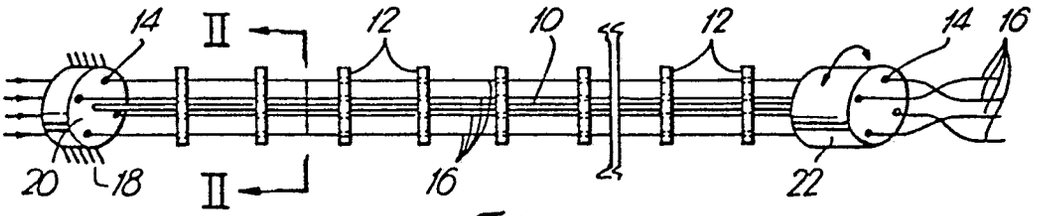


Fig-1

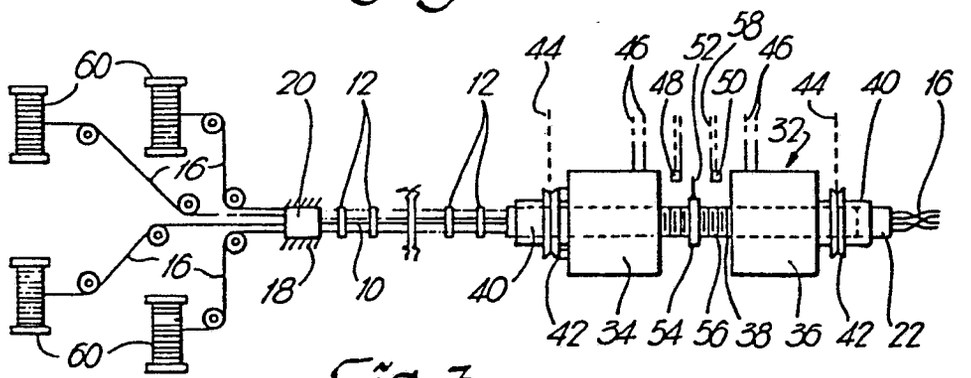


Fig-3

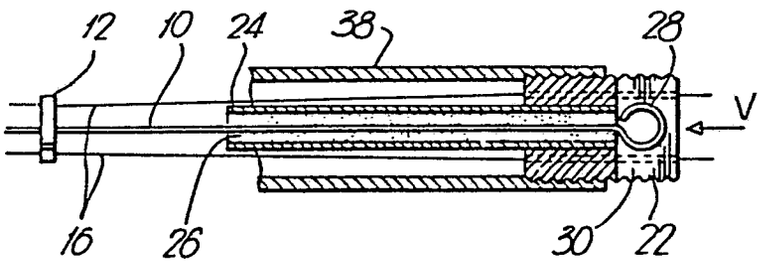


Fig-4

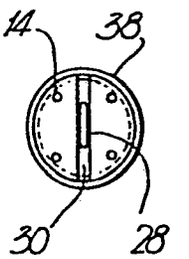


Fig-5



Fig-7

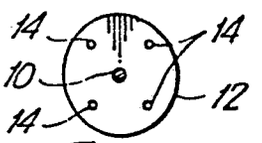


Fig-2

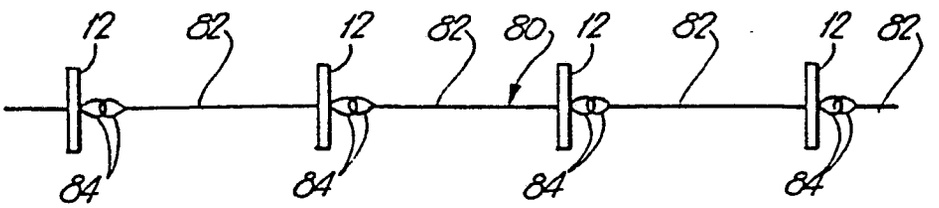


Fig-8

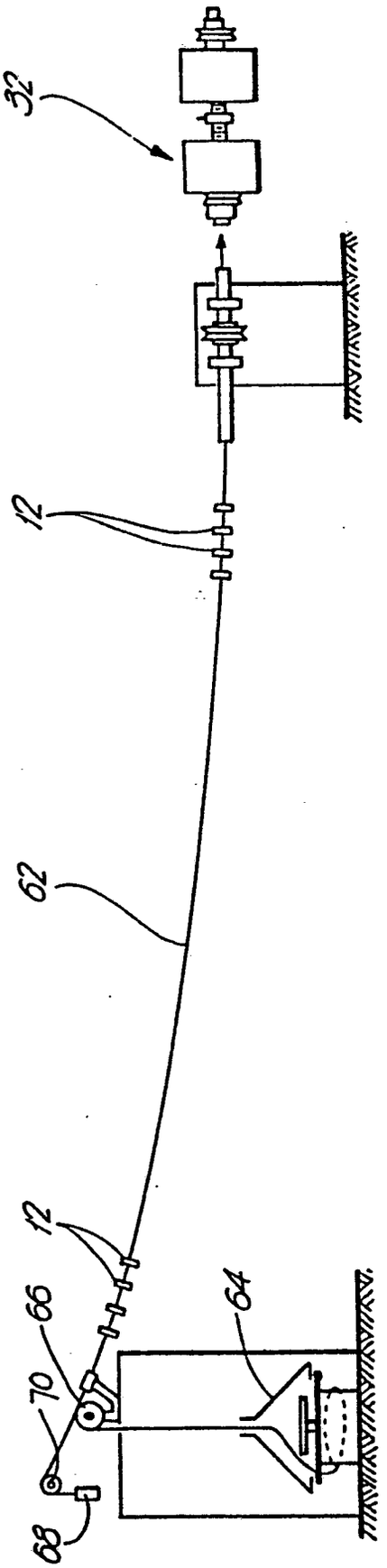


Fig. 6