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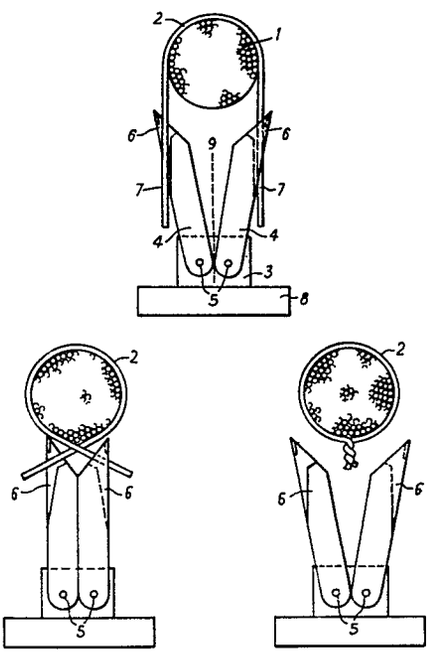
(54) Apparatus for twisting together the end portions of wire around a bundle.

(57) Apparatus for forming a twist knot in the ends (7) of wire (2) passing around a bundle (1) of rods or a large bundle of smaller bundles of rods has a head (3) which is rotatable about an axis (9) and carries a pair of arms (4) which are pivotable towards and away from the axis (9). The arms (4) have slots (6) to receive and hold the wire ends (7) so that when the head is rotated the ends are twisted together into a knot.

To provide a simple mechanism avoiding the need for control of the movement of the arms and to render the apparatus versatile, the arms (4) are substantially freely movable about their pivots (5), so that they are pulled inwardly by the wire ends themselves, during the initial period of rotation of the head.



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"Apparatus for twisting together the end portions of wire around a bundle"

This invention relates to apparatus for twisting together the end portions of wire around a bundle, so as to form a twist knot securing the wire, comprising a rotatable head, means for rotating the head about an axis, and a pair of arms each having a first end pivotally mounted on said head so that the second end is movable towards and away from said axis, there being a slot in said second end of each arm to receive the wire, wherein said slots respectively receive the ends of the wire in the open position of said arms and said arms are closed together as the head is rotated so as to twist the ends of the wire together.

Bundling machinery is used in rod and wire mills. There is small bundling equipment for bundling a number of rods, together with a counting device for rods and so

called large bundling equipment for bundling a number of small bundles of rods, together with a counting device for the small bundles.

To secure the bundles, wire lengths are passed circumferentially around them, and are knotted at the free ends. This knotting operation is at the present time usually performed manually; it is strenuous work and, with for instance wire or 5mm diameter, means that the wire must previously be annealed in order to render it soft enough to be manipulated. The annealing of the wire increases its cost.

Proposals for knotting machines have been made. See French patent specification 1 329 164 where two jaws grip the wire ends in the manner of pincers and twist them together. See also German patent specification No. 310 265 which discloses apparatus as described in the first paragraph above. In this apparatus, the pivoted arms are moved, in their open position, so as to embrace the bundle with their ends projecting beyond the bundle whereupon a straight and already cut length of wire is passed through the specially shaped slots in the ends of the arms. The arms are then withdrawn past the bundle so that the wire is bent and lies alongside three sides of the bundle, then the arms are pivoted so that their ends move together to bring the wire ends together, this being a positive action effected by moving guide slots

acting on pins on the arms, and the head carrying the arms is rotated to through 180° to twist the wire ends round each other.

This previously proposed apparatus has two particular disadvantages. Firstly, it is complicated, since complex means for controlling the movement of the arms is necessary. Secondly, automatic adaptation to different bundle sizes is not possible, because the wire is cut to length before being wrapped around the bundle.

The present invention has as its object the simplification of the apparatus, and also to provide means for forming a knot which is independent of the means for wrapping the wire around the bundle.

The invention as claimed is intended to solve these problems. It provides that the arms are pulled inwardly by the wire itself, as the head rotates. Thus the arms are freely pivotable, without the need for their positive movement. Bias means which do not prevent this free pivoting may be provided to return the arms to the open position after the knot is formed; when the rotation is about a vertical axis we prefer this bias to be provided by gravity.

The slots in the arms are shaped so as to clamp the wire automatically when the head begins to rotate.

This apparatus is used with separate means for wrapping the wire around the bundle and cutting it to length afterwards; thus the length of the wire can be adapted in each case to the bundle size. The head can perform as many rotations as is desired, in fact until the wore ends are pulled out of the slots in the arms into the knot (compare the 180° turn only of the old proposal discussed above). Thicker wire (e.g. 6mm) than is used for manual knotting can be used, providing a stronger knot, and prior annealing is not required.

By the invention it is possible to provide devices which can be universal for all types of arrangements e.g semi-automatic bundling, small bundle, single wire, single twist up to fully automatic bundling, vertical set-up, double wire, double twist.

Embodiments of the invention will be described below by way of example with reference to the drawings, in which

Figs. 1a, 1b and 1c show stages in the operation of a device embodying the invention, here illustrated diagrammatically, and shown forming a twist knot in a U-shaped bent wire previously applied to a small bundle of wires;

Figs. 2a, 2b and 2c show similar stages in the operation of the device of Fig. 1 on a U-shaped wire previously applied around a large bundle comprising a plurality of small bundles of wire;

Fig. 3 shows the device of Fig. 1 mounted below a cradle which receives a large bundle, as in Fig. 2;

Figs. 4a, 4b, 4c and 4d show the operation of two devices embodying the invention mounted on opposite sides of a bundling station of small bundles. Straight wire lengths being wrapped around the bundle and twist knotted;

Figs 5a, 5b, 5c and 5d show an arrangement similar to that of Fig. 4 wherein two devices of the invention are applied to tying two straight wires around a large bundle;

Fig. 6 is a view of the outer end of an arm of the devices of Figs. 1 to 5 showing one possible form of the throat-shaped slot which holds the wire end;

Fig. 7 is a perspective view of the arms of another device of the invention in their open position;

Fig. 8 is a perspective view of the device of Fig. 7 with the arms in their closed position; and Fig. 9 is a perspective view of the knot formed by the device of Figs. 7 and 8.

Fig. 1a shows a bundle of bar material 1, pre-formed by means of a trough, and having around it a U-shaped previously bent bundling wire 2 which has been applied either manually or by means of a machine (not shown), which pulls the wire from a store around the bundle and then cuts the wire at the appropriate point. A rotatable head 3 is mounted on a holder 8, which can be rotated round its axis 9 by means of a motor (not shown). The head 3 carries two jaws or arms 4 which at one end are mounted pivotally on the head 3 in such a way that their outer ends can move freely towards and away from the axis 9. The two arms 4 are, in this case, identical and are mounted 180° apart around the axis 9. At their outer ends the arms 4 are provided in one face with a throat-shaped slot 6 (see Figs. 6 for more detail). Fig. 1a shows the ends 7 of the U-shaped wire length 2 inserted e.g. by hand in the slots 6.

The wire length 2 is slightly wider than the actual bundle diameter, so that the ends 7 can be inserted easily into the slots 6.

When the head 3 is rotated, the wire ends 7 become tightly held in the slots 6, so that both arms 4 pivot towards the axis 9 during the initial rotation through 180° in which the wire ends 7 come into the position shown in Fig. 1b. In this position the bundling wire 2 lies stretched around the bundle 1.

Further turning of the head 3 causes the ends 7 of the bundling wire 2 to be completely twisted together, the ends 7 being dragged through the slots 6 as they are formed into the twist knot (see Fig. 1c). When these ends emerge from the slots, the arms 4 return to their starting (open) position. With a head roating about a horizontal axis, this is preferably done by means of an expansion spring arranged near the pivot points 5 of the arms 4. It the rotatable head is arranged with a vertical axis of rotation, opening of the arms may be brought about by the force of gravity. What is important is that the free inward rotating of the arms, pulled by the wire, during the initial period of rotation should not be substantially hindered.

Fig. 2 shows a similar machine, where a number of separate bundles 21, 22 etc are combined into a large bundle by means of a U-shaped bundling wire 23, which may be applied manually or as described above, by a machine. In operation, the ends 24 of the bundling wire 23 are inserted through the slots 28 of the arms 27, which are freely pivotable on a head 26 rotatable round an axis 25.

Fig. 3 shows a large bundle 33 made up of small bundles 31, by means of a trough 32. A U-shaped pre-bent bundling wire 33 is applied manually or by a suitable device.

Below the trough 32 there is a horizontal support 23 in which a head 35 is supported in bearings so as to be rotatable. The head 35 can be rotated in the direction of rotation indicated by a schematically drawn shaft 36. The head 35 bears a pair of arms 37, which are similar to the arms of Fig. 1 and 2. Their closed position is shown by broken lines. The twist knot is shown at 34.

Figs. 4 and 5 show another arrangement of a bundling machine which also allows fully automatic bundling of bundles.

A pre-formed bundle of bar material 41 is shown in Fig. 4a. On either side there is a vertical support 42 upon which is mounted a head 43, rotatable round a horizontal axis. Each head 43 is equipped with a pair of jaws or arms, similar to those of Figs. 1 to 3.

When the bundle 41, supported in a manner not indicated, is ready, to be bundled, the heads 43 are turned so that one arm or the head is at the bottommost position. A length of wire 45 is next pushed underneath the bundle through the slots 46 in the jaws 44. If so required this wire feed can be carried out automatically, and in that case cutting of the wire can also be automated.

As Fig. 4b shows a length of wire 48 is also inserted in the slots 47 of the top arms 44.

Fig. 4c shows the position in which the twop heads 43 have been rotated by 180° in opposite directions. The ends of the wires 45 and 48 are now crossed in the manner shown. Further rotation of the arms causes the wire ends to become twisted into knots and to come clear of the arms. The arms 44 expand again into their open position as shown in Fig. 4d. Withdrawal of the support of the bundle allows it to be removed, and while it is dropping the twisted ends can be bent around the bundle.

In Fig. 5 a similar machine is shown for double-twisting a large or composite bundle. The various stages of operation are shown as in Fig. 4.

Fig. 6 shows the slot at the far end of a typical arm 61 of the rotating heads shown in Figs. 1 to 5. Passing from one side of the arm to the other, this slot narrows to a throat and then broadens.

In the open position of the arms, the wire typically assumes the full-line position 60, while upon rotation of the head the wire becomes wedged and the arms close together, so that the wire adopts the broken-line position 60'.

In principle twisting can be performed in any position or orientation. In the embodiments illustrated vertical or horizontal has only been mentioned for convenience.

The length of the arms as well as the spacing from the pivot points of the arms to the trough or other support for the bundle should be suitably chosen for each case, and may be calculated in such a way that small as well as large bundles can be handled by a single machine according to the invention.

Figs. 7 and 8 show a more developed form of rotating twist head forming part of apparatus embodying the invention. The two arms 100. 101 which are mounted on the rotating head 102 by pivots 103 each have two parallel flanks 104 joined at their free ends 105 by identical shaped metal blocks 106. These blocks 106 have flat inner faces 107 which mutually abut in the closed position of the arms 100, 101 (Fig. 8) and which have central axially extending grooves 108. Also mounted on the head 102 is an axial column 109 carrying an axial spigot 110 which lies in the grooves 108 in the closed position when the conical extremity 111 of the spigot 110 projects into a cylindrical space 112 provided between the blocks 106 by semi-cylindical recesses 113 beyond the flat faces 107.

The rear walls of each recess 113 is open to a slot 114 which is partly overhung by a triangular flange 115. Outwardly projecting lugs 116 of each block 106 provide the outwardly diverging sides of each slot 114.

The slots 114 do not reach the inner faces 107.

In operation the wire ends are brought manually or automatically into the slots 114, before the head is rotated. Upon rotation, the wires are caught by the blocks 106, particularly by the flanges 115, so that the wire ends become twisted first around each other and later around the spigot 110. The cylindrical space 112 provides room for the twists, of the knot to collect. When the wire ends have entirely been absorbed into the knot sufficiently to come free of the slots 114, the arms 100 101 are released, and fall apart under the action of gravity.

The knot so formed is seen in perspective in Fig. 9 Part of the length extending around the bundle is shown at 120°. Adjacent this is a portion 121 where the wire is tightly twisted, while closer to the free ends 122 of the wire are the more open twists 123 formed around the spigot 110.

Claims

1. Apparatus for twisting together the end portions (7) of wire (2) around a bundle (1) so as to form a twist knot securing the wire, comprising a rotatable head (3) means for rotating the head about an axis (9) and a pair of arms (4) each having a first end pivotally mounted (5) on said head (4) so that the second end is movable towards and away from said axis, there being a slot (6) in said second end of each arm to receive the wire, wherein said slots respectively receive the ends of the wire in the open position of said arms and said arms are closed together as the head is rotated so as to twist the ends of the wire together, characterised in that said arms are pivotally mounted so as to be capable of free uncontrolled movement inwardly towards the axis (9) whereby the arms are pulled inwardly by the wire when the head rotates to form the knot.

2. Apparatus according to claim 1 characterised in that the arms (4) are freely pivoted on horizontal axes and are biassed outwardly by gravity.

Apparatus according to claims 1 and 2 characterised in that there are provided means for drawing the wire around the bundle from a continuous stock of wire and means for cutting off the length of wire extending around the bundle after the wire has been drawn.

4. Apparatus according to claims 1 to 3 characterised in that in their closed position the arms (100,101) provide a central space (112) which is preferably cylindrical and in which the knot is formed.

5. Apparatus according to claim 4 characterised in that an axially extending spigot (111) is located in said central space (112) the knot being formed by winding the end positions of the wire around the spigot (111).

FIG. 1a

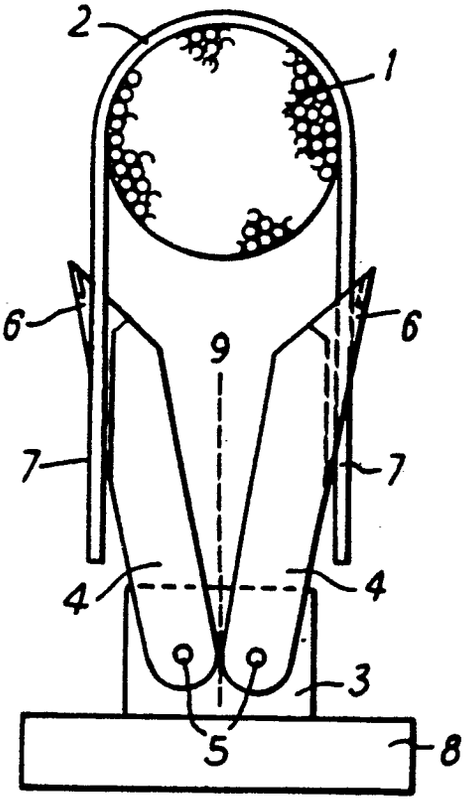


FIG. 1b

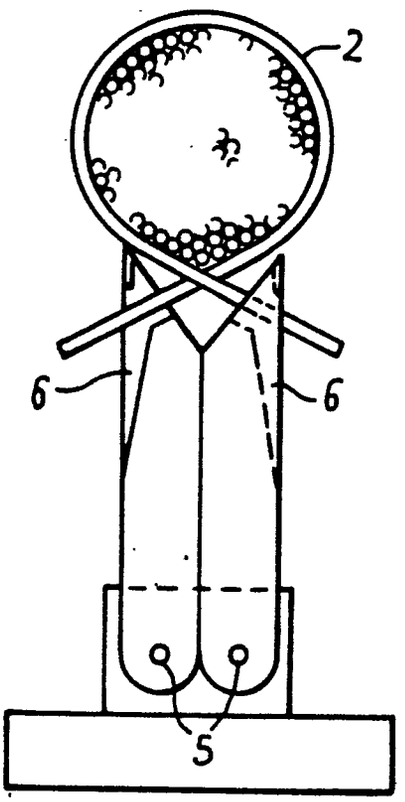


FIG. 1c

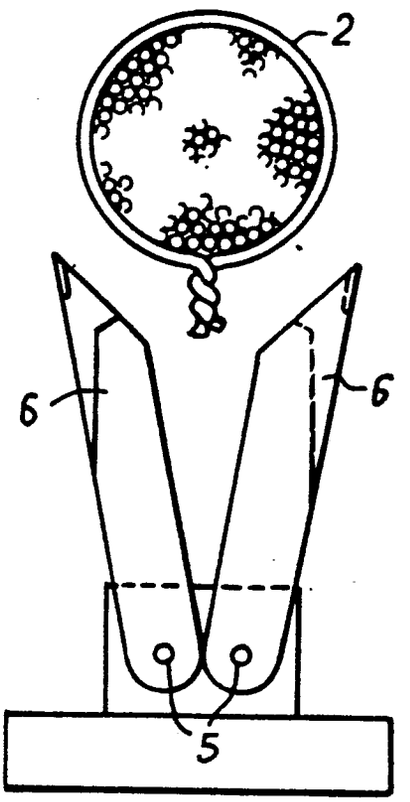


FIG. 2a

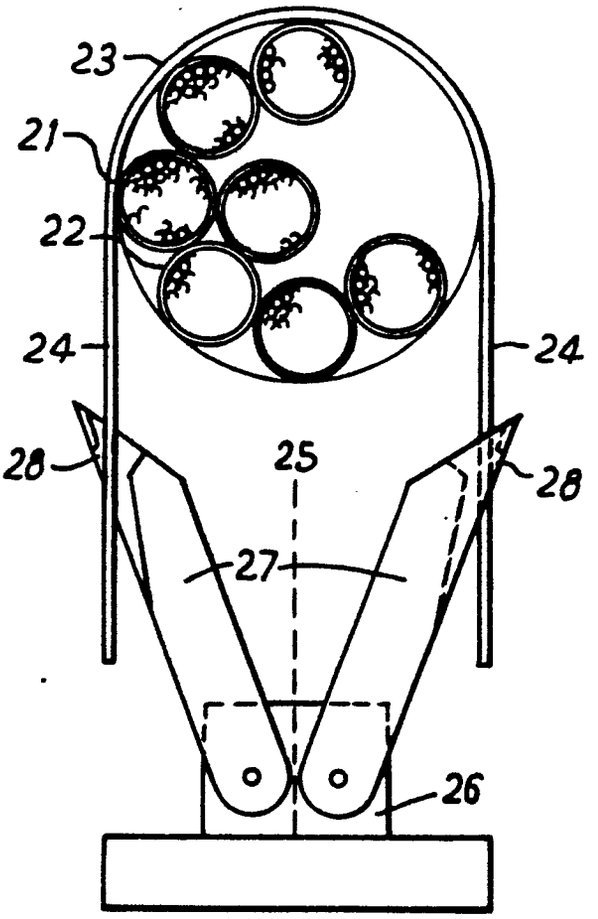


FIG. 2b

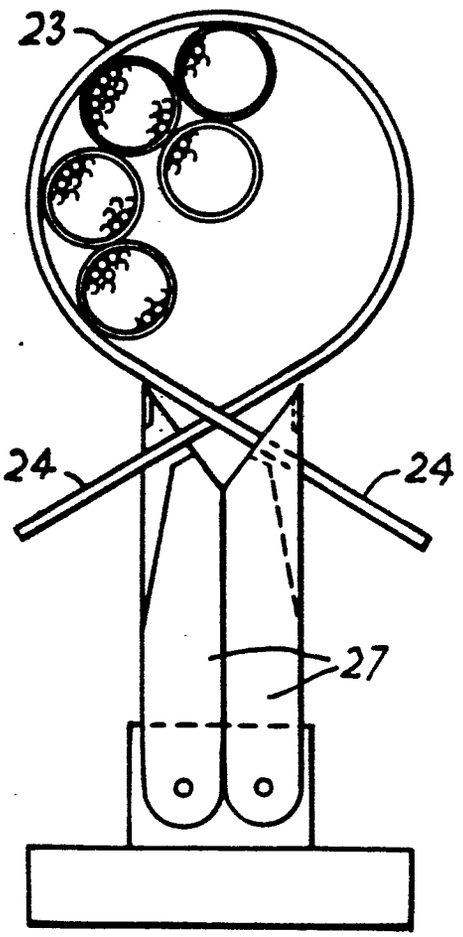


FIG. 2c

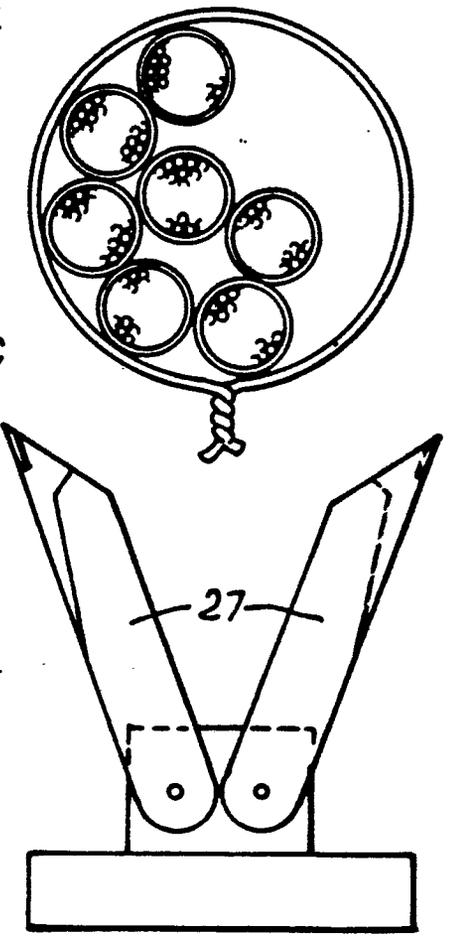


FIG.3

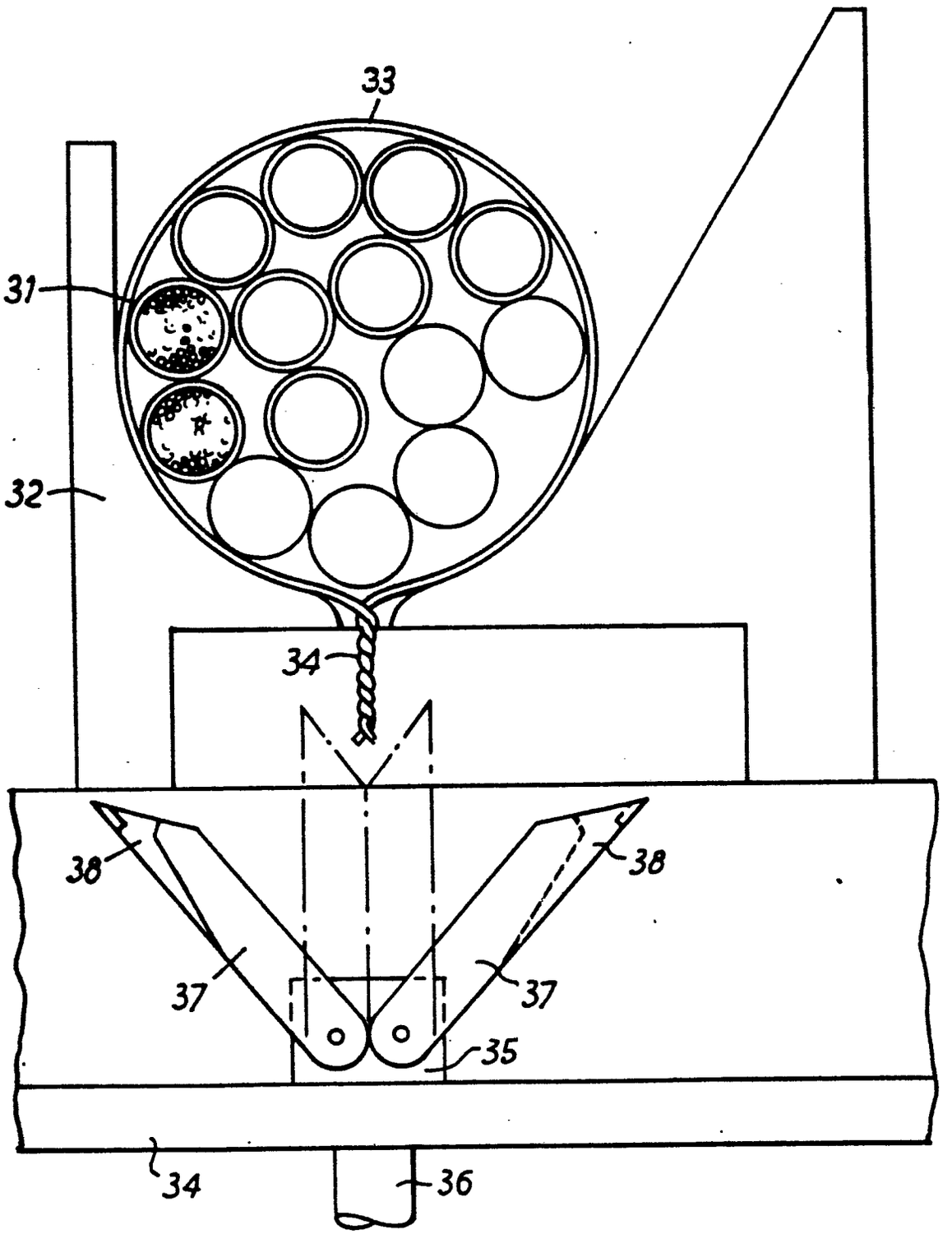


FIG 4a

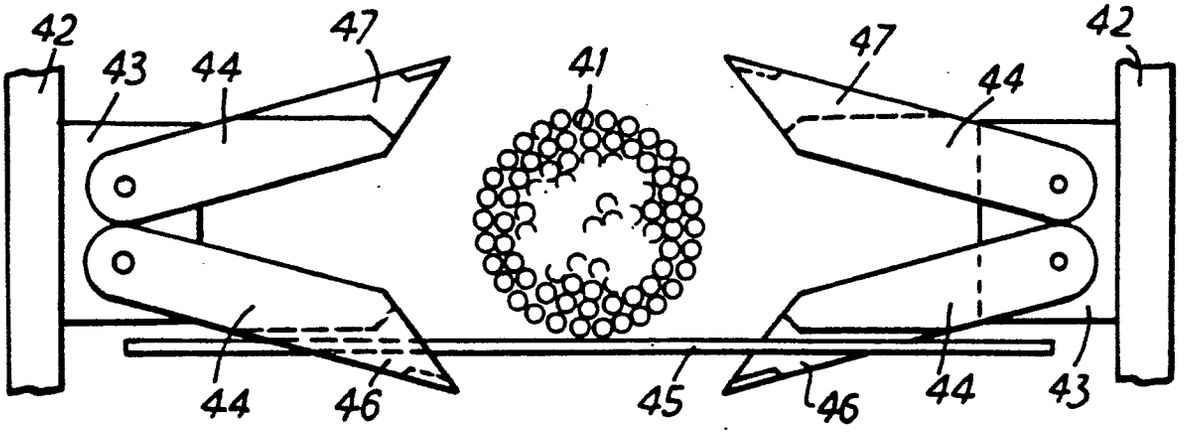


FIG.4b

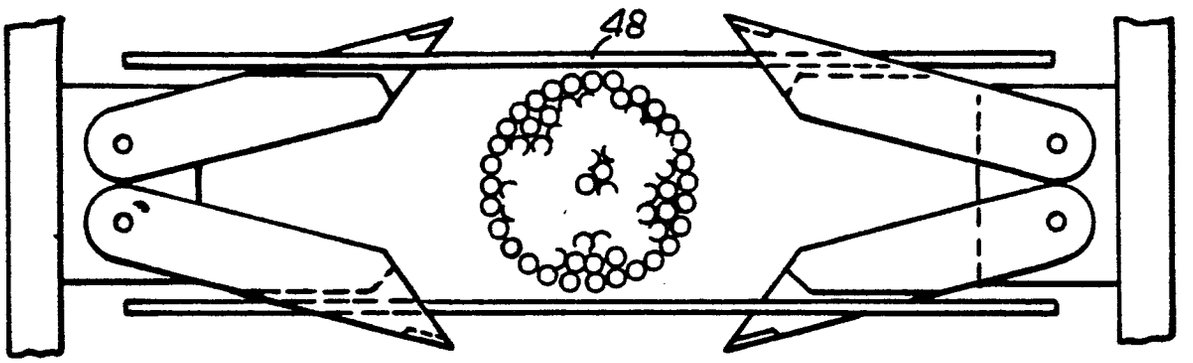


FIG.4c

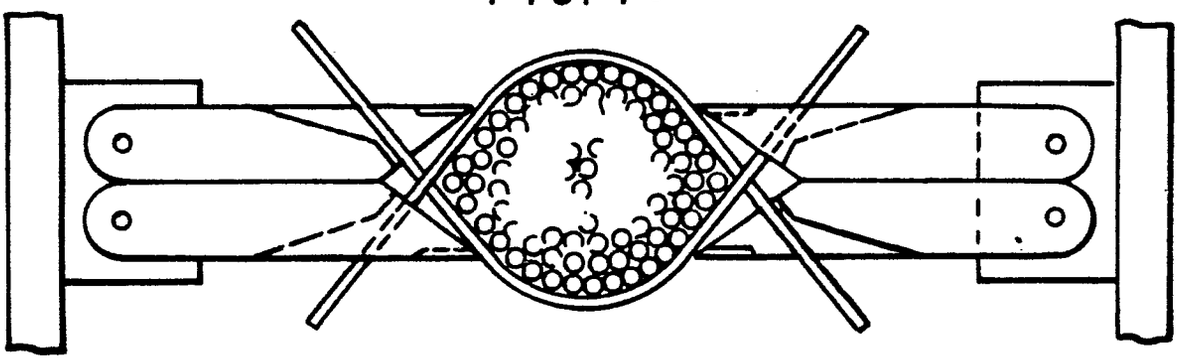


FIG.4d

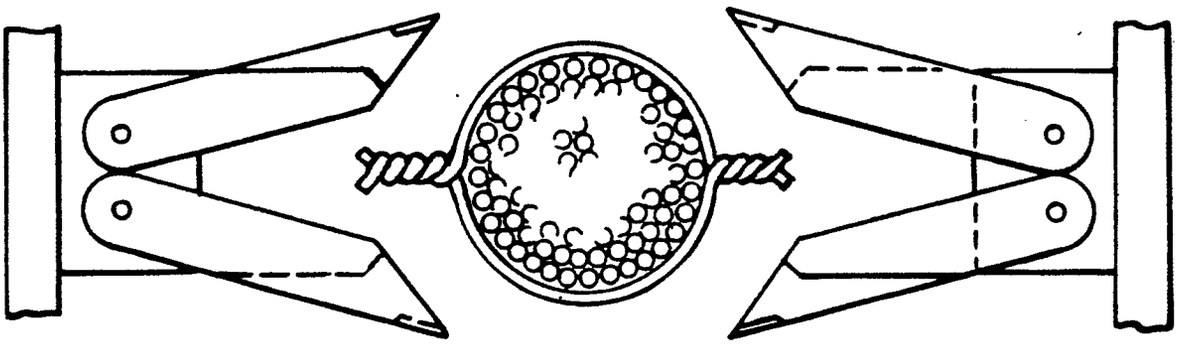


FIG.5a

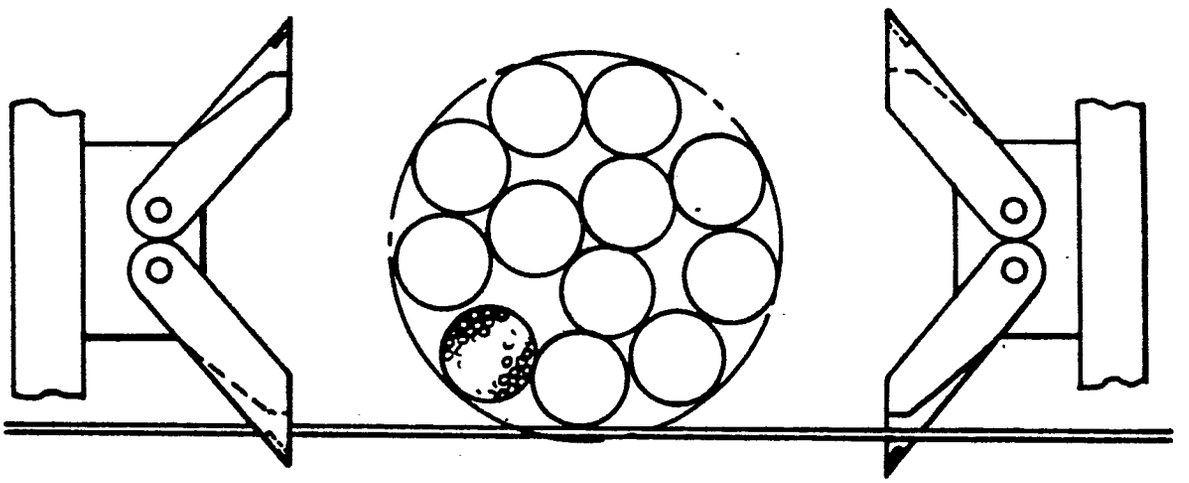


FIG.5b

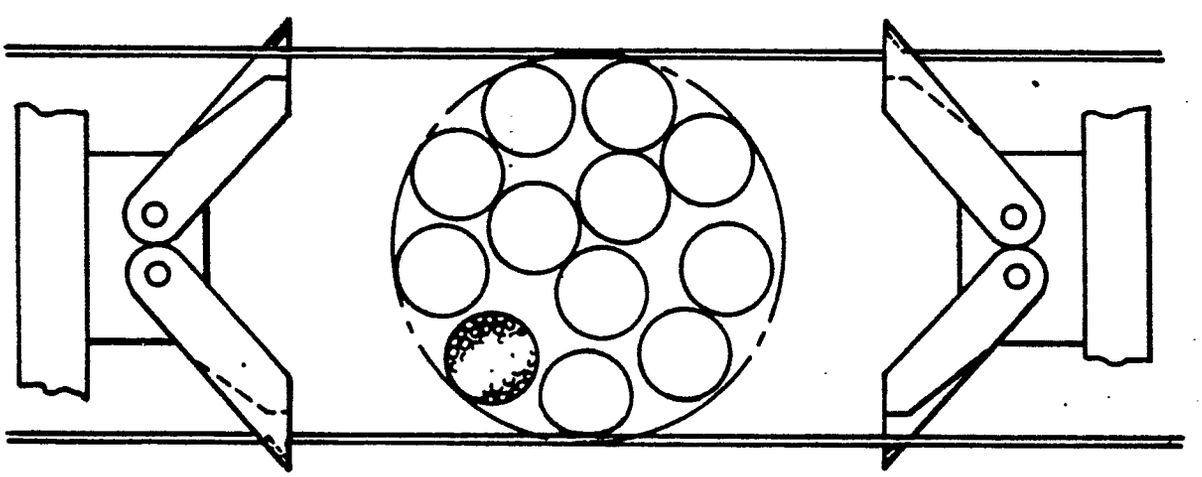


FIG. 5c

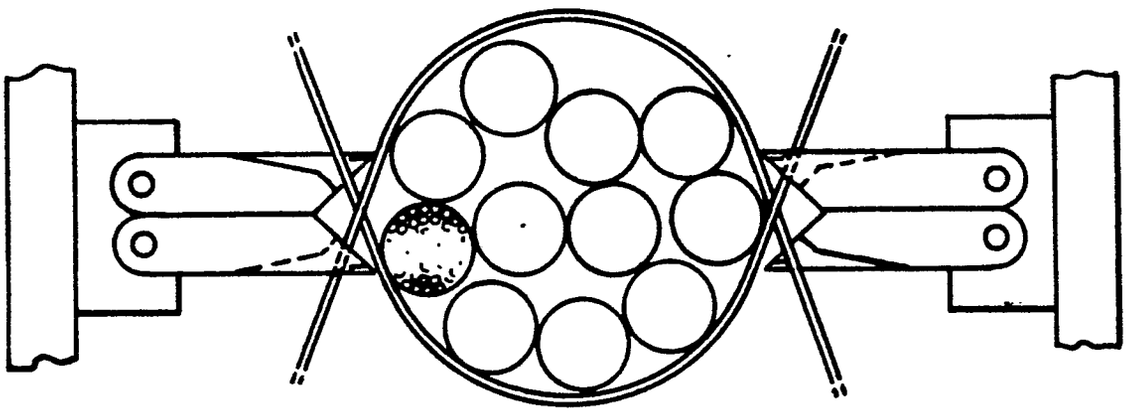
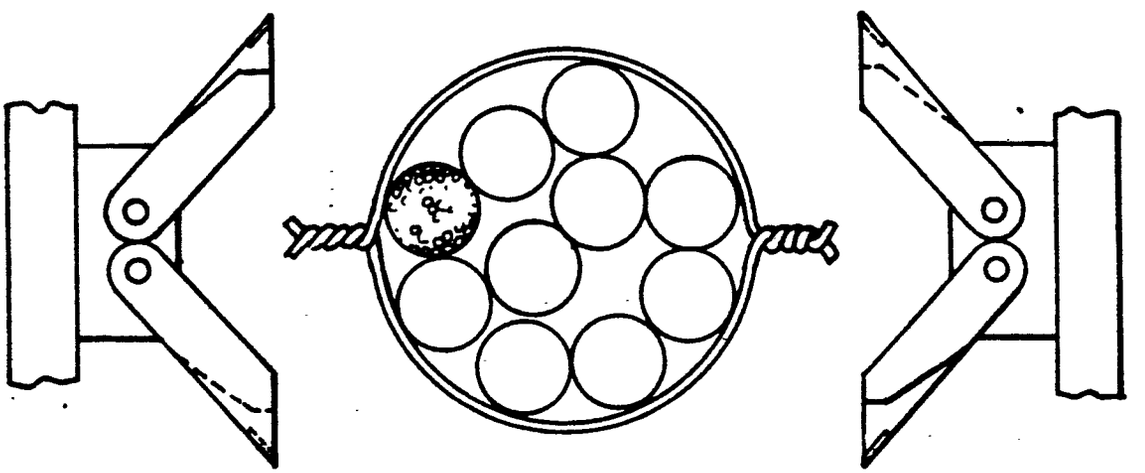


FIG. 5d



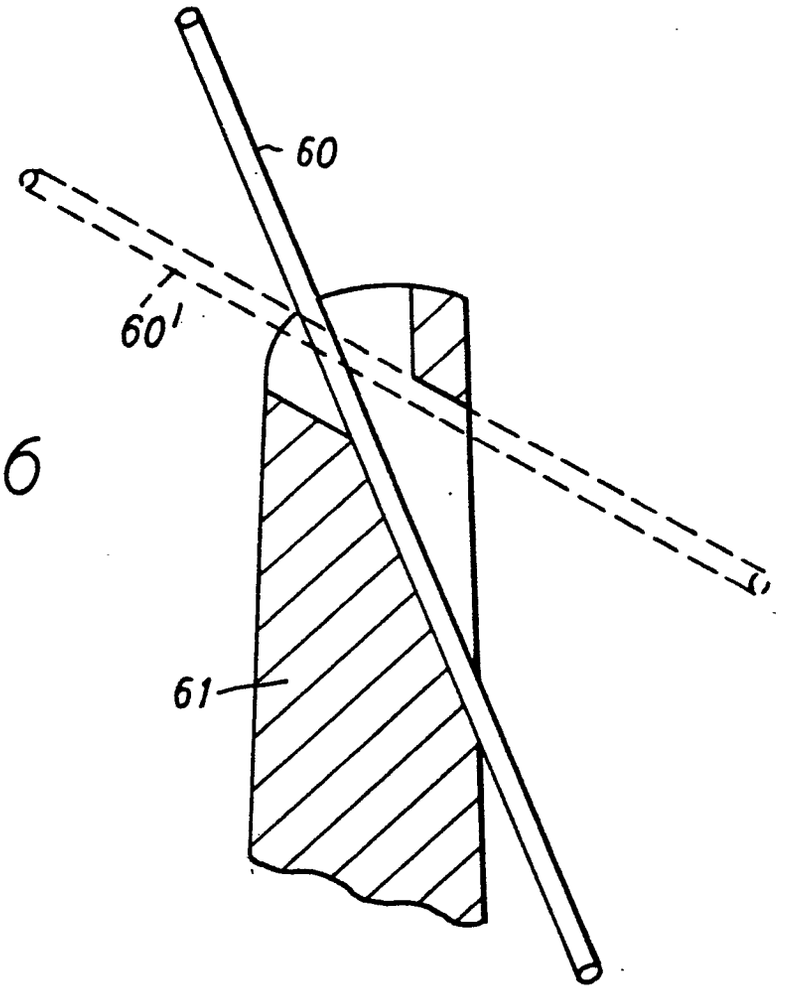


FIG.6

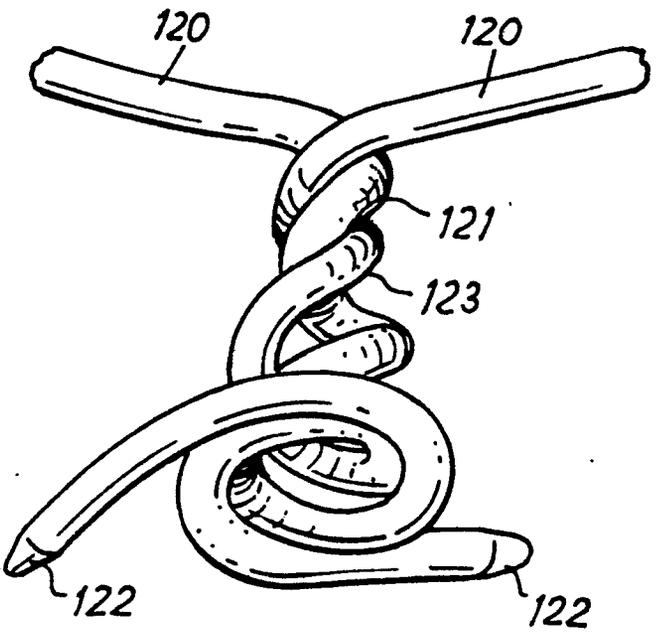
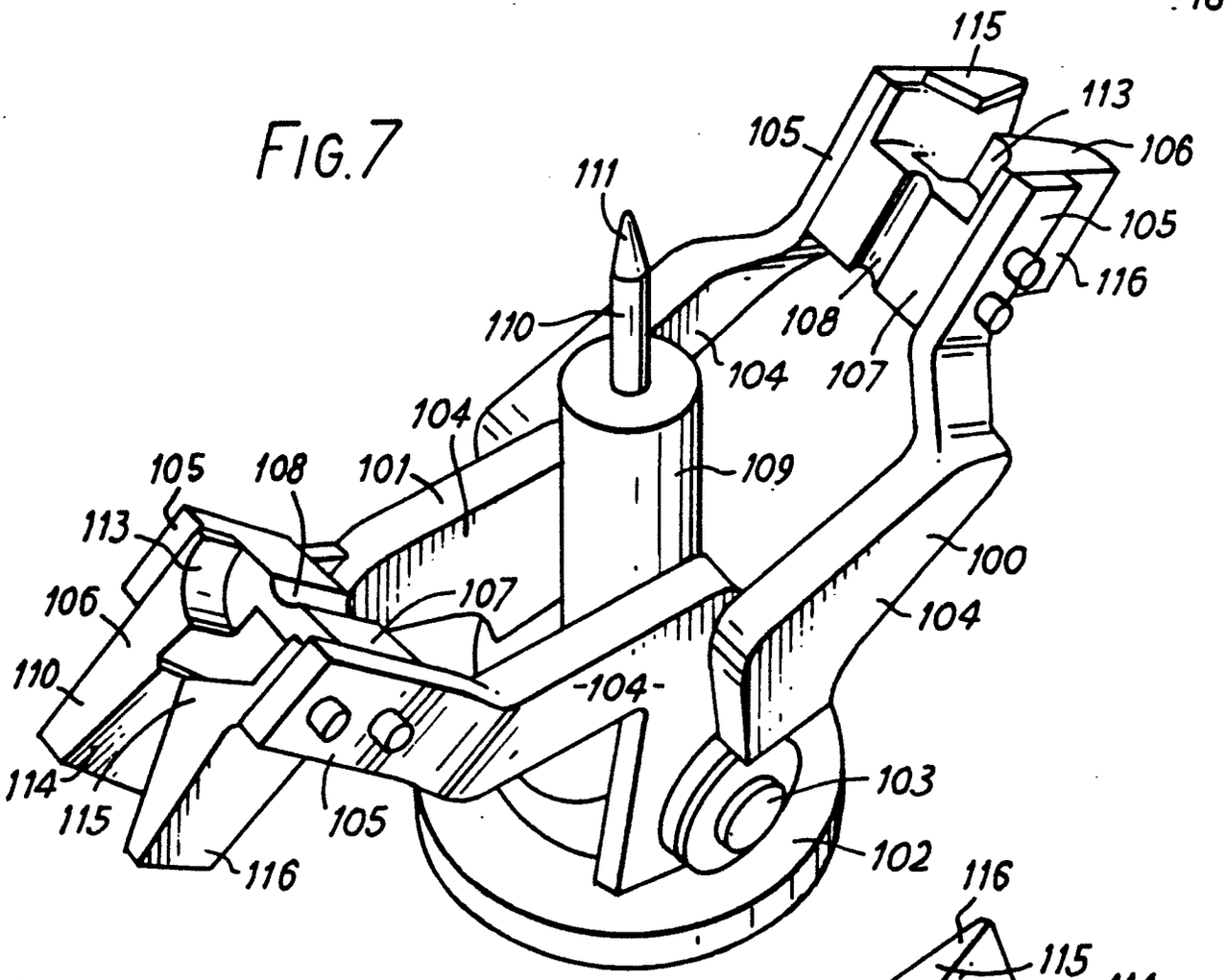


FIG.9

FIG.7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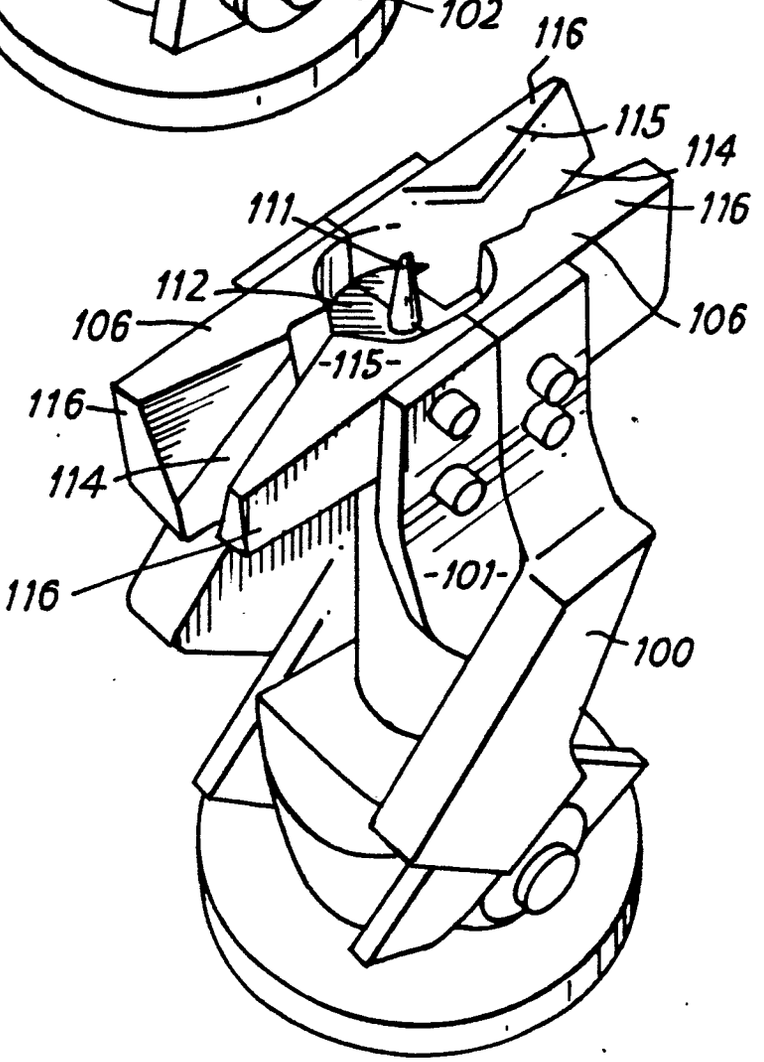
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FIG.8

European Patent Office

EUROPEAN SEARCH REPORT

Application number 0017674

EP 79200178.6

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	US - A - 1 684 723 (A.E. BASS) + Fig. 1,4-6 + --	1,3
	US - A - 4 117 872 (EVG) + Column 4, lines 65-68; column 5, lines 16-20; fig. 1,3 + --	1,3
D	DE - C - 310 265 (VEREINIGTE HÜTTENWERKE-BURBACH-EICH-DÜDELINGEN AG.) + Totality + --	
D	FR - A - 1 329 164 (V. GABILONDO E HIJOS S.L.) + Totality + --	
	CH - A - 494 675 (E. SCAMPICCHIO) + Totality + ----	1,3

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

B 65 B 13/28

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

B 21 F 7/00
B 21 F 15/00
B 65 B 13/00
B 65 B 27/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	28-05-1980	MELZER

EPO Form 1503.1 06.78