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(71) Applicant: **NIPPON ACCHAKUTANSHI SEIZO KABUSHIKI KAISHA**
4-8, Minamisenba 2-chome
Osakashi(JP)

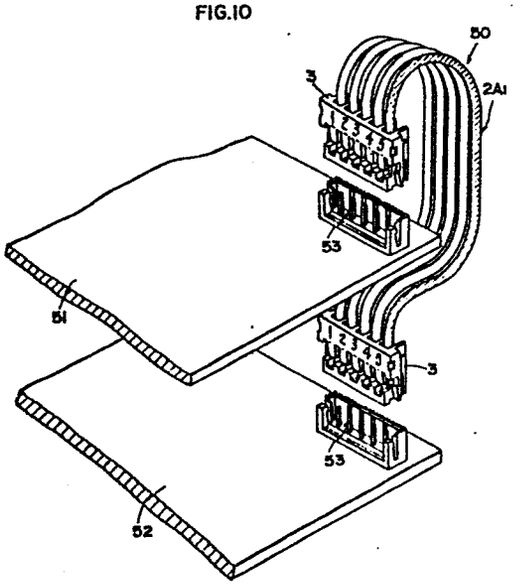
(72) Inventor: **Kashihara, Masatoshi**
19-4 Akutagawacho
Takatsukishi Osaka(JP)

(74) Representative: **Purvis, William Michael Cameron et al,**
D. Young & Co. 10 Staple Inn
London WC1V 7RD(GB)

(54) Apparatus for manufacturing electrical harnesses.

(57) Automatic apparatus, for manufacturing electrical harnesses (50) comprising a plurality of wires ($2A_1$) cut to a desired length and a multicontact type connector (3) attached to each of the ends of the wires ($2A_1$), fixes the connectors (3) to the wires ($2A_1$) in such a manner that their postures are completely reversed, thereby eliminating the necessity for twisting the wires ($2A_1$) when connecting the harness (50) to electrical devices (51,52).

FIG.10



Croydon Printing Company Ltd

APPARATUS FOR MANUFACTURING ELECTRICAL HARNESSES

The invention relates to apparatus for manufacturing electrical harnesses automatically and, more particularly, to fully automatic apparatus for manufacturing electrical harnesses of the kind which comprises a plurality of wires cut to a desired length and a multi-contact type connector attached to both ends of the wires.

In our published Japanese patent application No. 58/123686 an automatic apparatus for manufacturing electrical harnesses is described in which wires are cut to a desired length, and connectors are affixed to each of the opposing cut ends of the two wire groups by respective punch and die pairs. The two punch and die pairs are disposed adjacent to each other, and are simultaneously operable. Under this arrangement two connectors are affixed to the terminal ends of two wire groups by a single assembling operation.

The apparatus of our above-mentioned application has many advantages; one is that it is suitable for mass-production at low cost, and another is that the working efficiency is considerably increased. In addition, the apparatus as a whole is minimized in size because of the unique arrangement that the two punch and die pairs are located side by side with a cutting device interlocated therebetween. Furthermore, conductors can be affixed to the ends of wires cut to a short length, which would otherwise be difficult to do.

However, one drawback has been found with respect to a structure where the conductors are affixed to both ends of the wires in the same posture. Under this structure the circuit members of the contacts are located oppositely to each other, which necessitates that the wires are twisted through 180° so as to enable the circuit numbers thereof to accord with that of the conductor at the other end of the wires. Otherwise, the connection will be made between the contacts having wrong circuit numbers, which will result in electrical failure.

According to the invention, there is provided apparatus for making electrical harnesses including wires and electrical connectors, the apparatus comprising:

a wire supplying device for supplying wires along a wire feed path, wherein the wires are arranged side by side so that each of them is in parallel with the wire feed path;

a connector assembling device for affixing connectors to the terminal ends of the wires; and

a first chuck for pinching and transferring wires having the connectors affixed to the terminal ends thereof to a desired length in its advancing movement, the first chuck being reciprocally movable along the wire feed path;

characterised in that:

the connector assembling device comprises a first pair of punch and die and a second pair of punch and die, the punch and die in one pair being disposed in the reversed positions compared to those in the other pair with respect to the wire feed path, the two pairs of punches and dies being simultaneously operable, a cutting punch and die located between the first and second pairs of punch and die and operable independently thereof, and a connector supplying device for supplying the connectors onto the dies of the first and second pairs.

Thus the invention can provide a fully automatic apparatus which makes it possible to affix connectors to each end of two groups of wires in such a manner that the right circuit numbers are always in accord without twisting the wires through 180° when the wires are to be connected between two instruments or devices.

The invention is diagrammatically illustrated by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic front view showing one embodiment of apparatus for making electrical harnesses according to the invention;

Figure 2 is a vertical cross-section on a larger scale showing a preparatory assembling position of a connector attaching device of the apparatus of Figure 1;

Figure 3 is a cross-sectional view on a larger scale showing an assembling position of the device of Figure 2;

Figures 4 to 7 are cross-sectional views on a larger scale showing the operating states of an assembling device of the apparatus shown in Figure 1;

Figure 8 is a schematic plan view showing a finished electrical harness;

Figure 9 is a cross-sectional view taken on line 9-9 in Figure 8; and

Figure 10 is a schematic view showing an example of application of a finished electrical harness.

Figure 1 shows an overall view of apparatus for making electrical harnesses, the apparatus including a wire supplying device 10 for supplying wires 2 horizontally along a wire feed path (W) by way of rollers 6 and a tension roller 7. The apparatus also includes a connector assembling device 11 for affixing connectors 3 to the ends of wires 2A supplied continuously, and a moving chuck 12 (hereinafter referred to as the first chuck 12) for gripping the wires having the connector at its ends and pulling them to a desired length along the wire feed path (W). The first chuck 12 is reciprocally moved by means of a chain 9. A connector supplying device can be of known kind, for example a hopper feeder or a magazine, the description of which will be omitted for simplicity.

The wire supplying device 10 arranges a plurality of wires side by side, the wires being individually supplied from a number of reels 4 corresponding to that of the wires 2. The reference numeral 8 denotes a wire selecting and supplying device which selects a number of wires 2a corresponding to the number of poles of the connector 3.

The wire selecting and supplying device 8 includes a second chuck 13 for holding all the wires 2, and a third chuck 14 for holding the wires excluded from those to which connectors 3 are to be affixed. In addition, a wire guide 15 is included in the device 8, the wire guide 15 being located adjacent to the assembling device 11, and guiding the wires 2 along the wire feed path (W) to a connector assembling position. The second chuck 13, the third chuck 14 and the wire guide 15 are provided with a number of guide grooves 16, 17 and 18 corresponding to that of the wires which constitute the wire group 2 (normally 21 to 25 wires), wherein the grooves 16, 17 and 18 individually include a plurality of long cuts produced at equal intervals in parallel with the wire feed path (W). The interval is made equal to the pitch between each slot and the next in the contacts housed in an insulation housing. The wires 2 individually pass through the respective cuts, and reach the assembling device 11.

The second chuck 13 and the wire guide 15 are connected by means of a connecting rod 19, and they both can be moved slightly along the wire feed path (W) by means of a pneumatic cylinder 20. The third chuck 14 also can

be moved slightly along the wire feed path (W) by means of a pneumatic cylinder 21 mounted on the second chuck 13. This means that the third chuck 14 can be moved toward the wire feed path (W) equally by the pneumatic cylinders 20.

The assembling device 11 includes a first assembling punch (hereinafter referred to merely as the punch) 22 and a first die 23, and a second punch 24 and a second die 25, wherein the second punch and die pair 24,25 is located at the same side as the first chuck 12. The punches and dies in these pairs are disposed in such a manner that the punch of one pair and the die of the other are located on the same side with respect to the wire feed path (W). There are provided a cutting punch 26 and die 27 between the two punch and die pairs.

The die 23, the punch 24 and the cutting punch 26 are mounted on an upper slider 28, and the punch 22, the die 25 and the cutting die 27 are mounted on a lower slider 29. The upper slider 28 is provided with a connector presser 30 which oppresses the connectors under a spring (not shown) so as to locate the connectors 3 at a desired position adjacent to the open end of the die 23, and a wire guide 31 located adjacent to the punch 24, the wire guide 31 guiding and holding the wires when the connectors 3 are to be affixed to them. The connector presser 30 is also provided with a wire guide 32. The lower guide 29 is provided with its own wire guide 33 for guiding the free ends of the individual wires when the connectors 3 are to be affixed thereto, a connector presser 34 of the same type as that of the presser 30, and a wire chuck 35 movable in association with the wire guide 31. An additional wire guide 36 is provided adjacent to the punch 22, the wire chuck 36 being operable in association with the wire guide 32. The wire guide 33 is vertically movable, and is normally subjected to an upward urge under the action of a spring 37. When the assembling operation starts, the wire guide 33 is placed into abutment wih the die 23, and is slightly lowered under the assembling pressure. The wire chuck 35 is vertically moved by means of a pneumatic cylinder 38 mounted on the lower slider 29.

The cutting punch 26 is vertically moved by means of a pneumatic cylinder 39 mounted on the upper slider 28, independently of the punch 24 and die 23. As described below, the cutting punch 26 cuts the wires 2A in cooperation with the die 27 at the position shown in Figure 2, the position being hereinafter referred to as the preparatory position.

The upper slider 28 ascends and descends by means of a pneumatic cylinder 40, and is lowered to the assembling position shown in Figures 2 and 3. The lower slider 29 is caused to ascend or descend step by step by means of a first pneumatic cylinder 41 and a second pneumatic cylinder 42 mounted on the first cylinder 41 through a coupler 43. At first the lower slider 29 is raised up to the preparatory position shown in Figure 2 by the first cylinder 41, and then it is raised to the assembling position shown in Figure 3 by the second cylinder 42.

An example of the operation will now be described.

Referring to Figure 1, wires 2 are supplied from the reels 4, from which wires 2A are selected by the third chuck 14 in accordance with the number of poles of the connectors 3. The wires 2A are delivered to the assembling device 11, where the connector 3 placed on the die 23 is affixed to the terminal ends of the wires 2A. This is the initial stage of making electrical harnesses. In this case the upper slider 28 and the lower slider 29 are separated with the one being upward and the other being downward.

At this stage the first chuck 12 is moved to the centre of the assembling device 11 (Figure 4), and pinches the connector-affixed ends of the wires 2A while it is advanced away from the assembling device 11. As shown by dotted lines in Figure 4, the wires 2A are pulled out to a desired length.

As the first moving chuck 12 separates from the assembling device 11, the pneumatic cylinder 40 is operated to cause the upper slider 28 to descend to the assembling position, and the pneumatic cylinder 41 is operated to cause the lower slider 29 to ascend to the preparatory position. As a result, the first die 23 and the second punch 24 are lowered to the assembling position, and the first punch 22 and the second die 25 are raised to the preparatory position. This situation is shown in Figures 2 and 5. At this stage the cutting punch 26 is lowered by the pneumatic cylinder 39, and cuts the wires 2A in cooperation with the die 27. In Figure 5 the reference numeral $2A_1$ denotes that portion of wires 2A which is pulled out by the first chuck 12 to the desired length. As is evident from Figure 5, the connector 3 is affixed to the terminal ends of the portion of wires $2A_1$. This portion $2A_1$ is led to a position near the second punch 24 and die 25 by means of the wire chuck 35 and the wire guide 31 raised by the pneumatic cylinder 38. The wires 3 spearated from the portion $2A_1$ are pulled back

along the wire feed path (W) by the pneumatic cylinder 20, so as to enable the cut ends thereof to locate at a position (P) provided by the first punch 21, and the dies 22 and 23. Here the free terminal ends of the wires 2A are individually guided by the wire guide 33 (Figure 2).

The lower slider 29 is raised to the assembling position by means of the pneumatic cylinder 42. As shown in Figure 6, while the free terminal ends of the wires 2A are individually guided, the first punch 22 and the die 23 work in cooperation, thereby affixing the connector 3 already supplied on the die 25 to the tail terminal ends of the wire portion $2A_1$. At this time the wires 2A are pinched and held by the wire guide 32 and the wire chuck 36 at a position near the first punch 22 and die 23, and the wire portion $2A_1$ is pinched and held by the wire guide 31 and the wire chuck 35 at a position near to the second punch 24 and die 25. As a result, both wire groups 2A and $2A_1$ are prevented from moving while the assembling operation is carried out.

After the upper slider 28 and the lower slider 29 are separated with the one being moved upward and the other moved downward, the first chuck 12 resumes its advancing movement as shown in Figure 7, thereby pulling out the wire portion $2A_1$ having the connectors 3 at its both terminal ends. This portion $2A_1$ is a finished electrical harness 50. A cycle ends up with pulling out of the new wire portion $2A_1$ having the connectors 3 at both terminal ends. The procedure will be repeated.

As a result of the sequence of operation, the electrical harness 50 is obtained. As clearly shown in Figures 8 and 9, the finished electrical harness 50 comprises essentially the wire portion $2A_1$ cut to the desired length, and the connectors 3 affixed to the opposite terminal ends of the portion $2A_1$, wherein the connectors 3 are mutually in reversed positions. The wires are individually connected to respective contacts 3b having the circuit numbers corresponding to the number of the wires, wherein the contacts 3b are accommodated in insulation housing 3a. This has eliminated the risk of connecting the wires to wrong contacts. It is no longer necessary to turn the wires at 180^0 so as to enable them to accord with their circuit numbers of the contacts 3b. Thus the wiring work is facilitated.

As shown in Figure 10, the electrical harness 50 is used electrically to connect between printed boards 51 and 52. As seen in Figure 10, the wires are not twisted at all, which makes it easy to design the patterns

because the lines for the same signal are located at the same positions. In addition, since posts 53 with bases are fixed to the respective boards 51 and 52 in the same direction, they can readily be soldered without failure. Furthermore, the engagement of the connectors 3 with the posts 53 will be facilitated.

CLAIMS

1. Apparatus for manufacturing electrical harnesses, the apparatus comprising:

a wire supplying device (10) for supplying wires (2) along a wire feed path (W), wherein the wires are arranged side by side so that each of them is in parallel with the wire feed path;

a connector assembling device (11) for affixing connectors (3) to the terminal ends of the wires (2); and

a first chuck (12) for pinching and transferring wires having the connectors (3) affixed to the terminal ends thereof to a desired length in its advancing movement, the first chuck (12) being reciprocally movable along the wire feed path (W);

characterised in that:

the connector assembling device (11) comprises a first pair of punch (22) and die (23) and a second pair of punch (24) and die (25), the punch and die in one pair being disposed in the reversed positions compared to those in the other pair with respect to the wire feed path (W), the two pairs of punches and dies being simultaneously operable, a cutting punch (26) and die (27) located between the first and second pairs of punch and die and operable independently thereof, and a connector supplying device for supplying the connectors (3) onto the dies (23) and (25) of the first and second pairs.

2. Apparatus according to claim 1, further comprising a wire guide (33) for guiding the top terminal ends of the individual wires when the connectors are to be affixed thereto, the wire guide (33) being disposed between the punch (22) and die (23) of the first pair.

3. Apparatus according to claim 1 or claim 2, wherein the wire supplying device (10) comprises wire selecting and supplying devices (13), (14) and (15) for selecting, from those initially supplied, a number of wires (2A) in correspondence to the number of poles of the connector (3) to be affixed thereto.

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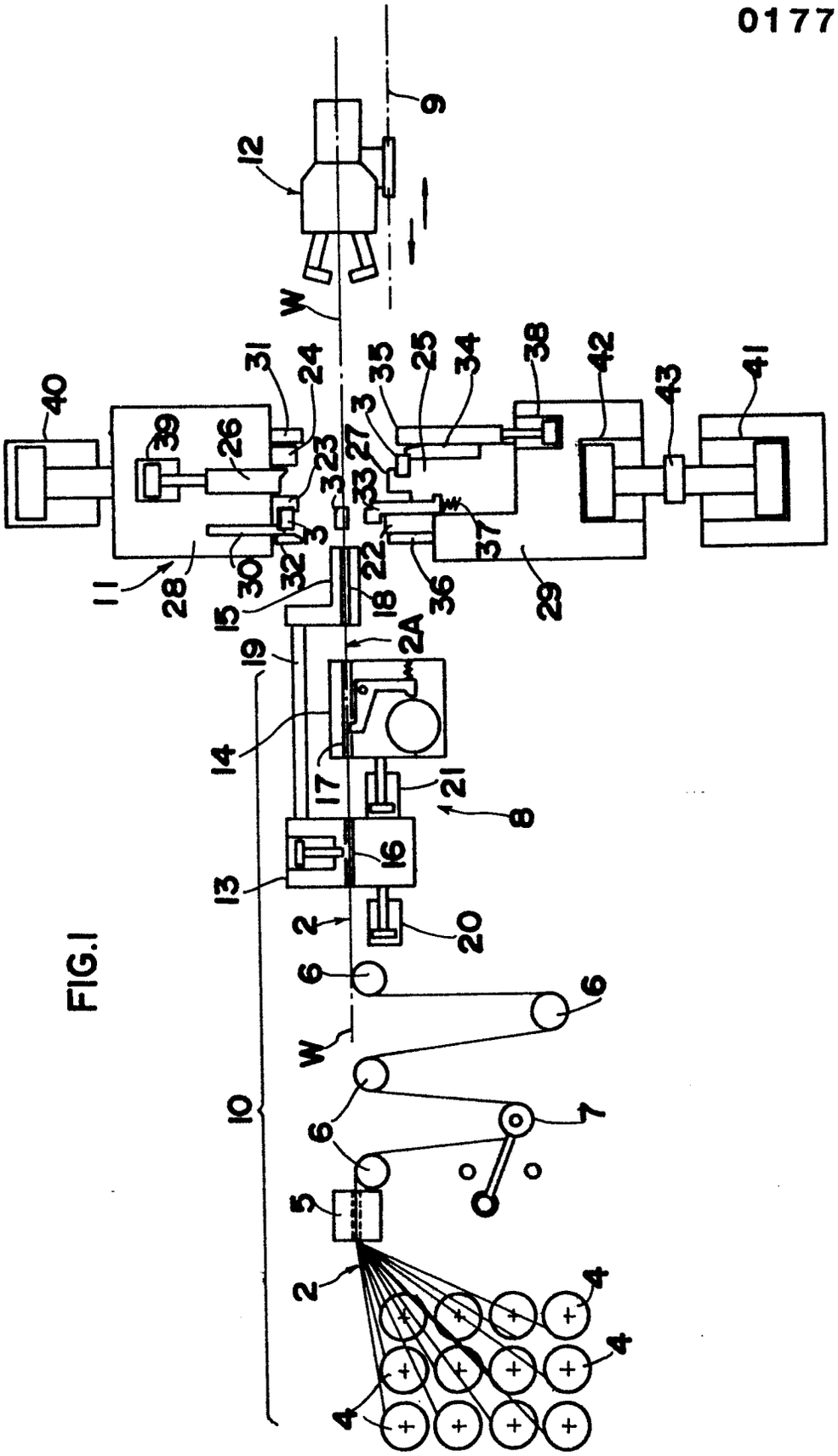

FIG.1

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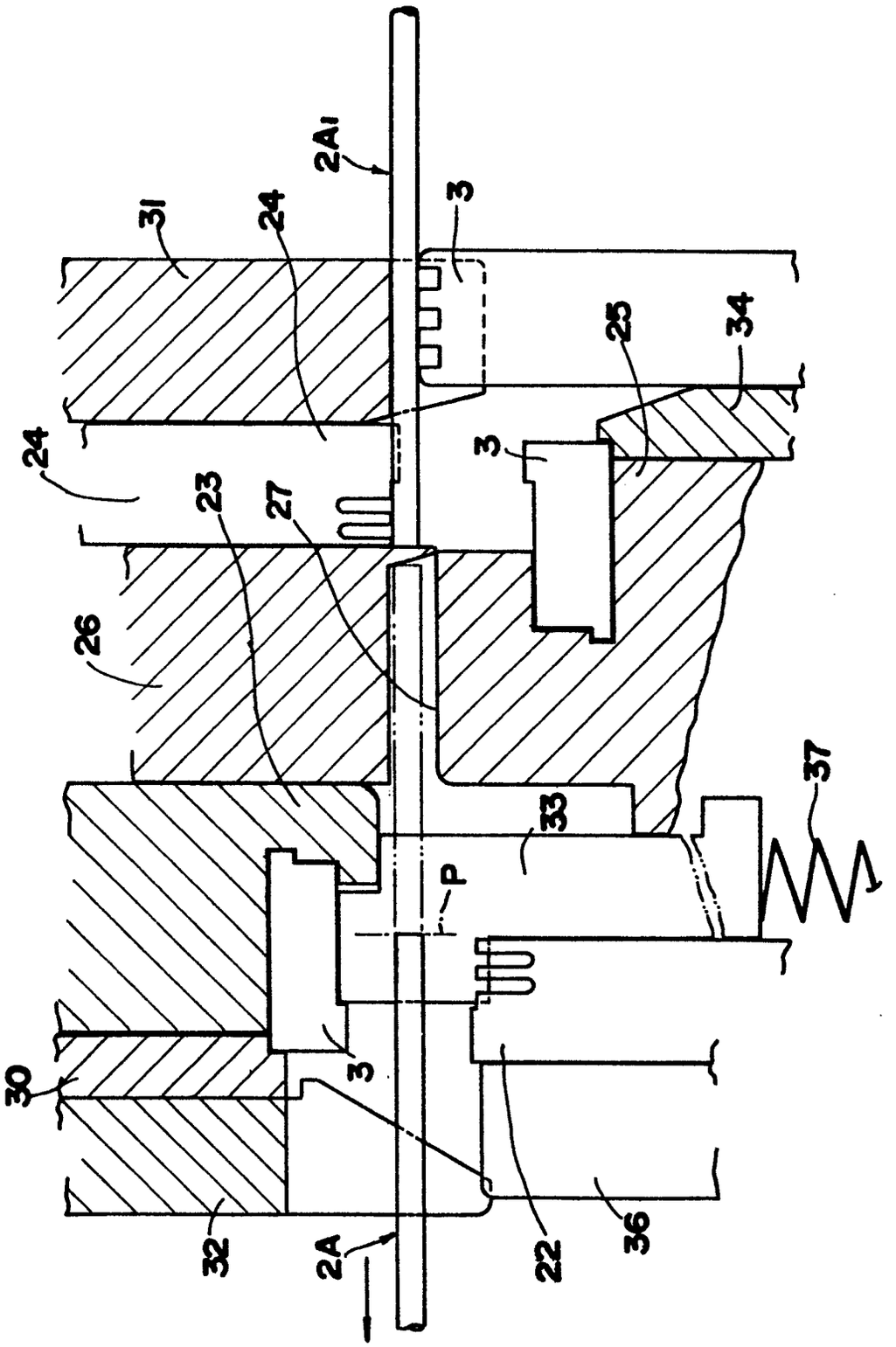

FIG.2

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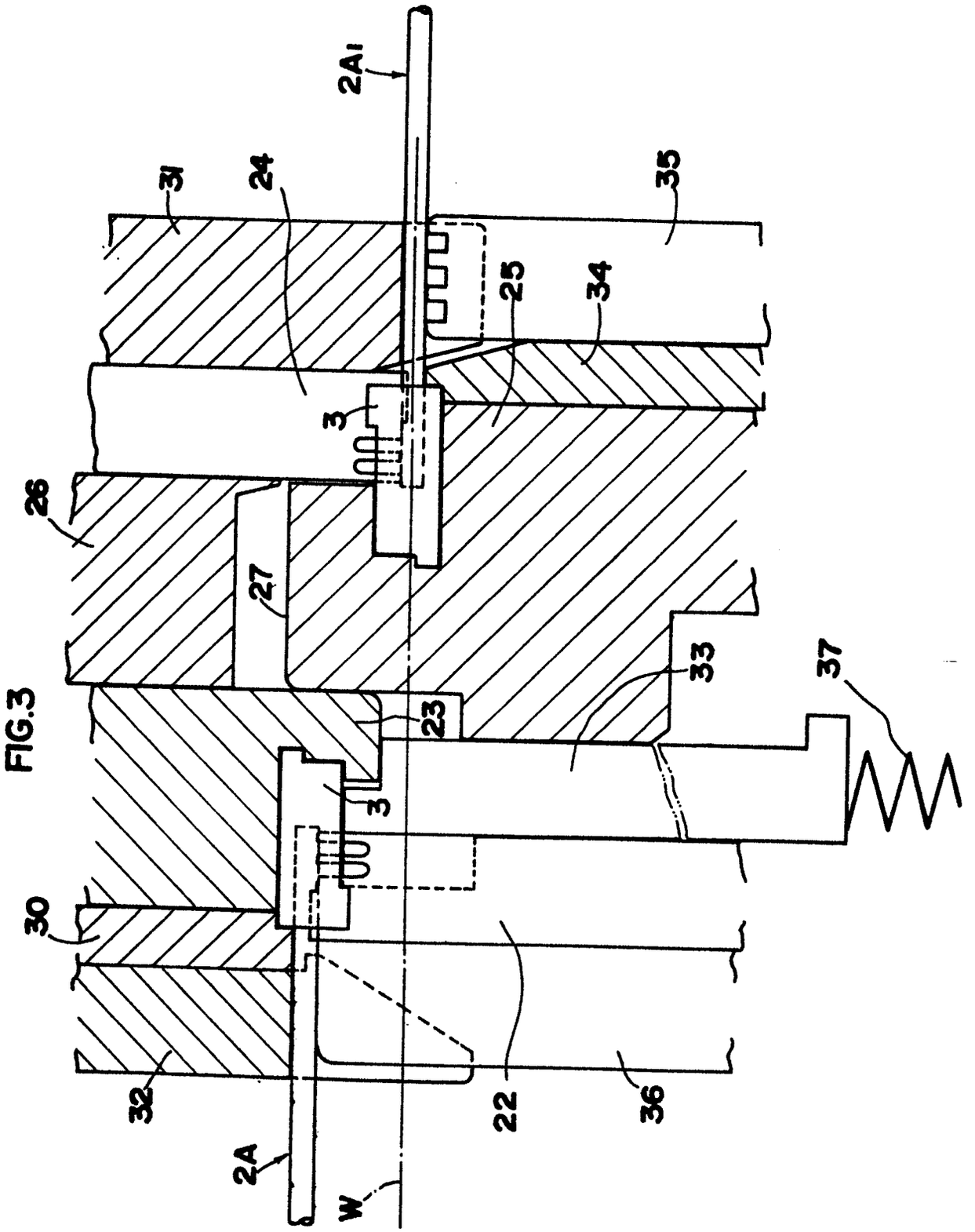

FIG.3

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FIG.4

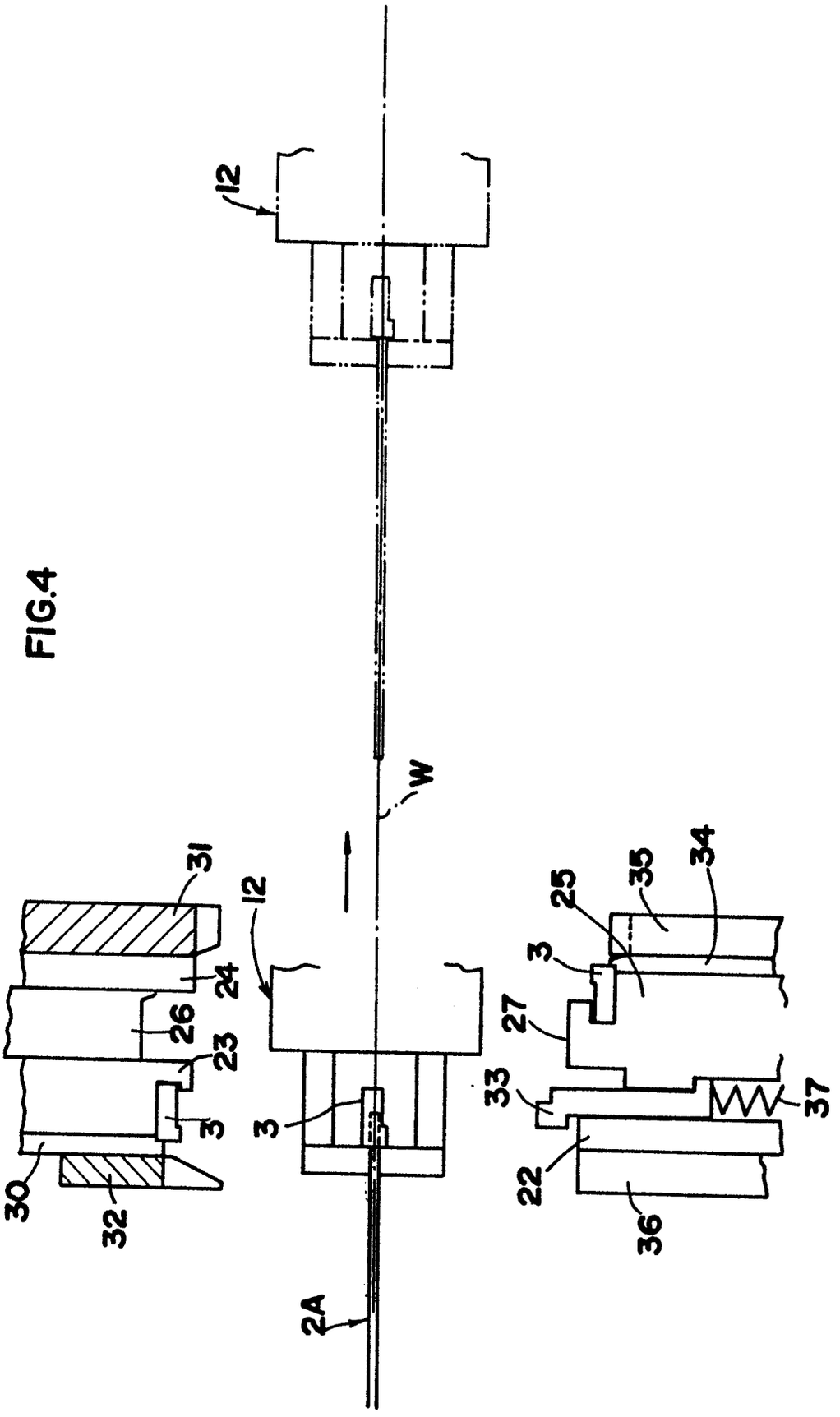

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FIG.5

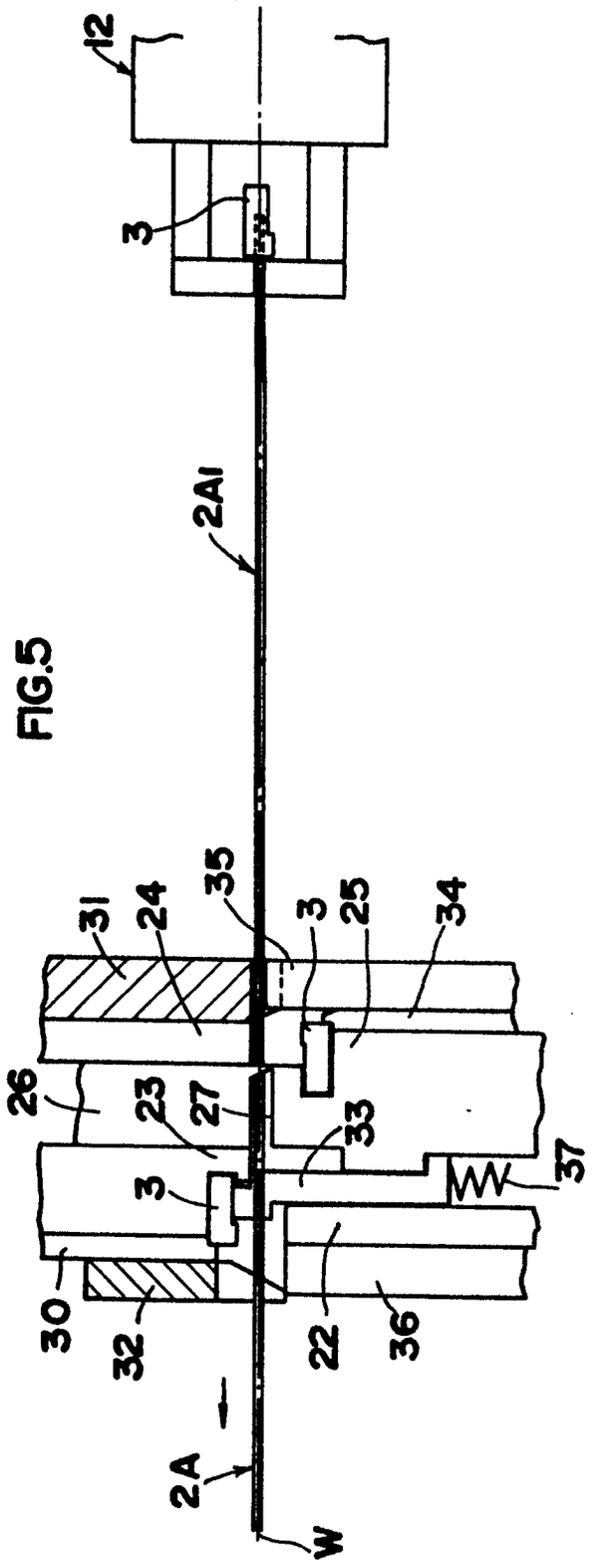

FIG.6

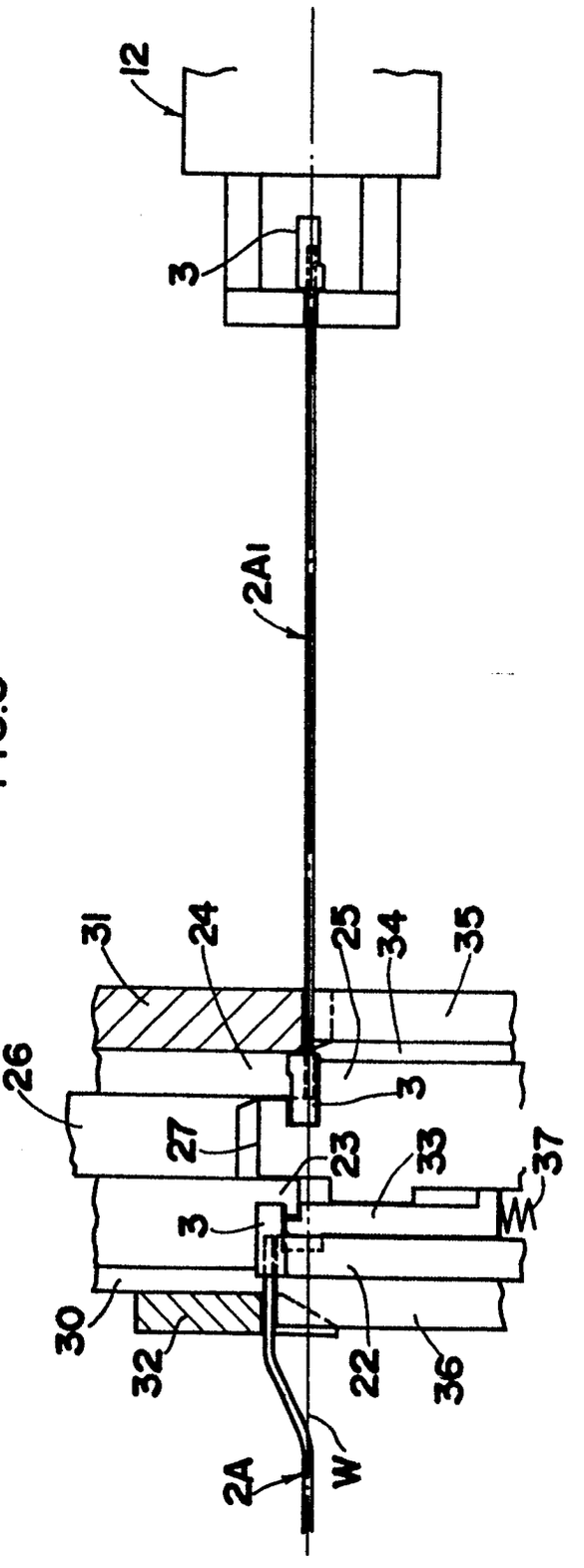

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FIG.7

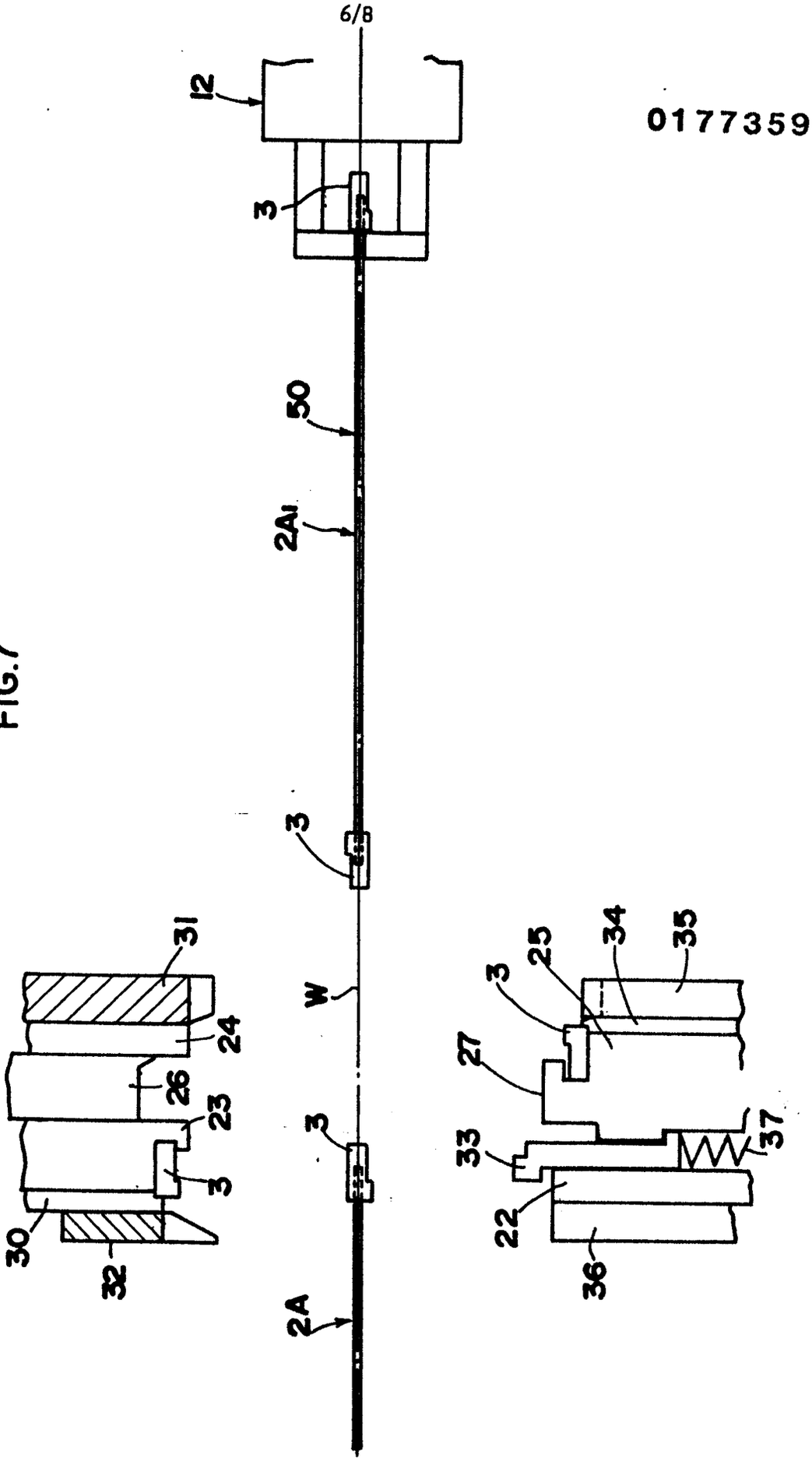

FIG.8

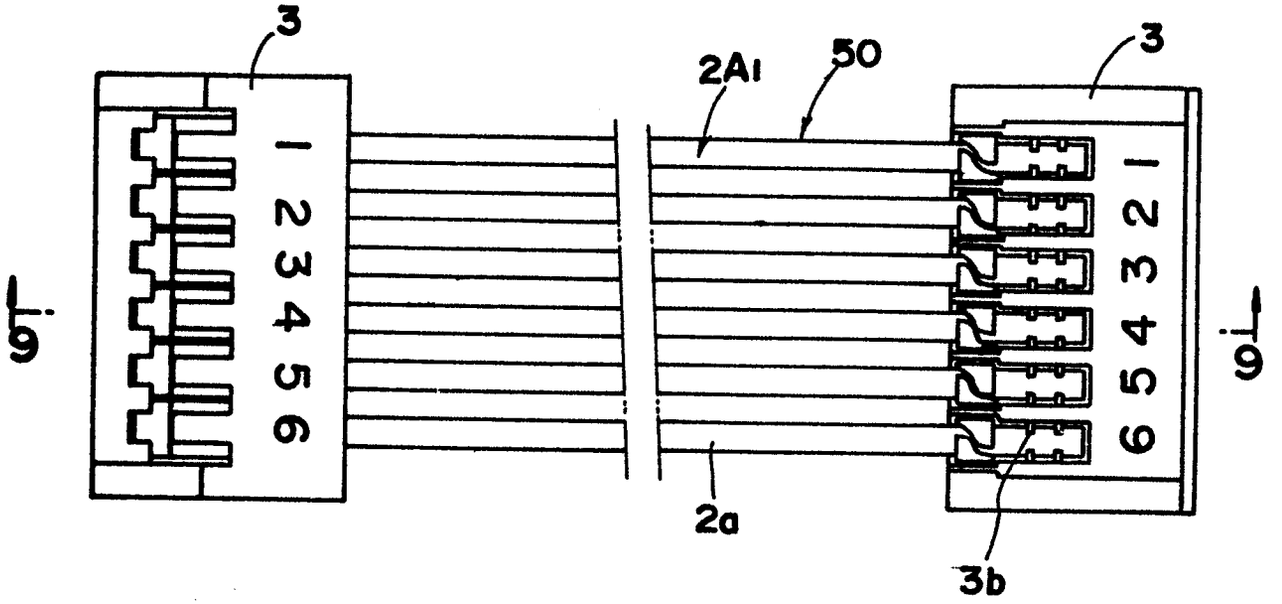

FIG.9

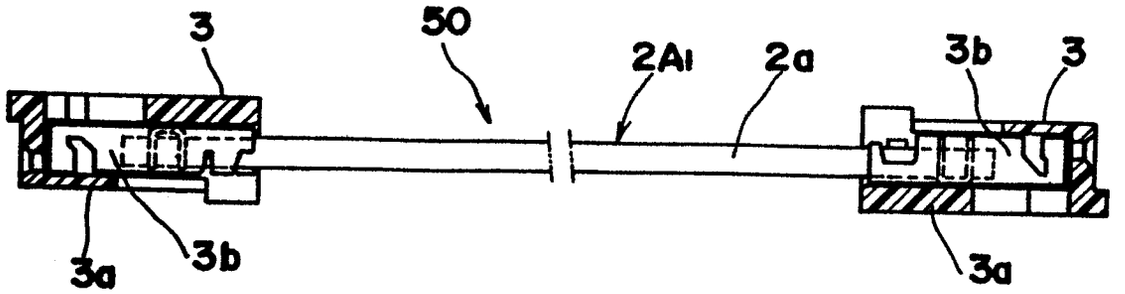

FIG.10