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54 **A HORIZONTAL ELECTROLYTIC METALLIZATION CELL PLANT WITH SOLUBLE ANODES, FOR THE CONTINUOUS ELECTROLYTIC TREATMENT OF STEEL STRIPS ON ONE OR TWO FACES.**

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Description

The present invention refers to the field of equipment for continuous galvanic treatment of metallic strips, particularly steel strips, by means of soluble anodes. Later particular reference will be made to an electrolytic zinc plating treatment. It must, however, be understood that any electrolytic treatment for coating, also with metals other than zinc, comes within the range of the present invention.

At present various types of horizontal cell plants for the continuous electrolytic zinc plating of strips are known.

In a first type of known plant, electrolytic zinc plating is carried out on both faces of a strip at the same time, by means of bar-shaped soluble anodes, positioned above and below the strip, transversely to the longitudinal direction of the strip. Plants of this type have the drawback that the anode bars wear out unevenly along their width, that is they wear out more at the centre and less at the edges, and therefore the distance between the strip to be treated and the centre of the anode bars increases and becomes greater than the distance between the strip and the edges of the bars; as the plating is affected by the distance, the result is unevenness of the plating itself in the transverse direction of the strip. A further drawback is the need to stop the plant in order to replace the worn bars, as this operation cannot be carried out while the plant is working. Finally, such a plant cannot be quickly and easily adapted for zinc plating strips on one side only.

In a second known type of horizontal cell plant, a strip for zinc plating on one side only is unwound from a coil outside the electrolytic bath and deviated by curving it with rollers so that it travels with its portion subjected to treatment being immersed in an electrolytic bath. The zinc plating is carried out on the lower face of the strip by means of soluble anodes positioned lengthwise to the strip, supported on sloping surfaces. Replacement of the anode bars is carried out continuously without the need to stop the plant. Although this type of plant has the advantage, with respect to the previous one, of eliminating down time due to the replacement of the bars, it cannot, however, be adapted for zinc plating the strip on both sides; in addition, in the case of strips of a relatively large thickness, the deviated or curved path of the strip can give rise to technical complications or high costs.

In some known plants, the feeding of the electrolytic solution to the bath takes place from above the latter by means of a supply pipe wherein flow regulation is carried out inside the bath tank the circulation is natural; draining takes place by

means of an overflow; this causes too weak a circulation of liquid which, in turn, gives rise to scanty, poor quality plating of the coating metal and also limits the density of the current which can be used.

In said second type of plant forced circulation of fluid is foreseen along the lower face of the strip, determined by orifices positioned below the strip. This solution, however, does not give valid teaching for the treatment of the strip on both faces.

In addition, in some other plants the strap enters and leaves the bath tank sliding along fixed lip seals; however it is easy for solid particles to be deposited on these, resulting in longitudinal scorings on the strip, caused by its sliding along these particles.

A further known drawback in the field consists in the fact that, because of the so-called "edge effect", the deposit on the longitudinal edges of the strip is of a greater thickness than at the centre of the strip and, in addition, has a spongy consistency from which particles easily become detached, which pollute the bath and are caught by the aforesaid lip seals, thus causing a scoring problem; where zinc plating is required on one face only owing to the edge effect, the other face is flooded also. A solution adopted up to now, where greater thickness is not acceptable, consists in trimming the edges of the strip, thus involving waste of material and additional work costs. A further solution adopted consists in placing "masks", that is two longitudinal hollow rods facing each other, along the edges of the strip; the masks are generally mounted so that their reciprocal distance can be regulated according to the width of the strip. One drawback of the known plants is, however, that the strip can undergo transverse oscillations, thus moving from the position which is ideal with respect to the masks.

EP-A-0 039 453 discloses a horizontal cell plant for continuous electrochemical treatment of strips, comprising soluble bar anodes, an electrolyte bath tank and two wringer rollers between which the strip passes sealed.

EP-A-0 276 725 discloses electrolyte distribution chambers positioned above and below the sample to be treated, the chambers being shaped as a plurality of holes.

One aim of this invention is to produce a horizontal electrolytic cell plant for the continuous treatment of strips by means of soluble electrodes positioned substantially lengthwise to the strip, in which it is possible to select the treatment of one face only or of both faces of the strip.

Another aim is to produce such a plant in which at every moment there is an optimal circulation of the solution of the electrolyte in the... bath tank, on the one face and the other of the strip.

A further aim is to produce a coating which is compact and adhering to the surface of the base strip to be treated.

A further aim is to produce a plant which does not need fixed lip seals, so as to eliminate the problem of scoring.

A yet further aim consists in providing the possibility of adapting the position of the masks to the oscillations of the strip.

These aims have been achieved, according to this invention, with a horizontal cell plant for continuous electrolytic treatment of strips, according to claim 1.

Other characterizing features of the invention are stated in the subsequent claims.

The first advantage consists in the fact that a coating is produced which is compact and adhering to the surface of the base strip to be treated.

Another advantage of the new plant consists in the fact that an optimal circulation of electrolyte in the bath is produced under the different process conditions.

Another advantage consists in the fact that the need for seals and for members in general subject to sliding on the strip is avoided, thus avoiding longitudinal scoring.

A further advantage consists in the fact that it is possible to provide treatment on one face only of the strip (when the movable anodic bars are moved say and/or the upper circulation of the electrolyte is interrupted), or of both faces of the strip (when the movable anodic bars are in the working position and the electrolyte circulates both above and below the strip).

A further advantage consists in the fact that the bath tank is symmetrical and can be used both for operation in the same or in counter flow direction.

Finally, by means of the oscillating mounting of the masks, their adaptation to strip oscillations is allowed.

A presently preferred exemplary embodiment of the invention will now be described with reference to the enclosed drawings, in which:

- Fig. 1 is a partly schematic, cut off longitudinal section of a horizontal cell plant for continuous electrolytic strip treatment;
- Fig. 1a is an enlarged, cut off illustration of a part of fig. 1;
- Fig. 2 is a cut off side view of the plant as a whole;
- Fig. 3 is a top view of the cell, on a reduced scale with respect to fig. 1;
- Fig. 4 is a section taken along 4-4 in fig. 3, with one part removed;
- Fig. 5 is a side view of the mask supporting and moving device, on an enlarged scale with respect to fig. 1;

Fig. 5a is a top plan view of the masks and of their supporting and moving device, shown cut off;

Fig. 6 is a cut off section taken along 6-6 in fig. 5a;

Fig. 7 shows a variant of the plant, in a section similar to fig. 1a, in which the upper anodes are fixed and the level of the electrolyte in the bath tank is variable;

Fig. 8 shows the variant of the plant in fig. 7 in a section similar to fig. 4;

Fig. 9 shows a further variant of the plant in a cut off section similar to fig. 1.

In the various figures, identical elements bear the same reference numbers.

A horizontal cell plant for the continuous electrolytic treatment of strips N, generally steel strips, by means of soluble anodes, is indicated as a whole with 10 and comprises a fixed structure, indicated as a whole with 12, made, for example, of various sheet metal elements welded together, and supported on supports 11 anchored to uprights 11a (fig. 2).

The structure 12 forms internally a bath tank 14 for the electrolytic liquid, into which the strip N to be coated passes continuously, unwound from a coil of strip, not shown. On the inlet side E of the strip, the fixed structure 12 (fig. 1a) forms a lower head 13 and an upper head 15 on which two adjustable inlet bars, 16 and 18 respectively are mounted, and define between them a strip inlet slit or orifice 20. Between the lower bar 15 and an element 22 (an anode guide bar, as will be described further on) which is fixed with respect to the structure 12, a distribution passage or chamber 23 is formed for the electrolytic liquid, and is preferably slightly sloping with respect to the level of the strip and directed towards it.

Between the upper bar 18 and an opposite wall 24 of the upper head 15 a distribution passage or chamber 25 for the liquid is formed, and is preferably sloping with respect to the level of the strip and directed towards it. Each distribution chamber or nozzle extends transversely to the strip for a width greater than or equal to the latter.

Electrolyte feeding manifolds, of which only end openings 13a, 15a are visible, are integral with the heads 13 and 15

The lower part of the fixed structure 12 of the bath tank bears two conductor bars 26 for the lower anodes. The bars are generally made of carbon and are supported on the structure 12 by means of insulating plates 29. Positive electric polarity is supplied, in a known way, to conductor bars 26 through appropriate electrical bars 30, through connection studs 31. The cell contains an anodic assembly made up of soluble type lower 32 and

upper 34 anode bars. The lower anode bars, positioned substantially lengthwise or obliquely with respect to the axis of the path of the strip, and located side by side, are supported on sloping supporting surfaces consisting of the same carbon bars 26 (fig. 4). The upper anode bars 34 are also positioned substantially lengthwise or obliquely with respect to the direction of movement of the strip and are supported with their extremities on sloping conducting support surfaces (fig. 1a), integral with a mobile structure 40.

The slope of the longitudinal anode bars supporting surface allows the wear on the bars to be compensated, in known manner; each more worn bar is removed from one side of the plant (on the right in fig. 4) and replaced with a new bar on the opposite side of the plant, (on the left in fig. 4) and each time a known pushing device 42 (figs. 3 and 4) moves the assembly of upper and lower bars a distance equal to the width of a bar.

The positive polarity is supplied to the upper anodes 34, on each side, through a flexible electric bar 44 (fig. 1; fig. 7), a rigid electric bar 46, and a conductor plate 47 which forms the supporting surface 38 for the anode bars 34. By means of an insulating plate 48, the plate 47 is applied to a crosspiece 49 supporting the upper anodes, which, in its turn, is supported by a movable crosspiece 50. What has been described for one end of the upper anode group applies to the other end also. The movable crosspieces 50 (fig. 1) are integral with jack stems 54 (fig. 2) or with any other lifting system, so that the upper group of anodes can be lifted when treatment of a strip on the lower face only is required, and lowered into working position when treatment of a strip on both faces is required.

Both at the inlet and the outlet of the bath tank, the strip meets two counter-rotating rollers (51, 53 and 91, 90), the lower of which is a conductor of negative polarity electric current and the upper acts as a press.

Both at the inlet and the outlet of the bath tank the strip meets a pair of counter-rotating wringer rollers, 59, 59; 60, 60 respectively, positioned with their horizontal axes transversal to the strip and having on their sides two lateral sealing sectors, 61, 62 respectively.

Inside the bath tank the strip slides into the space 56 defined along the lower and, if any, upper anodes.

Each of the sealing sectors 61, 62 is formed with two arc shaped cavities 63, 63, 64, 64, so as to form a seal against the wringer rollers. At their lower part the sealing sectors are integral with the respective heads 65, 65'. An adjustable plate 66 is integral with one of these heads; an adjustable overflow port 68 for the discharge of the electrolyte is defined between the upper surface of the plate

66 and the lower wringer roller. An adjustable sealing plate 67, which seals against the surface of the lower finger roller, is integral with the other head 65.

The electrolyte containing zone is therefore defined by the heads 65 and 65', by the lateral sectors 61, 62, by the wringer-rollers 59, 60 and by the plates 66, 67. At its outlet the strip passes between the wringer rollers and therefore has no sliding contact with any member.

A weir regulating valve is indicated with 69 in figure 1, and is also used for draining the plant. In the case of plants with a high electrolytic recirculation flow, a variant (fig. 9) is foreseen which includes a vertical drain duct 108 capable of creating a vacuum to facilitate the inflow of the electrolyte.

The plant also comprises a mask group 70 (fig. 1, fig. 5 and fig. 5a), to avoid excessive and irregular deposit phenomena on the longitudinal edges of the strip.

The mask group (figs. 1, 5, 5a, 6) comprises, in the known manner, two rods 72, being the said masks, having substantially V shaped longitudinal cavities, opposite to each other and positioned in the electrolytic bath along one side and the other of the strip, between the upper and lower anodes. Each mask is mounted on a support 74; the two supports slide on a transverse guide bar 76. Each support 74 is made integral, by means of an arm 75, with a slider 77 (fig. 6) whose position can be adjusted on a mask centering shaft. 78. Generally the sliders 77 are made up of nut screws and the shaft 78 has opposite threads 78a, b. The shaft 78 is rotatably supported on a fixed framework 80, to which a gearmotor unit 82 can be applied, in a known manner, to determine the rotation and therefore regulate the position of the sliders 77 according to the width of the strip.

According to a characteristic of this invention, a cylinder/piston unit 86 is applied to the shaft 78 by means of a sliding rotary coupling 84, available on the market. This is controlled by a sensor (not shown) which detects the position of the edge of the strip so that the entire shaft 78/slider 77 unit and the relative masks 72 can be moved along the axis of the shaft 78, so as to follow the oscillations of the strip N, moment by moment, transversely to its feed direction.

For its working the plant is prearranged with the upper anodes raised, for treatment of the lower face of the strip only, or with the anodes lowered, for treating both faces of the strip, and with the masks in an adjusted position with respect to each other, according to the width of the strip.

The electrolyte in the plant is injected under pressure through the distribution chambers 23, 25, at a pressure according to the speed required for recycling the electrolyte in the bath tank, and comes

out through the overflow port 68.

The strip N travels along the bath tank in the same or in the opposite direction from the electrolyte, not having, in any case, any sliding contact, either when entering or leaving.

Number 120 shows an already known liquid collection funnel.

A variant of the described plant (figs. 7 and 8) consists of an electroplating cell having its upper anodes in a fixed position (fixed crosspiece 49') , and a hydraulic system which allows the level of electrolyte in the bath tank to be maintained alternately at two predetermined heights, shown in fig. 8 with dotted lines and reference nos. 105 and 106. The elements with identical reference nos., as in fig. 1a, are identical and will not be described.

When the electrolyte is maintained at the highest level, 105, the upper anodes are immersed and it is possible to carry out electrolytic coating on both sides of the strip.

When the electrolyte is maintained at the lowest level 106, that is, slightly higher with respect to the path line of the strip, the upper anodes are not immersed in the electrolyte. In this case electrolytic coating is carried out on the lower side of the strip only.

The system for setting the electrolytic level at the two foreseen heights comprises an exhaust manifold with two chambers, an upper one 101 and a lower one 102 (fig 8). An on-off valve 103 connected to the lower chamber allows operation through the upper chamber weir 95 when it is closed, and operation through the lower chamber weir 115 when it is open.

The level of both the weirs can be regulated by an adjustable rod 104.

According to another fundamental characteristic of the invention, provision is made for the flow of electrolyte to be regulated in accordance with the current density, by operating, for example, regulating valves (not shown) positioned on the delivery side of the feed or electrolytic pumps, or by using variable delivery pumps. By current density the ratio is meant between the electrolytic current intensity and the surface of the strip concerned. This allows the production of a compact coating, adhering to the strip surface.

Claims

1. A horizontal cell plant, with soluble anodes, for continuous electrolytic treatment of strips (N), comprising: a bath tank (14) for the electrolyte; an anode assembly in said bath tank comprising bar-shaped anodes; an electrolyte inlet end and an outlet end in the bath tank both the bath tank inlet and outlet ends comprising two counter-rotating wringer rollers (59, 60) be-

tween which the strip passes sealed, characterized in that said anodes are supported on sloping surface supports, at least two distribution chambers (23, 25) are positioned one above and the other below the path of the strip, sloping with respect to the path of the strip; the distribution chambers (23, 25) extend over the whole width of the strip, the anode assembly comprises a pushing device (42) for pushing the anodes forward when it is necessary to carry out the replacement of the worn anodes; said plant further comprising upper anodes (34) and lower anodes (32), the upper anodes being positioned above the path of the strip, the lower anodes being positioned below the path of the strip; the upper anodes being movable between a working position, in which they are opposite to the lower anodes and are immersed in the electrolyte, and a rest position, in which the upper anodes are clear of the electrolyte

2. A plant according to claim 1, characterized in that the upper anode (34) support surfaces (38) are integral with bars (46), which are, in turn, integral with lifting jack stems.

3. A plant according to claim 1, characterized in that it has longitudinal masks (72) positioned along the longitudinal edges of the strip to avoid excessive or irregular deposits of material, the said masks being movable horizontally and vertically with respect to the edges, each mask being integral with an arm (75), each arm being integral with a slider (77), the sliders being movable in opposition to each other on a shaft and controlled from a strip position sensor.

4. A plant according to claim 3, characterized in that the sliders (77) are movable simultaneously and in opposition to each other on a shaft (78); said shaft being connected by a sliding rotary coupling to a cylinder-piston capable of moving the shaft axially, the cylinder-piston being controlled from said strip position sensor.

5. A plant according to claim 1, characterized in that the height of the electrolyte in the bath tank is determined between a higher level, wherein the anodes positioned above the path of the strip are wetted, and a lower level, which reaches just above the strip, by means of an upper (95) and a lower (115) weir, the upper weir being in communication with an upper chamber (101), the lower weir being in communication with a lower chamber (102), the

latter being in communication with a duct comprising an on-off valve (103).

Patentansprüche

1. Horizontale Elektrolytzellenanlage mit löslichen Anoden für die kontinuierliche elektrolytische Behandlung von Bändern (N) mit einem Behälterbad (14) für den Elektrolyt, einer Anodenanordnung in dem Behälter mit stangenförmigen Anoden, einem Elektrolyteinlaßende und auslaßende an dem Behälter, die beide zwei gegenlaufende Quetschwalzen (59,60) aufweisen, welche das Band, zwischen den Walzen dichtend eingeschlossen, passiert, dadurch gekennzeichnet, daß die Anoden von geneigten Trägerflächen getragen sind, zumindest zwei Verteilerkammern (23,25), die eine oberhalb, die andere unterhalb der Bahn des Bandes und geneigt zu dieser angeordnet ist, daß die Verteilerkammern (23,25) sich über die gesamte Breite des Bandes erstrecken, daß die Anodenanordnung eine Vorschubvorrichtung (42) zum Zustellen der Anoden nach Maßgabe des Anodensverbrauchs aufweist, daß die Anlage weiterhin obere Anoden (34) und untere Anoden (32) aufweist, von denen die oberen oberhalb der Bandbahn, die unteren Anoden unterhalb dieser Bandbahn angeordnet sind und die oberen Anoden zwischen einer Arbeitsstellung, in der sie gegenüber den unteren Anoden angeordnet und in den Elektrolyt eingetaucht sind, und einer Ruhestellung oberhalb des Elektrolyts bewegbar sind.
2. Anlage nach Anspruch 1, dadurch gekennzeichnet, daß die Trägerflächen (38) für die obere Anode (34) mit Balken (46) verbunden sind, welche ihrerseits mit Hubvorrichtungen verbunden sind.
3. Anlage nach Anspruch 1, dadurch gekennzeichnet, daß sie Längsmasken (72) aufweist, die längs der Längskanten des Bandes angeordnet sind, um übermäßige oder ungleichmäßige Materialablagerungen zu vermeiden, wobei die Masken horizontal und vertikal bezüglich der Kanten verlagerbar sind und jede Maske mit einem Arm (75) verbunden und jeder Arm mit einem Gleitteil (77) in Verbindung steht und die Gleitteile gegeneinander auf einer Achse bewegbar von einem Positionssensor für das Band gesteuert sind.
4. Anlage nach Anspruch 3, dadurch gekennzeichnet, daß die Gleitteile (77) gleichzeitig und gegeneinander auf einer Achse (78) bewegbar sind und die Achse über eine Gleit-

Dreh-Kupplung mit einem Zylinderkolben verbunden ist, der die Achse axial verlagern kann, wobei der Zylinderkolben durch den Positionssensor für das Band gesteuert ist.

5. Anlage nach Anspruch 1, dadurch gekennzeichnet, daß der Füllstand des Elektrolyts in dem Bandbehälter durch ein oberes Niveau, bei welchem die über dem Bandweg angeordneten Anoden befeuchtet werden, und einem unteren Niveau, das gerade über das Band reicht, bestimmt ist, und zwar mittels eines oberen (95) und eines unteren (115) Wehr wobei das obere Wehr mit einer oberen Kammer (101) und das untere Wehr mit einer unteren Kammer (102), die mit einer Leitung mit einem Auf/Zu-Ventil (103) verbunden ist, kommuniziert.

Revendications

1. Installation de cellule horizontale, avec anodes solubles, pour le traitement électrolytique en continu d'acier feuillard (N) comprenant: une cuve (14) pour l'électrolyte; un groupe d'anodes dans ladite cuve, comprenant des anodes en forme de barre; une extrémité d'entrée pour l'électrolyte et une extrémité de sortie dans la cuve, les deux extrémités d'entrée et de sortie de la cuve comprenant deux rouleaux essoreurs contretournants (59, 60) entre lesquels le feuillard passe hermétiquement, caractérisée en ce que lesdites anodes sont soutenues sur supports à plan incliné, au moins deux chambres de distribution (23, 25) sont disposées l'une au-dessus et l'autre au-dessous du parcours du feuillard, inclinées par rapport au parcours de feuillard; les chambres de distribution (23, 25) s'étendent sur toute l'ampleur du feuillard, le groupe d'anodes comprenant un poussoir (42) pour pousser les anodes, quand il faut effectuer le remplacement des anodes usées; ladite installation comprenant en outre un groupe d'anodes supérieures (34) et d'anodes inférieures (32), les anodes supérieures étant disposées au dessus du parcours du feuillard, les anodes inférieures étant positionnées au dessous du parcours du feuillard; les anodes supérieures étant déplaçables entre une position de travail, où elles se trouvent face aux anodes inférieures et où elles sont plongées dans l'électrolyte, et une position de repos où les anodes supérieures sont libres de l'électrolyte.
2. Installation selon la revendication 1, caractérisée en ce que les surfaces de support (38) de l'anode supérieure (34) sont solidaires des bar-

res (46) qui sont à leur tour solidaires des tiges de vérins de levage.

3. Installation selon la revendication 1, caractérisée en ce qu'elle présente des masques longitudinaux (72) disposés le long des cotés longitudinaux du feuillard afin d'éviter des dépôts excessifs ou anormaux de matériau, lesdits masques étant mobiles en sens horizontal et vertical par rapport aux cotés, chaque masque étant solidaire d'un bras (75), chaque bras étant solidaire d'un curseur (77), les curseurs étant mobiles en opposition entre eux sur une tige et étant contrôlés par un capteur de la position du feuillard.
4. Installation selon la revendication 3, caractérisée en ce que les curseurs (77) sont mobiles contemporanément et en opposition entre eux sur une tige (78), ladite tige étant reliée à l'aide d'un joint coulissant à rotation à un cylindre-piston qui peut déplacer la tige axialement, le cylindre-piston étant contrôlé par ledit capteur de la position du feuillard.
5. Installation selon la revendication 1, caractérisée en ce que la hauteur de l'électrolyte dans la cuve est déterminée entre un niveau supérieur, où les anodes placées au-dessus du parcours du feuillard sont mouillées, et un niveau inférieur, où elle arrive juste au-dessus du feuillard, à l'aide d'un déversoir supérieur (95) et d'un déversoir inférieur (115) le déversoir supérieur étant en communication avec une chambre supérieure (101), le déversoir inférieur étant en communication avec une chambre inférieure (102), cette dernière étant en communication avec un conduit comprenant une soupape d'arrêt (103).

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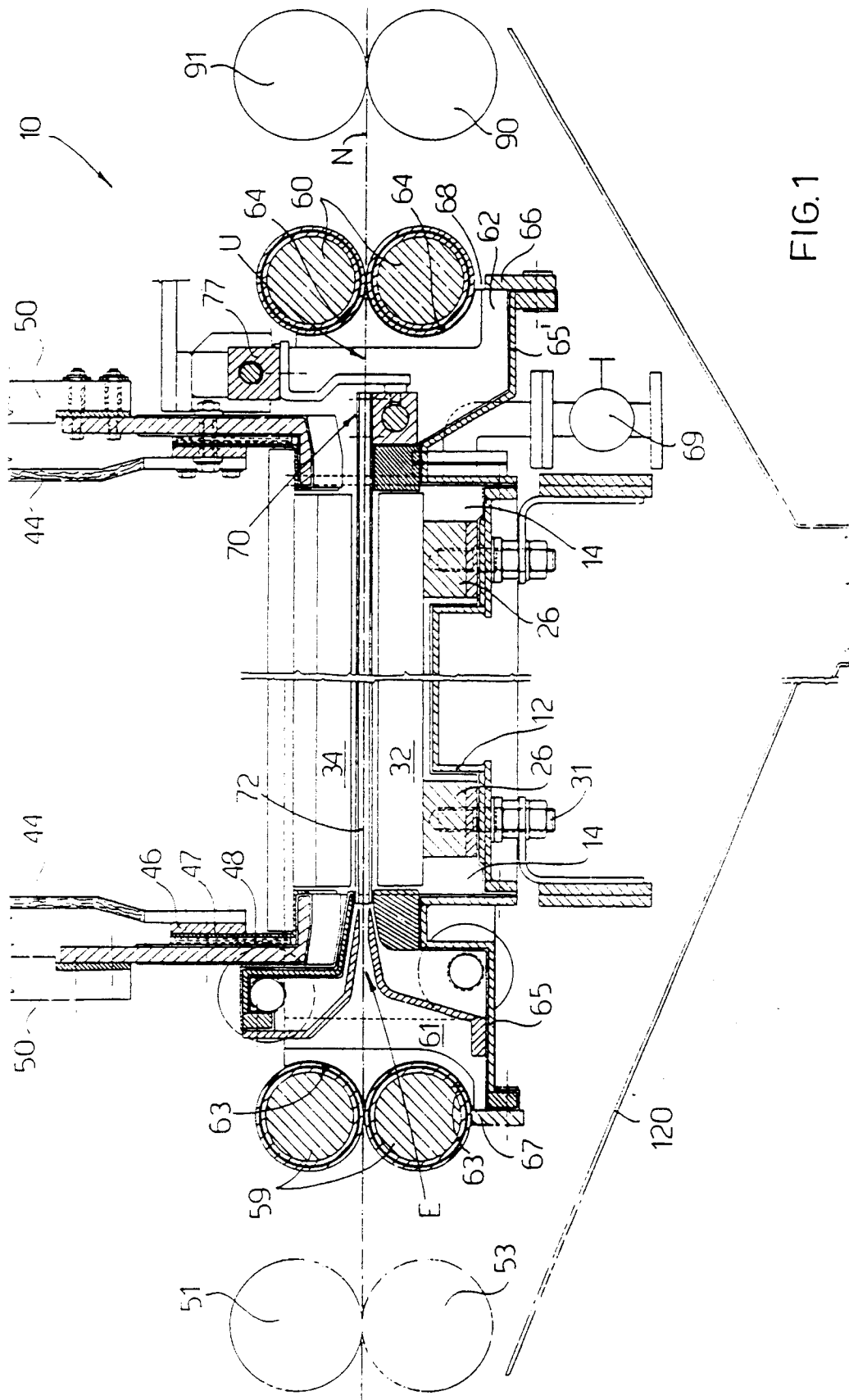


FIG. 1a

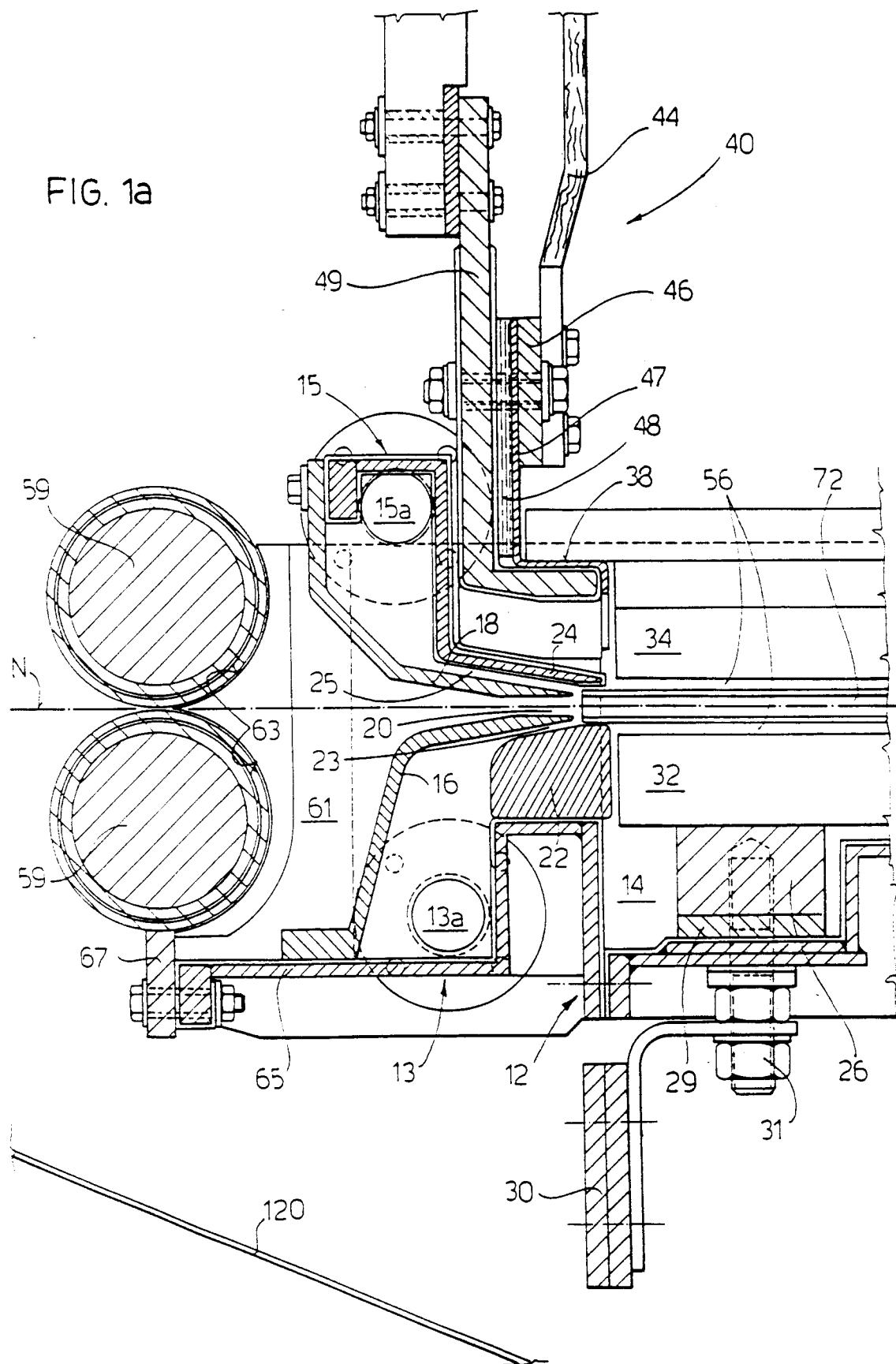
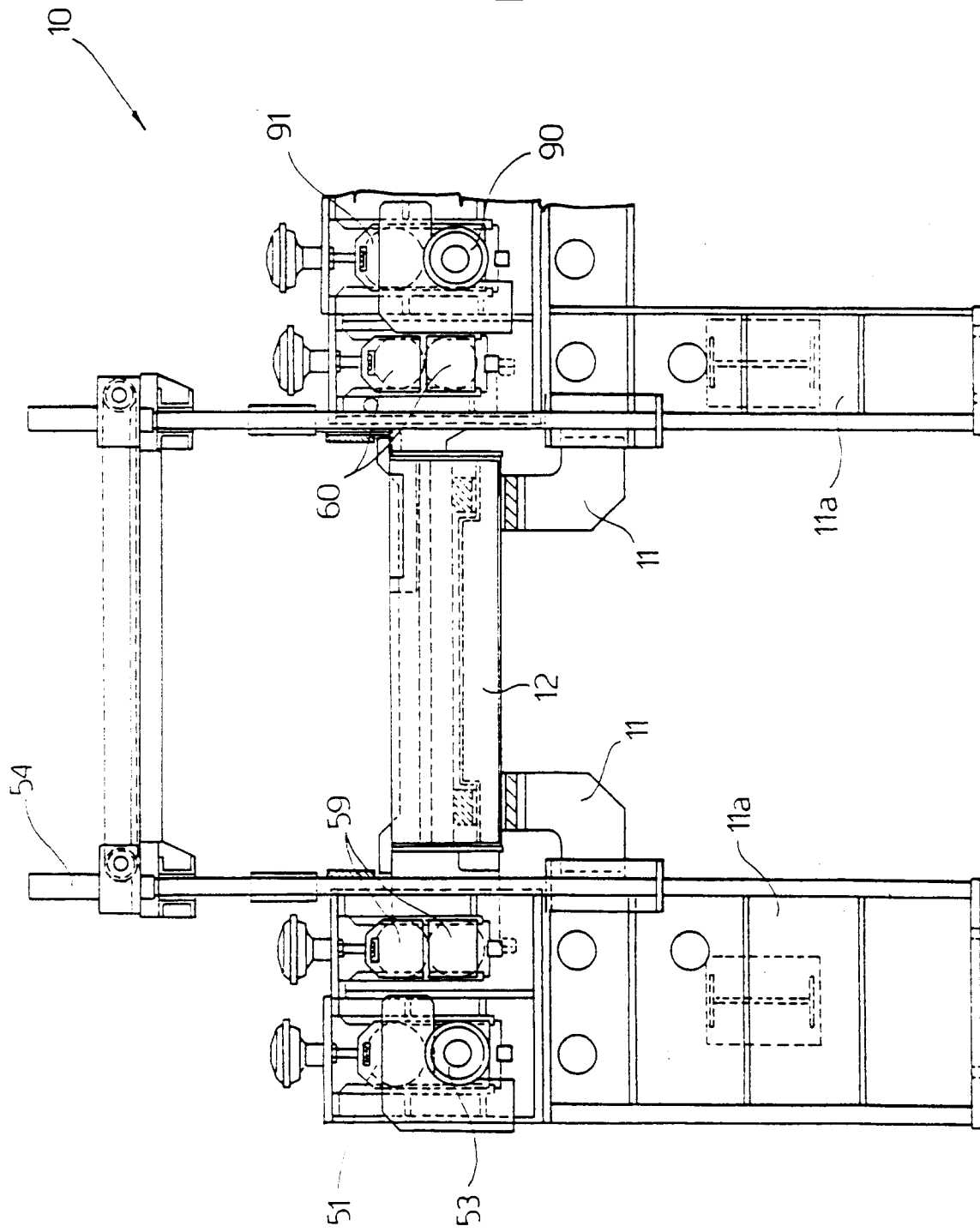


FIG. 2



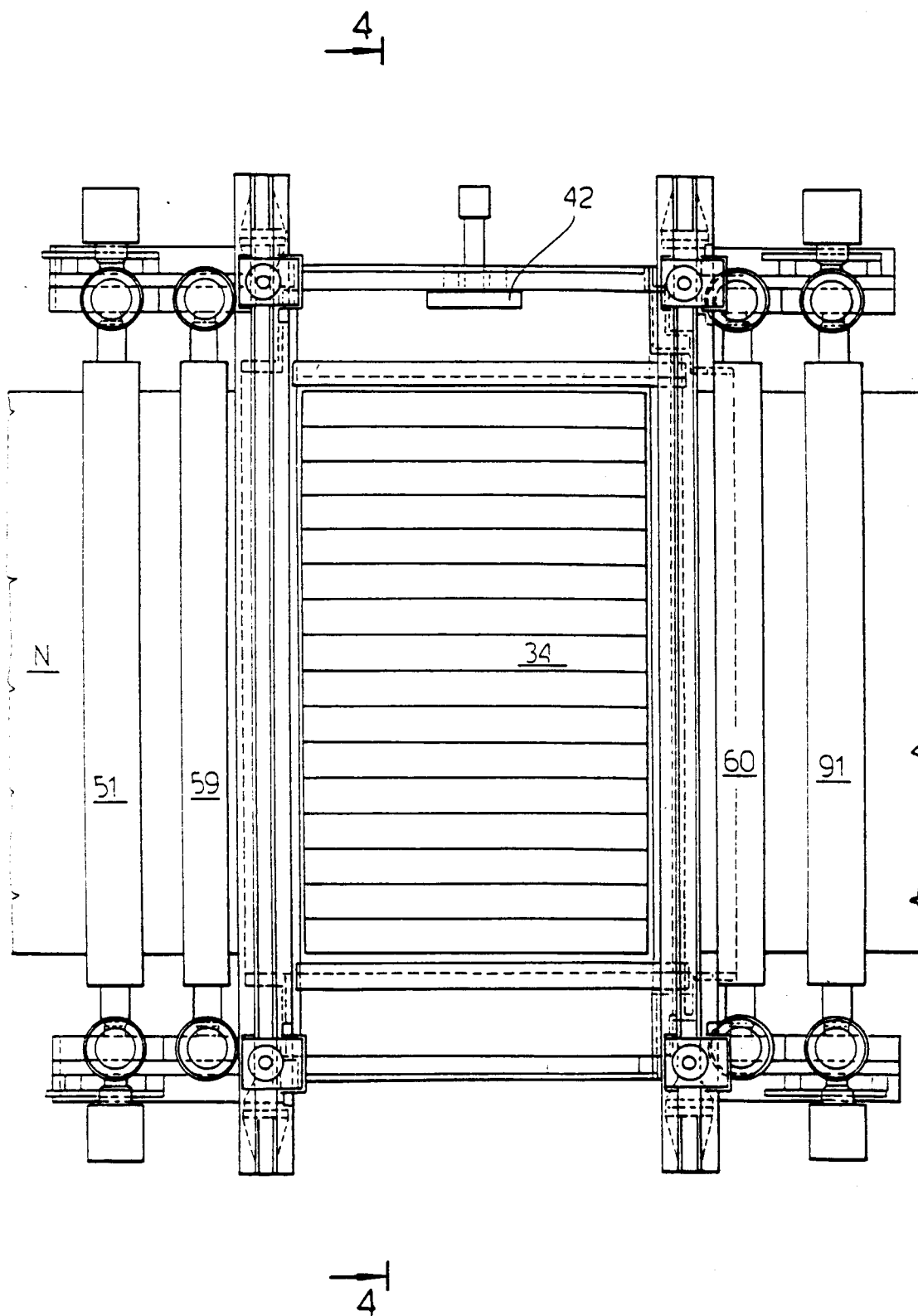
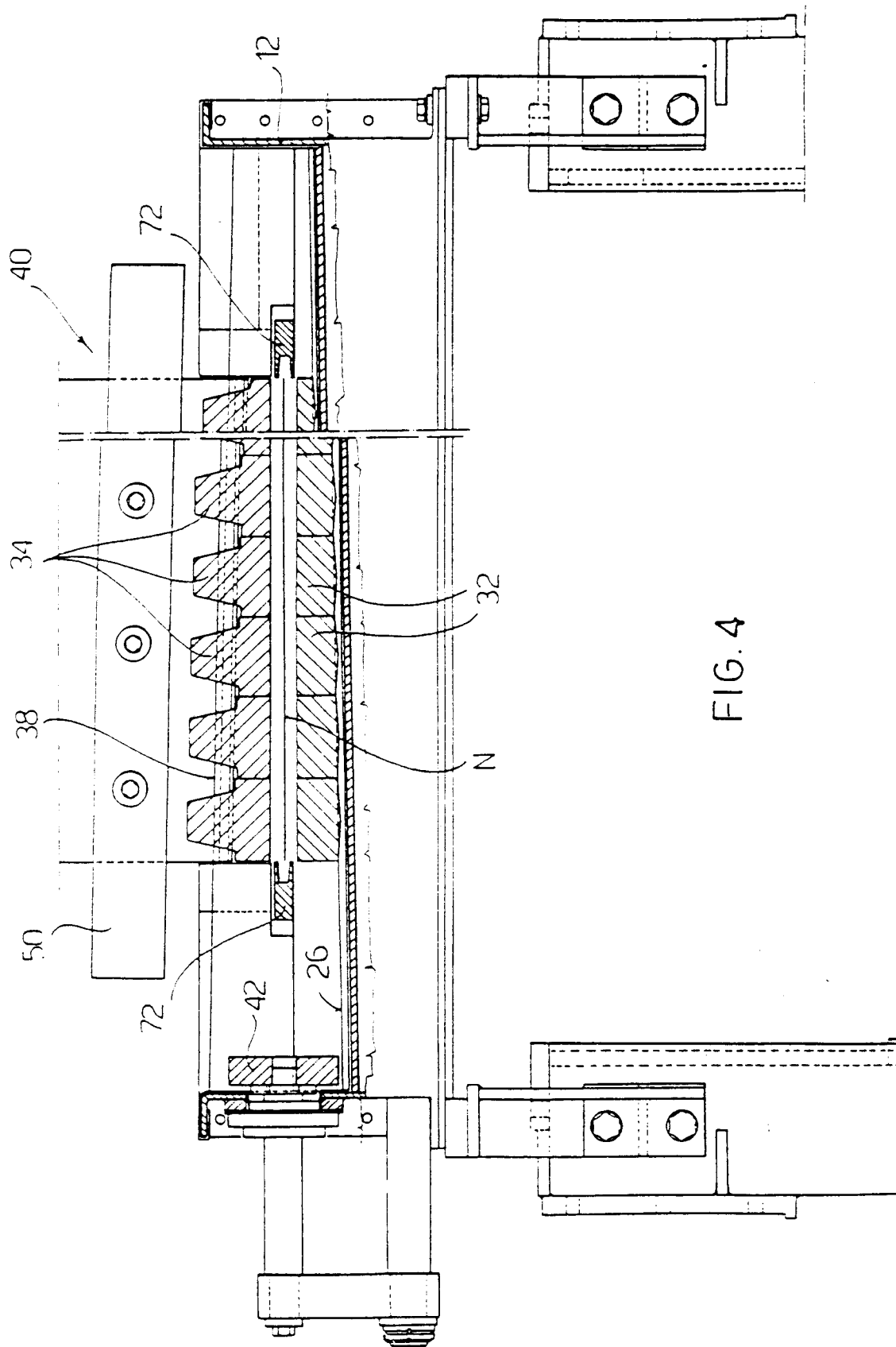
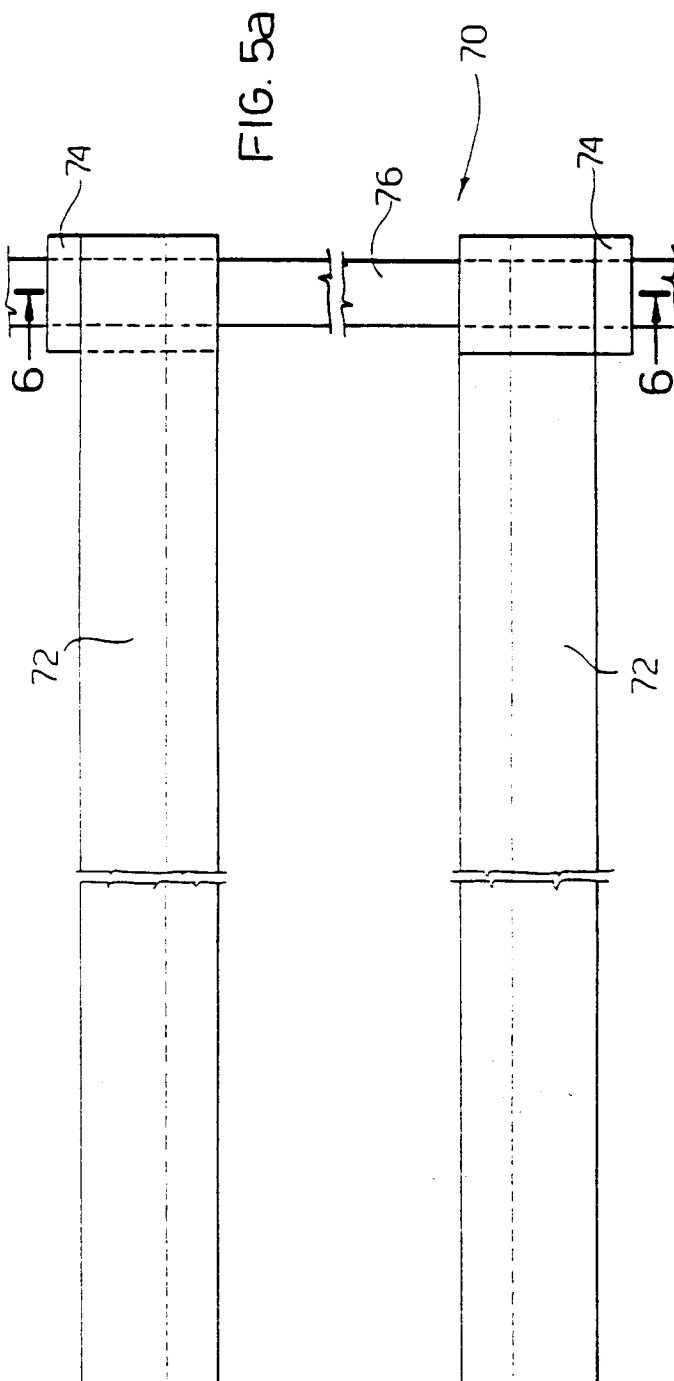
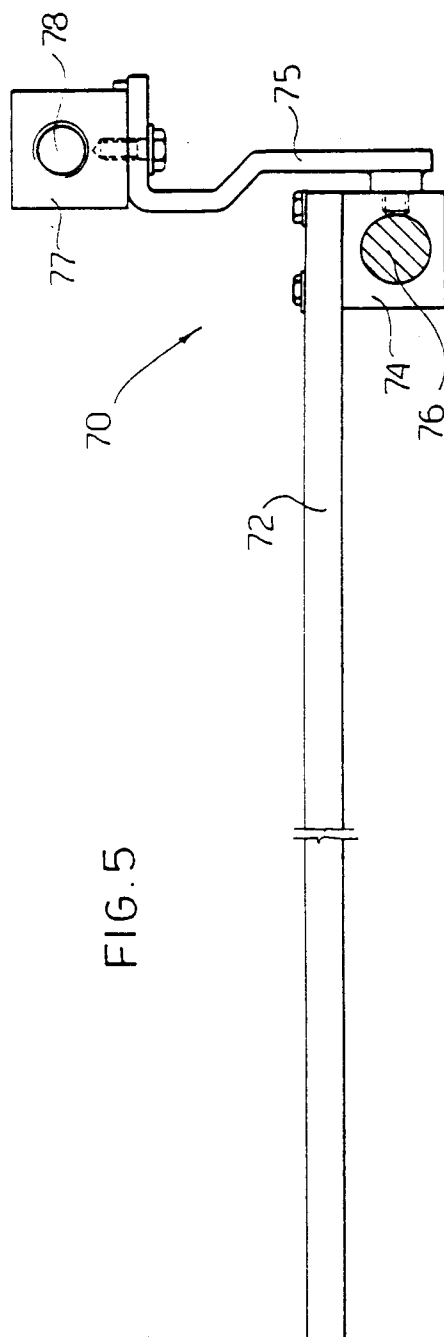


FIG. 3





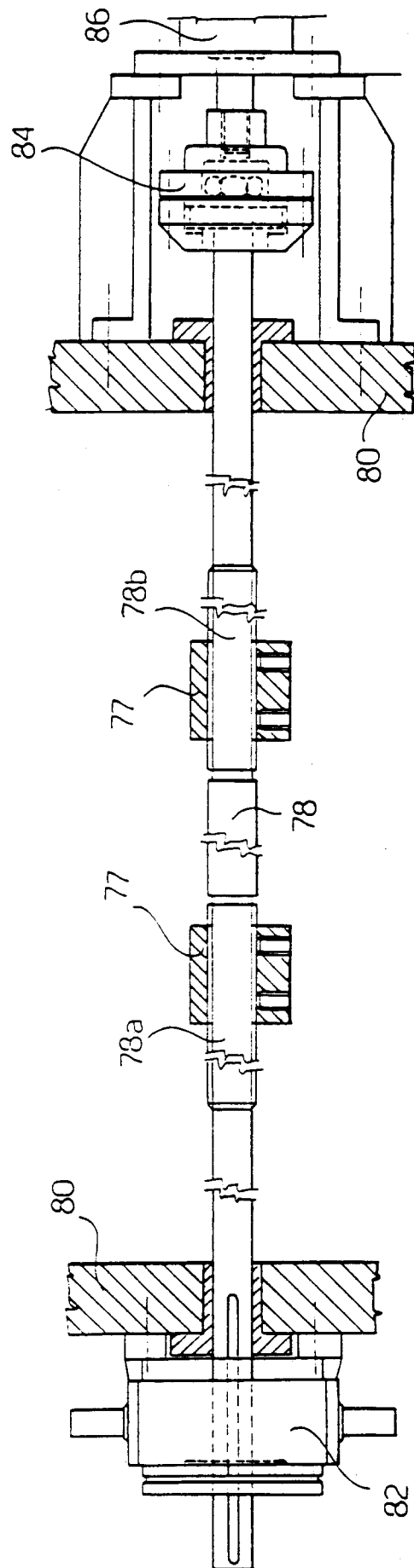


FIG. 6

