(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 063 869**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **82301606.8**

(22) Date of filing: **26.03.82**

(51) Int. Cl.³: **B 26 D 3/00**, F 16 L 59/02

(30) Priority: **09.04.81 GB 8111158**

(43) Date of publication of application: **03.11.82 Bulletin 82/44**

(84) Designated Contracting States: **AT BE CH DE FR GB IT LI LU NL SE**

(71) Applicant: **Fibreglass Limited, Prescot Road, St. Helens Lancashire WA10 3TR (GB)**

(72) Inventor: **Day, Roland St. George Dowling, 56 Heyes Avenue, Rainford Merseyside (GB)**

(74) Representative: **Wilson, Joseph Martin et al, WITHERS & ROGERS 4 Dyer's Buildings Holborn, London EC1N 2JT (GB)**

(54) A method of splitting a hollow product.

(57) A method of longitudinally splitting a hollow tubular product comprising the steps of (a) providing longitudinal relative movement between the product and two blades of a cutter assembly arranged so that the blades partially cut through a portion of the wall of the product one from the inside and one from the outside to form two longitudinal slits in spaced planes with the inner ends of the slits adjacent to another and (b) applying a shearing force to the material in the region of the adjacent inner ends of the slits in a direction away from the planes of the slits to fracture the thickness of material between the inner ends of the slits to define a single stepped slit extending along the tubular product.

EP 0 063 869 A2

A METHOD OF SPLITTING A HOLLOW PRODUCT

The present invention relates to a method and an apparatus for splitting a hollow product and more particularly of producing a longitudinal slit of stepped profile through the wall of the product. The invention also includes a hollow product when made in accordance with the method and/or by the apparatus.

The product may for example be a hollow tubular sheath manufactured from glass fibres bound together with a binder. Such sheaths can be used for insulating pipes or conduits. A method of producing a longitudinal slit through the wall of a hollow cylindrical sheath is described in French Patent Specification No. 2,271,006. In one of the embodiments described in that specification an apparatus is employed whose cutter assembly comprises two blades disposed in two substantially parallel planes spaced a small distance apart. Each of the two blades partially cuts through a portion of the wall of the sheath from the inside and outside respectively so as to create two spaced, substantially parallel, longitudinal slits in the wall. The spacing between the two slits is sufficiently small to make it possible to fracture the thickness of the material separating them. The

blade which partially cuts through a portion of the inside wall is carried on a fixed cylindrical rod which passes through the centre of the hollow sheath. The rod is itself supported by a vertical supporting member fixed on a frame located external of the sheath. The vertical supporting member is aligned with the longitudinal slits formed in the sheath so that as the sheath is moved axially against and past the vertical supporting member the edge of that member, which is tapered, cuts through or fractures the material separating the slits. The resulting product is a sheath having a slit along its entire length, the slit being a straight line slit passing through the whole wall thickness of the sheath.

One of the disadvantages of the apparatus described in French Patent Specification No. 2,271,006 is that the vertical supporting member causes damage to the surfaces of the material between which the slit is defined. When the sheath is placed around a pipe or conduit it is necessary to bring those surfaces into intimate contact. Damaged surfaces, however, result in air being trapped in gaps between the surfaces and this reduces the overall insulating capability of the sheath when in use.

According to one aspect of the present invention there is provided a method of longitudinally splitting a hollow tubular product comprising the steps of (a) providing longitudinal relative movement between the product and two blades of a

cutter assembly arranged so that the blades partially cut through a portion of the wall of the product one from the inside and one from the outside to form two longitudinal slits in spaced planes with the inner ends of the slits adjacent to one another characterised by the additional step (b) of applying a shearing force to the material in the region of the adjacent inner ends of the slits in a direction away from the planes of the slits to define a single stepped slit extending along the tubular product.

The invention also includes a method of longitudinally splitting a hollow tubular product comprising the steps of providing longitudinal relative movement between the product and two blades of a cutter assembly so that the blades partially cut through a portion of the wall of the product one from the inside and one from the outside respectively thereby forming two longitudinal slits, each slit lying in a respective one of a pair of spaced planes and having their inner ends adjacent to one another, applying a shearing force in the material in the region of the adjacent inner ends of the slits in a direction away from the planes of the slits to fracture the thickness of the material between the inner ends of the slits to define a single longitudinal slit having an intermediate step, and subjecting the material on each side of the stepped

profile slit to shearing forces to open up the intermediate step and provide clearance for a part of the cutter assembly connecting the two blades to pass through the stepped profile slit.

According to another aspect of the present invention there is provided an apparatus, for providing a longitudinal slit through the wall of a hollow tubular product, comprising a blade assembly with two blades each of which lies in one of a pair of spaced apart planes, the blades being arranged to cut longitudinal slits partially through the wall from the inside and the outside of the product with the inner ends of the slits adjacent to one another and means to provide relative longitudinal movement between the product and the blade assembly characterised by the provision of means for exerting a stress in the material in the region of the longitudinal slits so that the stress acts substantially at right angles to the plane of the slits to fracture the thickness of material between the inner ends of the slits to define a single longitudinal slit having a stepped profile.

The invention also includes an apparatus for providing a slit having a stepped profile through the wall of a hollow tubular product, the apparatus comprising a blade assembly and means for providing relative longitudinal movement between the

product and the blade assembly, the blade assembly comprising two blades connected together by a connecting part, each blade lying in a respective one of a pair of spaced planes, the blades having a cutting section formed with a cutting edge for cutting a longitudinal slit partially through an inside and outside wall of the product respectively, means being provided for exerting a stress in the material in the region of the longitudinal slits, the stress acting substantially at right angles to the planes of the slits being sufficient to fracture the thickness of material between the inner ends of the longitudinal slits to define a single longitudinal slit having a stepped profile, and means for exerting shearing forces on the material in the region of the stepped slit, the shearing forces acting in planes substantially parallel to the planes of the longitudinal slits so as to open up the slit to allow the connecting part to pass through the stepped slit.

The invention further includes a hollow product having a stepped profile slit preferably of substantially Z profile through its wall, the stepped profile slit being formed in accordance with the above method and using an apparatus as set out.

tapered follower section for passing through the stepped slit and exerting shearing forces on the material in the region of the stepped slit, the shearing forces acting in planes substantially parallel to the planes of the longitudinal slits so as to open up the slit to allow the connecting part to pass through ~~the stepped slit.~~

The connecting part connects together the follower sections of the two blades and holds them spaced apart in a fixed relationship to one another. Conveniently the connecting part is flat and disposed in a plane substantially orthogonal to the planes in which the blades lie.

The pair of spaced planes in which each longitudinal slit lies can be either parallel or non-parallel to one another. It is convenient, however, to arrange the spaced planes to be substantially parallel to one another so that the resulting stepped slit has a Z profile.

In order that the fracture of the material between the inner ends of the longitudinal slits be made straight and smooth it is desirable that the two longitudinal slits formed, and hence the cutting sections of the blades, are level or overlap one another slightly. The degree of overlap is dependent on the material of the product to be fractured but for a laminated glass fibre product the overlap conveniently lies in the range 0 mm to 10 mm. Preferably the overlap lies within the range 0 mm to 5 mm.

Each blade may have its cutting and follower section made as separate sections or the whole blade may be made as one integral part. It is convenient, however, to make the cutting and follower sections as separate parts of different material, for example the cutting section can be made from a hardened steel whilst the follower section can be made of mild steel. The connecting part between the follower sections can then also be made of mild steel enabling the two follower sections and connecting part to be fabricated as one integral part.

Preferably a further blade is provided for producing a straight longitudinal slit partially through another portion of the inside wall of the product, substantially opposite the stepped slit, the uncut material in line with that slit serving as a hinge enabling the product to be opened and closed without the sections coming apart.

The method and apparatus can be used for splitting tubular products having any cross section, for example circular, square, oblong or polygonal cross sections. Sheaths for pipe insulation are usually cylindrical and so have a circular cross section. When splitting sheaths having a circular cross section the stress which fractures the thickness of material between the inner ends of the longitudinal slits is a hoop stress, whilst the shearing forces which open up the stepped profile slit act in radial directions.

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

Fig. 1 is a perspective view of an apparatus according to the present invention,

Fig. 2 is a perspective view of the cutter assembly in Fig. 1,

Fig. 3 is a side elevational view of the cutter assembly of Fig. 2,

Fig. 4 is a section along the line I-I in Fig. 3,

Fig. 5 is a section along the line II-II in Fig. 3,

Fig. 6 is a cross section through a partially slit sheath and

Fig. 7 illustrates how radial shearing forces are applied to the material defining a slit having a Z profile.

The apparatus in Figure 1 comprises a V-shaped channel 2 made from sheet metal, a section along the base of the channel 2 being cut away so as to define a longitudinal slot 4. The top of the channel 2 is bent so as to form two flat longitudinal edges 5 and each edge 5 is supported on top of a number of blocks 6 disposed at spaced intervals along one of the flat edges of a respective support 8 having a U cross section. The supports 8 are connected together at each end by a respective metal cross member 10 and are supported on a

pair of spaced metal blocks 12 and 13.

A pusher arm 14 is mounted for reciprocatory movement along the slot 4 and the top of arm 14 is cut away so as to provide clearance to enable it to pass by a cutter assembly 16. The drive mechanism for pusher arm 14 is enclosed in block 12.

The cutter assembly 16 depends from a flange plate 18 which is secured to a fabricated steel block 20. The block 20 is attached to one end portion of a ram 22 the other end portion of which is slidably mounted within a hollow cylindrical housing 24. Vertical adjustment of the cutter assembly 16 is made by adjusting the position of ram 22 relative to housing 24 by means of a drive mechanism in block 13.

Referring to figures 1 and 2 the cutter assembly has three fin shaped blades 28, 30 and 32. The blade 28 is held in a blade carrier 26 attached along the bottom edge of the flange plate 18, the blade 28 being secured to the carrier 26 by a number of bolts 27. The blade 30 is connected to the blade 28 by a horizontal connecting part 29 which serves to hold the blade 30 in a fixed offset position relative to the blade 28. The blade 30 has one of its edges secured to a cylindrical bullet shaped rod 44, the diametrically opposite part of the rod 44 carrying the blade 32.

The blades 28 and 30 have two sections, a cutting section made of hardened steel and a follower section

made of mild steel. The cutting sections are indicated by numerals 34 and 36 respectively and can be considered as those portions of the blades to the left of the lines S in figure 2. The follower sections are indicated by numerals 38,40 respectively and are those portions of the blades to the right of the lines S in figure 2. The blades 28 and 30 are fixed relative to one another so that at least a portion of their cutting sections overlap one another, best illustrated in figures 3 and 4. The extent of the overlap is very important and is adjusted in dependence on the type of product which is to be split and the spacing between the blades 28 and 30. When cutting a hollow cylindrical insulating product, for example one made from glass fibres bound together by a binder, and with the blades 28 and 30 spaced apart by a distance of approximately 12 mm, the overlap lies preferably within the range 0 to 5 mm.

Each of the cutting sections 34 and 36 have a cutting edge 46 and 48 respectively and the portion of the cutting section leading to the cutting edge is tapered, as best shown in figure 4. In figure 4 the taper is one side only, alternatively the taper could be from both sides. The remainder of the cutting section is made fairly thick, for example 3 mm, for a purpose to be described later.

The follower sections 38,40 have a substantially uniform thickness throughout but are provided with flared or tapered edges 50 and 52 (see figure 3). The

edge 50 of the follower section 38 spreads downwardly and the edge 52 spreads upwardly giving an increasing degree of overlap between the follower sections.

In operation a hollow product, for example a hollow cylindrical product having a laminar glass fibre structure, is first placed in the V-shaped channel between the pusher arm 14 and the cutter assembly 16. The pusher arm 14 is moved at a uniform speed and pushes the hollow product in an axial direction, that is in the direction of arrow A in figure 1. Initially the cutting edges of the three blades 28, 30 and 32 cut through the wall of the product as it is advanced and produce three partial cuts in the wall of the product as shown in figure 6. The cutting edge 46 of blade 28 cuts partially through the outside wall of the product to produce slit 60, the cutting edge 48 of blade 30 cuts partially through the inside wall of the product to produce slit 62, and the cutting edge of blade 32 partially cuts through the inside wall of the product to produce slit 64.

The partially slit product continues its axial movement and the thickened portion of the cutting sections 34,36 then pass through the slits 60,62 which have their inner ends adjacent to one another. The thickened portions of the cutting sections 34,36 widen the slits 60,62 and in so doing exert forces in the material in the region of the adjacent inner ends of the slits 60,62 in a direction away from the planes of slits 60,62 and sufficient to fracture the thickness of the material between the inner ends of the slits 60,62 to produce an intermediate step between those ends. As the

slits 60,62 overlap only slightly so the fracture takes place along one of the laminations of the material between the inner ends of the slits 60,62 and the resulting fracture is straight and smooth. The resulting slit now has a Z profile, and the surfaces 66,68 of the material overlap at the stepped portion of the slit.

The product continues along its axial path past the follower sections 38 and 40 towards the region of the connecting part 29. If the surfaces 66,68 of the material at the intermediate step of the slit are to remain undamaged and smooth it is necessary to prevent the connecting part 29 from coming into contact with those surfaces. It is for this reason that the flared edges 50,52 are provided and as best seen in figure 7 they exert radial shearing forces on the overlapping surfaces 66,68 to open up the slit so as to allow the connecting part 29 to pass between the overlapping surfaces 66,68 without causing them damage.

The resulting product has a longitudinal Z-profile slit through the whole of its wall and a longitudinal slit 64 partially through its wall. The unfractured material below the slit 64 acts like a hinge and enables the product to be opened and closed around a cylindrical pipe or conduit, the straight and smooth overlapping surfaces 66,68 coming into intimate contact and providing an effective air seal.

It is to be understood that the cutting section and

follower section of each blade can be integrated with one another or can be manufactured from separate parts. For example in figure 2 each of the blades 28,30 can be manufactured from a respective single sheet of hardened steel, the line S merely being representative of that portion of the blade where the Z profile slit has been completely formed.

Alternatively the cutting sections 34,36 can be made as separate hardened steel parts to that of the follower sections 38,40 which are made of mild steel. In such an embodiment it is desirable that the end of the cutting section 34 closely abuts against the end of the follower section 38, that is along line S, whilst the end of the cutting section 36 closely abuts against the follower section 40, also being along line S. If the ends of the cutting sections 34,36 did not abut against the ends of their follower sections 38,40 so that they were spaced apart, then there is a danger that the Z profile slit formed by the cutting sections 34,36 would close after formation due to the resilience of the product material, and the end of the follower sections 38,40 would then cut its way through the centre of the slit damaging the surfaces.

We have therefore provided a method and an apparatus for splitting a hollow product in accordance with which two adjacent cutting blades make slits in the product wall

from opposite sides thereof, the slits being in planes slightly spaced apart from one another with the inner ends of the slits adjacent to one another and in which means is provided for fracturing the thickness of the material between the inner ends of the slits in such a way as to make a complete slit of Z shaped profile.

CLAIMS

1. A method of longitudinally splitting a hollow tubular product comprising the steps of (a) providing longitudinal relative movement between the product and two blades of a cutter assembly arranged so that the blades partially cut through a portion of the wall of the product one from the inside and one from the outside to form two longitudinal slits in spaced planes with the inner ends of the slits adjacent to one another characterised by the additional step (b) of applying a shearing force to the material in the region of the adjacent inner ends of the slits in a direction away from the planes of the slits to fracture the thickness of material between the inner ends of the slits to define a single stepped slit extending along the tubular product.

2. A method of longitudinally splitting a hollow tubular product comprising the steps of providing longitudinal relative movement between the product and two blades of a cutter assembly so that the blades partially cut through a portion of the wall of the product from the inside and one from the outside respectively thereby forming two longitudinal slits, each slit lying in a respective one of a pair of spaced planes and having their inner ends adjacent to one another, applying a shearing force in the material in the region of the adjacent inner ends of the slits in a direction away from the planes of the slits

to fracture the thickness of the material between the inner ends of the slits to define a single longitudinal slit having an intermediate step, and subjecting the material on each side of the stepped profile slit to shearing forces to open up the intermediate step and provide clearance for a part of the cutter assembly connecting the two blades to pass through the stepped profile slit.

3. An apparatus, for providing a longitudinal slit through the wall of a hollow tubular product, comprising a blade assembly with two blades each of which lies in one of a pair of spaced apart planes, the blades being arranged to cut longitudinal slits partially through the wall from the inside and the outside of the product with the inner ends of the slits adjacent to one another and means to provide relative longitudinal movement between the product and the blade assembly characterised by the provision of means for exerting a stress in the material in the region of the longitudinal slits so that the stress acts substantially at right angles to the plane of the slits to fracture the thickness of material between the inner ends of the slits to define a single longitudinal slit having a stepped profile.

4. An apparatus for providing a slit having a stepped profile through the wall of a hollow tubular product, the apparatus compising a blade assembly and means for providing relative

longitudinal movement between the product and the blade assembly, the blade assembly comprising two blades connected together by a connecting part, each blade lying in a respective one of a pair of spaced planes, the blades having a cutting section formed with a cutting edge for cutting a longitudinal slit partially through an inside and outside wall of the product respectively, means being provided for exerting a stress in the material in the region of the longitudinal slits, the stress acting substantially at right angles to the planes of the slits being sufficient to fracture the thickness of material between the inner ends of the longitudinal slits to define a single longitudinal slit having a stepped profile, and means for exerting shearing forces on the material in the region of the stepped slit, the shearing forces acting in planes substantially parallel to the planes of the longitudinal slits so as to open up the slit to allow the connecting part to pass through the stepped slit.

5. An apparatus as claimed in claim 3 or 4 in which the cutting section of each blade has a thickened portion for exerting the stress required to fracture the thickness of material between the inner ends of the longitudinal slits.

6. An apparatus as claimed in claim 3 or 4 or 5 in which each blade has a tapered follower section for passing through the

stepped slit and exerting the shearing forces to open up the slit to allow the connecting part to pass through the stepped slit.

7. An apparatus as claimed in claim 6 in which the connecting part connects together the follower sections of the two blades and holds them spaced apart in a fixed relationship to one another.

8. An apparatus as claimed in claim 7 in which the connecting part is flat and disposed in a plane substantially orthogonal to the planes in which the blades lie.

9. An apparatus as claimed in any one of claims 3 to 8 in which the planes of the blades are parallel to one another.

10. An apparatus as claimed in any one of claims 3 to 8 in which the planes of the blades are not parallel to one another.

11. An apparatus as claimed in any one of claims 3 to 10 in which the cutting sections of the blades are level or overlap one another slightly e.g. by no more than 5mm or by no more than 10mm.

12. An apparatus as claimed in claim 6 when dependent on claim 3 in which the cutting and follower sections of the blades are made as separate sections.

13. An apparatus as claimed in any one of claims 3 to 12 in which a further blade is provided for producing a straight longitudinal slit partially through another portion of the inside wall of the product substantially opposite the stepped slit.

14. A hollow product having a stepped profile slit preferably of substantially Z profile through its wall, the stepped profile slit being formed in accordance with the method defined in claim 1 or 2.

15. A hollow product having a stepped profile slit preferably of substantially Z profile through its wall, the slit being produced using an apparatus as claimed in any one of claims 3 to 13.

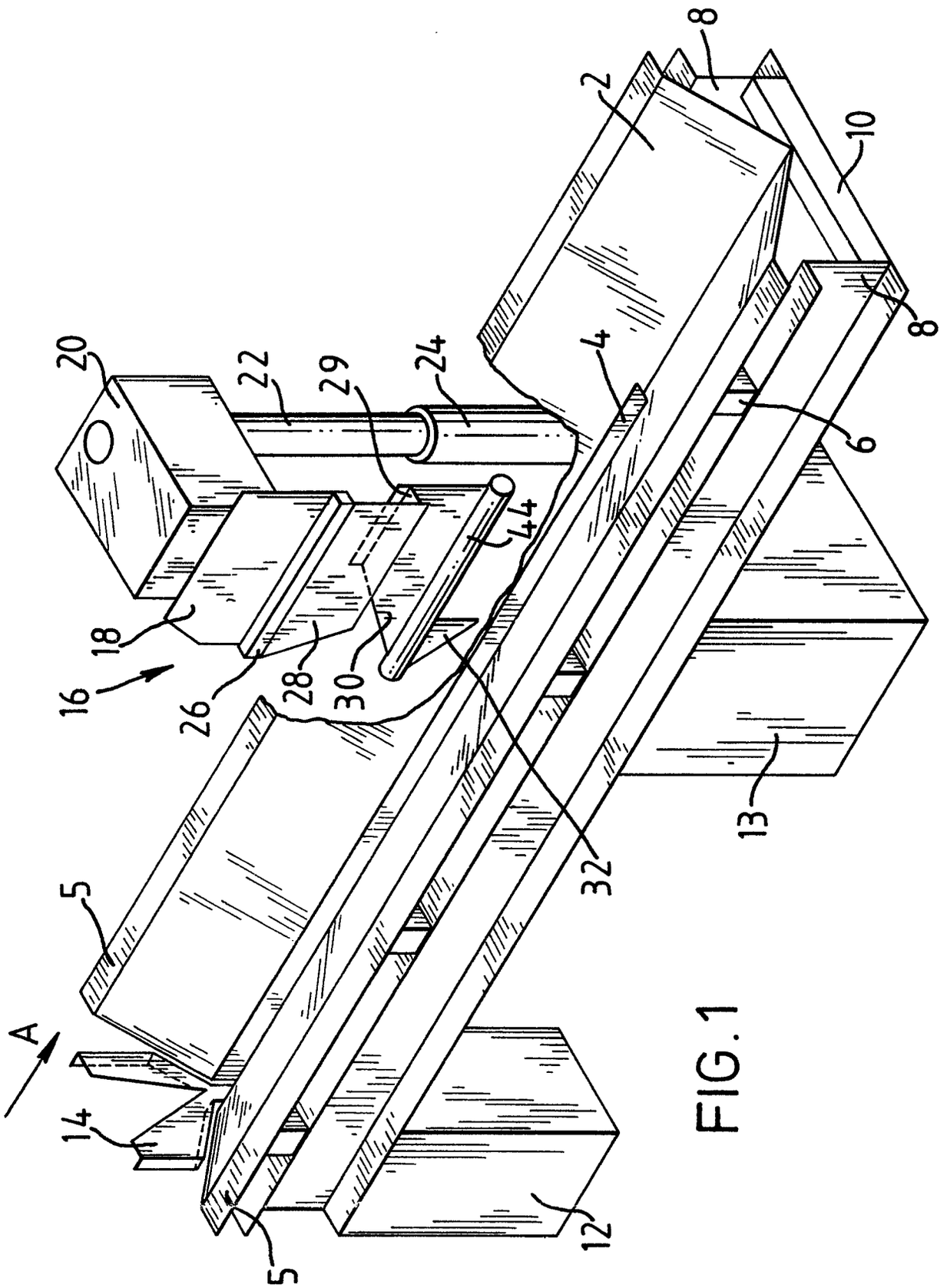

FIG. 1

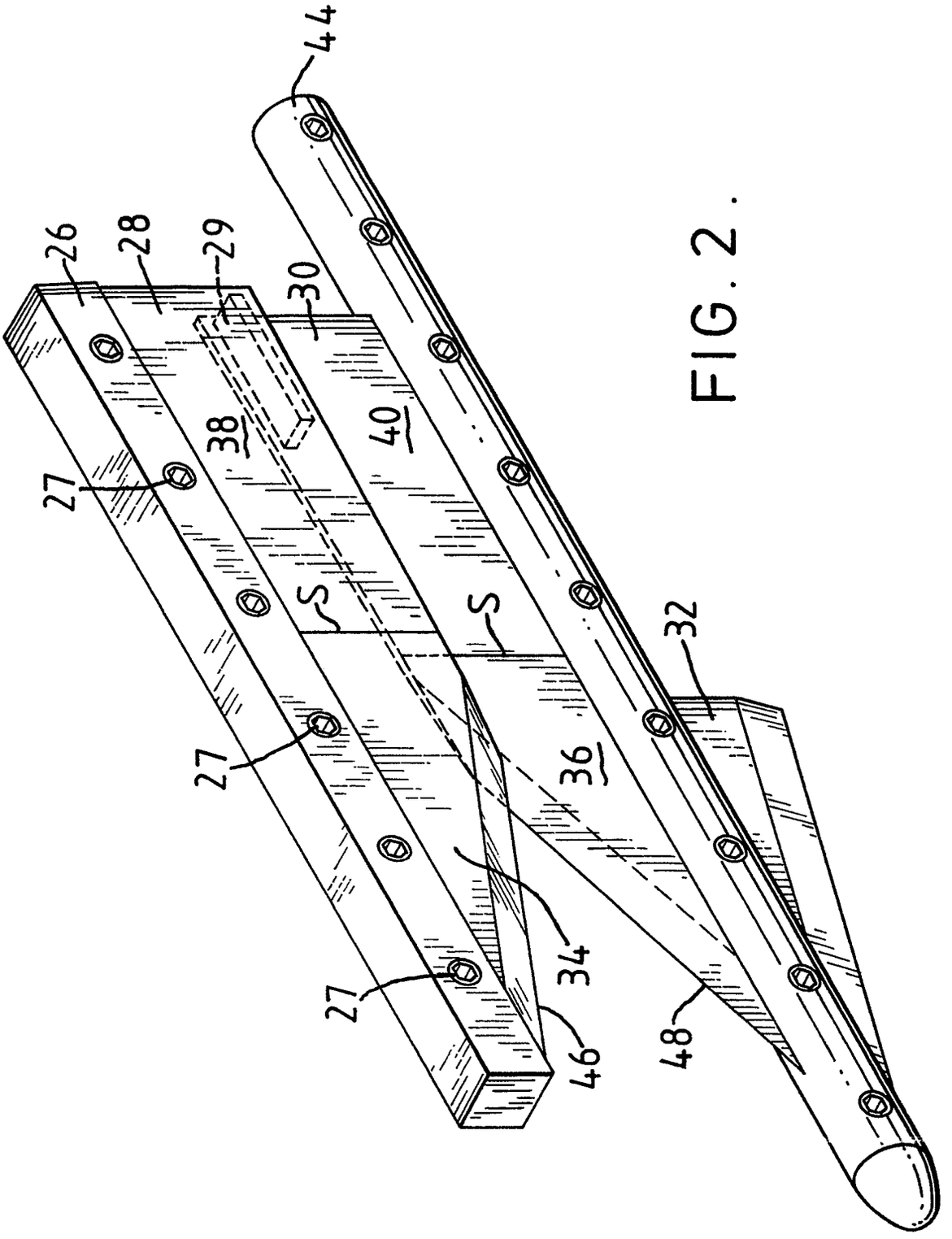

FIG. 2.

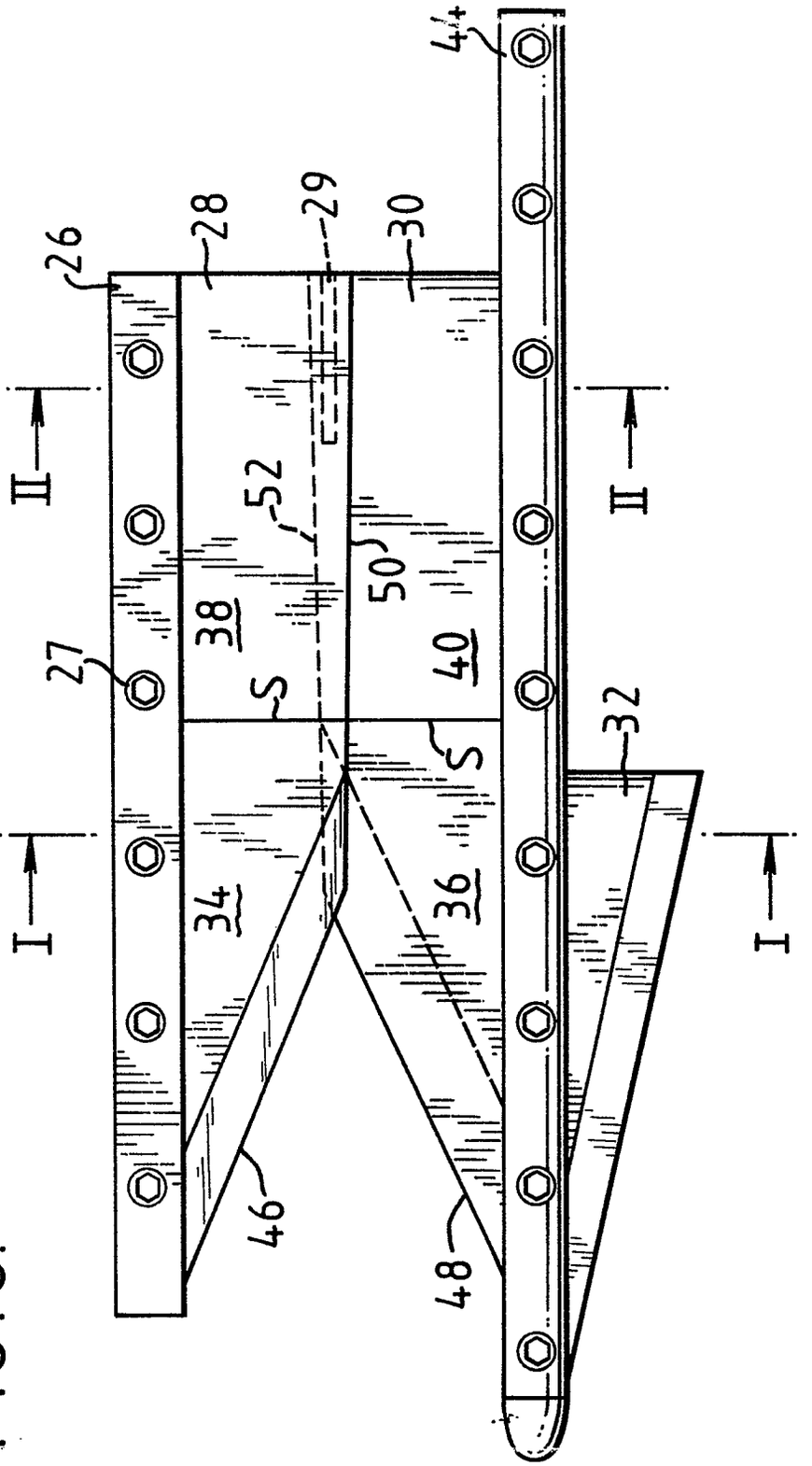

FIG. 3.

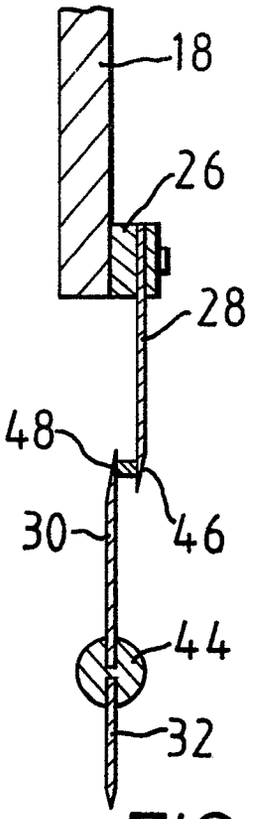

FIG. 4

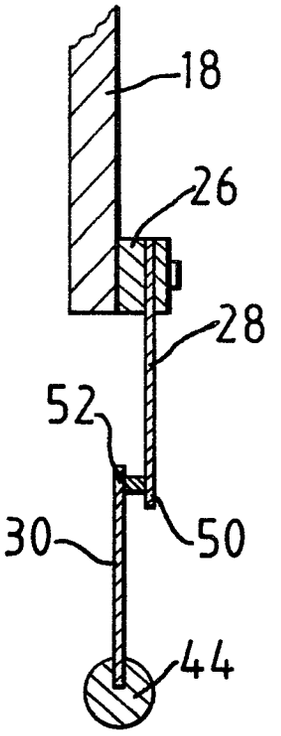

FIG. 5

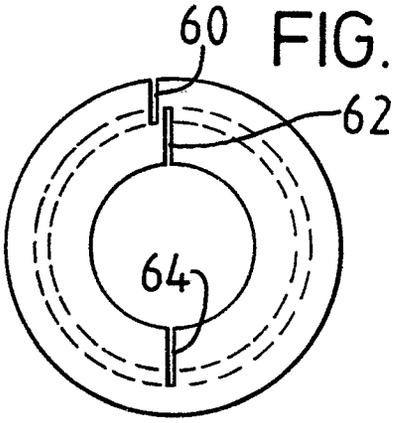

FIG. 6

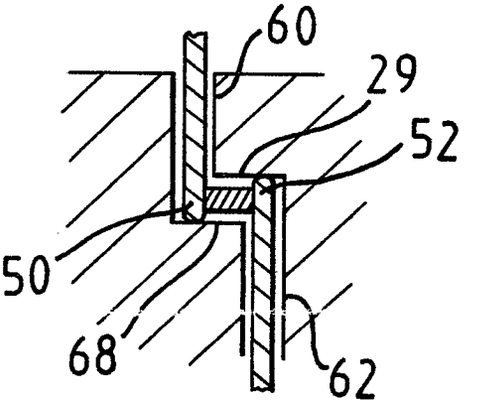

FIG. 7