



(72) PAREIN, ERIC, BE

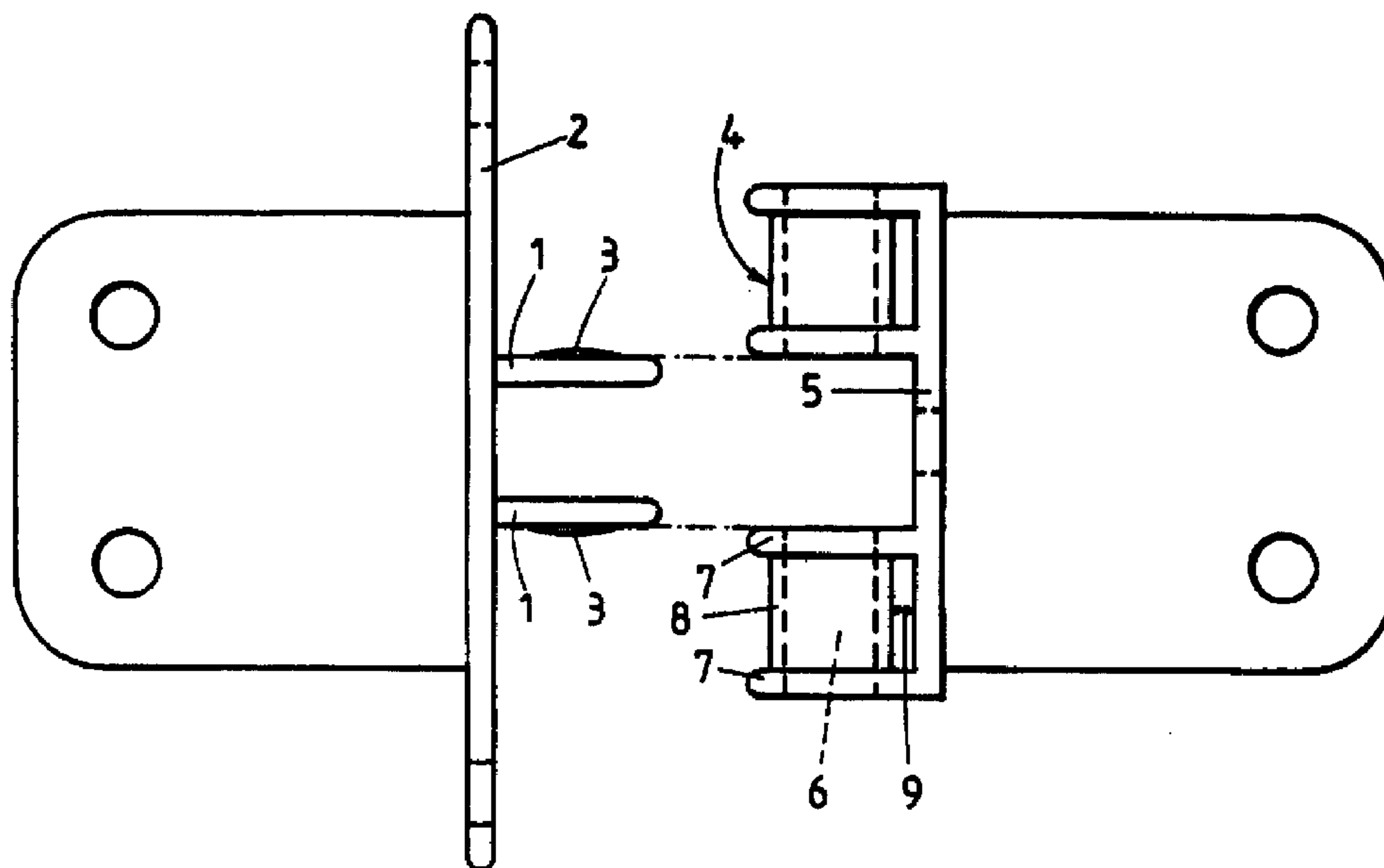
(71) PAREIN, ERIC, BE

(51) Int.Cl.⁶ F16C 11/04, F16B 21/08, A63H 33/06, E05D 9/00

(30) 1997/01/06 (9700006) BE

(54) **CONNEXION CHARNIERE**

(54) **HINGE CONNECTION**



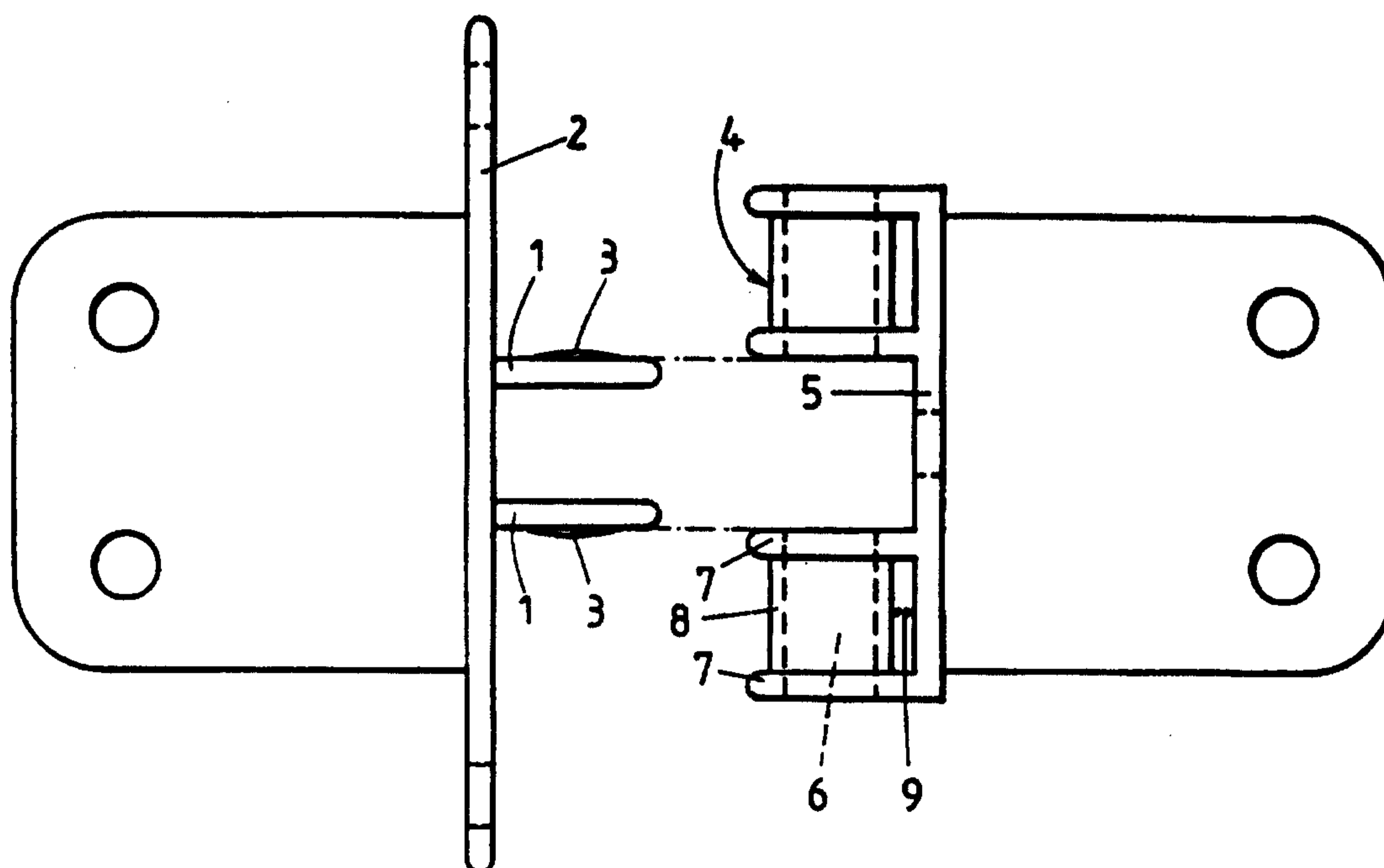
(57) L'invention a trait à une connexion charnière comprenant un élément mâle appliqué sur une plaque d'appui. Ledit élément mâle est doté de saillies (3) destinées à être ajustées élastiquement entre une paire d'éléments femelle (4) appliqués sur une autre plaque (5) d'appui. Conformément à l'invention, ledit élément mâle est formé de deux jambes (1) mâles parallèles, où chaque jambe (1) comprend une desdites saillies (3) et où chacun desdits éléments femelle comprend un trou (6) de part en part permettant le passage d'une desdites saillies (3).

(57) The invention relates to a hinge connection comprising a male member applied on a base plate, said male member having protrusions (3) provided to be hingedly and resiliently fitted between a pair of female members (4) applied on a further base plate (5). According to the invention, said male member is formed by two parallel male legs (1), wherein each leg (1) comprises one of said protrusions (3), and that each of said female members comprises a through hole (6) for engaging one of said protrusions (3).

**PCT**WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : F16C 11/04, E05D 9/00, A63H 33/06, F16B 21/08	A1	(11) International Publication Number: WO 98/30808 (43) International Publication Date: 16 July 1998 (16.07.98)
(21) International Application Number: PCT/BE98/00001 (22) International Filing Date: 6 January 1998 (06.01.98) (30) Priority Data: 9700006 6 January 1997 (06.01.97) BE (71)(72) Applicant and Inventor: PAREIN, Eric [BE/BE]; Boomsesteenweg 259, Bus 8, B-2020 Antwerpen (BE). (74) Agents: VOSSWINKEL, Philippe et al.; Gevers Patents, Holidaystraat 5, B-1831 Diegem (BE).		(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>

(54) Title: HINGE CONNECTION**(57) Abstract**

The invention relates to a hinge connection comprising a male member applied on a base plate, said male member having protrusions (3) provided to be hingedly and resiliently fitted between a pair of female members (4) applied on a further base plate (5). According to the invention, said male member is formed by two parallel male legs (1), wherein each leg (1) comprises one of said protrusions (3), and that each of said female members comprises a through hole (6) for engaging one of said protrusions (3).

- 1 -

"Hinge connection"

5 The present invention relates to a hinge connection comprising a male member applied on a base plate, said male member having protrusions provided to be hingedly and resiliently fitted between a pair of female members applied on a further base plate.

10 Such a hinge connection is known from FR-A-2 534 484 to Bersani wherein said male and female members are provided on construction elements. Both the male and female members are formed by cylindrical projections, wherein the male members comprise protrusions, fitting in corresponding excavations provided in the female members, or vice versa. The male and female members are thus plain cylinders with protrusions or excavations and are thus relatively thick. This thickness ensures a good stability of the hinge connection. Such a thickness is however inconvenient for manufacturing purposes, since
15 upon moulding such a hinge connection, considerable cooling times are required for cooling the male and female members.

The problem of the invention is to provide a hinge connection having a reduced cooling time upon moulding but which still ensures a good stability of the connection.

20 This problem is solved by the hinge connection according to the invention which is characterised in that said male member is formed by two parallel male legs, wherein each leg comprises one of said protrusions, and that each of said female members comprises a through hole for engaging one of said protrusions.

- 2 -

The hinge connection is ensured by connecting the male legs with protrusions between the female members having through holes. The particular construction of the male and female members, i.e. two male legs and two female members having through holes, enables to
5 keep the thickness of the elements forming the hinge connection limited, so that the cooling time may be kept relatively short.

In a first preferred embodiment of the hinge connection according to the invention, each of said female members is formed by two parallel female legs connected by an intermediary piece. Preferably,
10 said intermediary pieces are mounted offset from said further base plate. This enables to further reduce the thickness of the female members and consequently to further reduce the cooling time upon moulding and still ensure the stability of the connection.

In order to improve the hinge movement of the hinge
15 connection according to the invention, said intermediary pieces are cylindrical pieces and said through holes and protrusions are cylindrical. In addition or as an alternative, said male and female members are provided with rounded free ends.

Preferably, said legs comprise rounded borders. This
20 facilitates the engagement or removal of the hinge connection.

For enabling to use the hinge connection according to the invention for connecting relatively large plates, said legs comprise an enlarged base applied on said base plate, respectively further base
plate.

25 The hinge connection according to the invention may further comprise a locking member for locking the connection of said male member to said female member, wherein said locking member comprises a locking leg provided to be placed between said male legs and a release leg extending essentially perpendicularly to said locking
30 leg. This particular construction of locking member can easily be inserted

- 3 -

manually between the male legs and removed by gripping the release leg with a pair of pincers.

5 The hinge connection according to the invention may further form a construction element comprising at least one base plate with at least one male member and at least one further base plate with at least one female member according anyone of the claims 1 to 9. This construction element may be used as a toy and enables to create complex structures wherein planning and use of imagination is required. This contributes to the development of a child playing with those construction elements.

10 In particular, the construction element comprises at least three base plates forming a closed area, wherein said base plates are connected by a connection plate extending in a plane perpendicular to said base plates. This connection plate enhances the strength of the construction element and enables also to form a container for receiving all kinds of objects or goods, for example sweets. The formed container may also be used as packaging.

15 A preferred embodiment of the construction element according to the invention comprises two parallel base plates and two further parallel base plates forming together a square, wherein the two base plates each comprise said male legs applied symmetrically with respect to the middle of the base plate and wherein the two further base plates each comprise said pair of female members, each female member of said pair extending at an extremity of the further base plate in such a manner that one of said female legs extends in prolongation from an extremity of one of said base plates. Preferably, the distance between the female legs is equal to L , the distance between the male legs is equal to L , the height of the legs is equal to L , the length of the base plates is equal to $3L$ and the height of the base plates is equal to L . This enhances the possibilities of forming complex structures by using several

- 4 -

of such construction elements, since two construction elements of this type may be connected in four different ways to each other and each hinge connection provides a full 180 degrees positioning.

5 The present invention further relates to a tool provided for disconnecting a connection of a female member from a male member according to anyone of the claims 1 to 16, wherein said tool comprises two spaced apart lever legs, each lever leg being provided for being positioned between said two female legs for tilting said female member out of said male member.

10 The invention will now be described further in detail referring to the annexed drawings. In the drawings, a same reference numeral has been attributed to a same or similar feature.

Figure 1 is a plan view of a first preferred embodiment of the hinge connection according to the invention.

15 Figure 2 is a plan view of a first preferred embodiment of a construction element with the male and female members according to the invention.

20 Figure 3 is a plan view of a second preferred embodiment of a construction element with the male and female members according to the invention.

Figure 4 is a section view taken along lines IV-IV from Figure 3.

Figure 5 is a section view taken along lines V-V from Figure 3.

25 Figure 6 is a perspective view of a pyramidal element with a squared base fitting in the construction element of Figures 3 to 5.

Figure 7 is a perspective view showing two construction elements according to Figures 3 to 5 into which pyramidal elements according to Figure 6 are fitted.

- 5 -

Figure 8 is a side view of a hinge connection having male and female members according to Figures 1 to 5.

5 Figure 9 is a side view of another embodiment of a hinge connection, wherein the axis of the hinge is at a greater distance from its base and wherein the male and female legs comprise an enlarged base for stability purposes.

Figure 10 shows a perspective view of the female members according to Figure 9.

10 Figures 11 and 12 illustrate a locking member, provided for locking the connection of the male member with the female member of the hinge connection according to the invention.

Figure 13 shows another embodiment of a hinge connection according to the invention with the locking member of Figures 11 and 12.

15 Figure 14 illustrates a linking member for connecting intermediary pieces from two female members.

Figure 15 shows an application of the male and female members in a CD holder box.

20 Figure 16 shows an application of the male and female members in a photograph frame.

Figure 17 is a partial cross section according to lines XVII-XVII in Figure 16.

Figure 18 is a perspective view of a container with male and female members according to the invention.

25 Figure 19 is a plan view of a frame having hinge connections according to the invention.

Figures 20 and 21 shows a first preferred embodiment of a tool provided for disengaging the hinge connection according to the invention.

- 6 -

Figure 22 shows a second preferred embodiment of the tool.

Figure 23 shows another embodiment of a linking member according to the invention.

5 Referring to Figure 1, there is shown a preferred embodiment of the hinge connection according to the invention. A male member formed by two parallel male legs 1 is applied on a base plate 2. Each of the male legs 1 comprise a protrusion 3. The hinge connection further comprises a pair of female members 4 applied on a further base
10 plate 5, between which the male legs 1 with protrusions 3 may be hingedly and resiliently fitted.

According to the invention, each of the female members 4 comprise a through hole 6 for engaging one of the protrusions 3. By providing a male member having two legs and a pair of female members
15 with a through hole, the thickness of the elements forming the hinge connection may be kept limited, so that upon moulding such a hinged connection, "hot spots" or amassment of material are avoided. Consequently, the cooling time of such a hinge connection may be relatively short. Providing a through hole 6 in the female members may
20 easily be achieved upon moulding by inserting a rod having the same cross sectional shape as the hole to be applied. For moulding the hinge connection according to the invention, use is made of a plastic material, for example polypropylene or ABS.

Figure 1 shows a preferred embodiment of the female
25 members, wherein each of the female members is formed by two parallel female legs 7 connected by an intermediary piece 8, wherein the intermediary piece is mounted offset from said further base plate, as indicated by arrow 9 (Figure 1). According to an alternative, each of the female members may be formed by one piece; in this case however, the
30 through hole, instead of being cylindrical according to the shape of the

- 7 -

intermediary piece, should have a shape corresponding to the shape of the female members, in particular a longitudinally extended shape with a rounded end (in cross section), in order to avoid "hot spots". This particular shape corresponds to the shape of the female legs illustrated in Figure 4.

It should be noted that preference is given to rounded shape of the male and female members, as for example illustrated in Figures 4 and 5, enhancing in this way the hinge movement of the hinge connection. The connection of the elements is facilitated by providing legs with rounded free ends as for example clearly shown in Figures 1 and 3.

Figure 2 illustrates a first preferred embodiment of a construction element according to the invention, comprising a base plate 2 and a further base plate 5 with male and female members as described hereinabove. This construction element may be for example used in a square plate wherein each corner of the plate is provided with such a construction element. In this way, different square plates, having the same dimension and provided with the construction elements according to Figure 2, may be hingedly fixed together for forming complex structures.

Figure 19 shows an alternative of Figure 2, wherein only one male leg of the male member is applied on the base plate and only one of the pair of female members is applied on the further base plate. Providing such construction elements on a square plate enables also to form complex structures, wherein two male legs on one side of the square may be hingedly fitted between two female members, wherein each female member is located at a corner of the plate.

Referring now to Figures 3 to 5, there is shown a second preferred embodiment of the construction element according to the invention. According to this embodiment, there are two parallel base

- 8 -

plates 2 with male legs 1 and two further parallel base plates 5 with female members 4. The base plates 2 and 5 are linked together in such a manner to form a square. As shown in Figure 3, the male legs 1 are applied symmetrically with respect to the middle of the base plate 2 and each female member 4 extends at an extremity of the further base plate in such a manner that one of the female legs 7 extends in prolongation from an extremity of one of said base plates.

As can be clearly deduced from Figures 3 to 5, two construction elements may be assembled by hingedly fitting the male legs from one construction element between the female members of another construction element, wherein the hinged connection may be rotated over 180°, forming an angle between 90 and 270 degrees with respect to each other. 90 and 270 degrees form two stop positions (one of which is shown in Figure 20), since the female legs 7 from one construction element comes into contact with a base plate of the other construction element. When a pressure is applied beyond those stop positions, the hinge connection is disengaged.

Besides the advantage of avoiding "hot spots" upon manufacturing, gaining time and material, the through hole offer additional construction possibilities, i.e. when assembling several construction elements, male legs may be fitted at both sides of the through hole. In particular, upon assembling construction elements in one plane in such a manner that a first construction element is fitted between female member of a second construction element, and one of the male members of the second construction element is fitted between female members of a third construction element, then one of the female members of the first construction element will be spaced off with a distance L from one of the female members of the third construction element, so that a male member of a fourth construction element may be fitted between the latter two female members. These additional

- 9 -

construction possibilities may contribute to the stability and diversity of the formed structure. The through holes also offer the possibility to receive a number of accessories, for example carrying an axle for forming a car or holding a string for forming a necklace. The through
5 holes also offer the possibility to disengage construction elements from each other by inserting a lever such as a pen.

It is also possible to assemble female members from different construction elements with each other by providing a pin through the through holes.

10 The construction element according to Figures 3 to 5 has preferably the following dimensions : distance between the female legs L, distance between the male legs L, height of the legs L, length of the base plates 2 and 5 equal to 3L and height of the base plates 2 and 5 equal to L. Consequently, an imaginary square 10 is formed with sides
15 having a length equal to 5L. Thus, the construction element is designed in such a way - male and female members have all the same length, width and height - that the hinges are not only provided for interlocking different elements, but are also that, when construction elements are engaged, the edges of the legs are touching, leaning and resting on the
20 base plate of the other element. Thus a structure can be given great stability and a great vertical resistance to pressure.

Preferably the base plates 2 and 5 are connected by a connection plate 11 extending perpendicularly to the base plates 2 and 5, enhancing the strength of the construction element. In this way, a
25 container is also formed. In the embodiment shown in Figures 3 to 5, the height of the construction element (shown in Figure 4) is also equal to L. It is also conceivable to form containers with a larger height in order to increase the volume of the container. Figure 18 shows a possible embodiment, wherein the bottom portion 28 of the container is
30 dimensioned in order to fit within a construction element of Figure 3 and

- 10 -

wherein assembled within that construction element, the height is equal to $5L$ so as to correspond with the length of the sides of the imaginary square of Figure 3. In this way, the container forms an imaginary cube with sides equal to $5L$ and is compatible with the construction elements of Figures 3 to 5 and may therefore be used in connection therewith to form complex structures. The container of Figure 18 further comprises a cap 27 in order to form a closed object. Such a container may be used for containing objects, goods or liquids. A container can also be formed with a separate conditioned element 36. In other words, the container of Figure 18 comprises one element 36 in the form of a cube with the hinge connection. According to an alternative, the element 36 is separated into an element with the hinges and a separate element which may be in another material, for example cardboard.

The element of Figures 3 to 5 can also receive cardboard elements comprising numbers, letters or images.

The construction element according to the invention may also be used as a cap for a container, for example for a bottle. In this case, a threaded closure element should be provided in the element of Figures 3 to 5.

For the same compatibility reasons as explained hereinabove, the square plate used in connection with the construction elements of Figure 2 should preferably have sides with a length for example equal to $11L$, so that three elements of Figure 3 to 5 linked together may be hingedly fitted to the formed construction with the square plate.

By using a number of construction elements according to Figures 3 to 5, it is possible to form a hollow elongated bar. In order to reinforce the structure, a beam may be fitted into the hollow area for supporting the formed object. Figures 6 and 7 shows another way to reinforce the structure of the construction elements. A pyramidal element

- 11 -

12 comprise a squared base 13 fitting within the square formed by the base plates 2 and further base plates 5. The height H is essentially equal to $\frac{1}{2}$ of the length of the base plate 2, which is thus equal to 1,5L. The reason why the pyramidal element 12 should have this height will be clear from Figure 7, showing two construction elements each having a pyramidal element 12 fitted thereon. With six construction elements and six pyramidal elements, a closed cube can be formed.

The hinge connection according to the invention may be used for hingedly connecting plates to each other, such as illustrated in Figures 8 to 10. According to the embodiment of Figure 8, the width of the base plate 2 determines the maximum thickness of one of the plates 15. The embodiment according to Figures 9 and 10 enables to increase this maximum thickness by enlarging the distance of the axis from the hinge from the base plate. This enlarged distance determines now the maximum thickness of one of the plates 15. In Figures 9 and 10, the male and female legs 1 and 7 comprise an enlarged base 14 for ensuring stability of the hinge connection. The female legs are connected by a plate 35 for further stability. As can be deduced from Figures 8 and 9, plate 15 is two times thicker in Figure 9 than in Figure 8, since the width of the enlarged base 14 is two times the width of the base plate 2. As illustrated in Figure 9, the hinge connection is for example fixed to the plate by means of screws 16.

Referring to Figures 11 and 12, there is shown a locking member 17 according to the invention. This locking member comprises a locking leg 18 provided to be placed between the male legs 1, as shown in Figure 13. A release leg 19 extends perpendicularly to the locking leg 18 and is provided to be gripped by a pair of pincers for facilitating release of the locking member. As shown in Figures 11 and 12 there is provided a release leg at both sides of the locking leg. According to an

- 12 -

alternative, there is provided only one release leg at only one side of the locking leg.

Figure 13 further shows another embodiment of the hinge connection according to the invention, wherein the base and further base plates 2 and 5 have a stepped shape, so that different base plates 2 and 5 may be connected adjacent each other by means of screws (not shown) for example. A washer 31 may be provided for the hinge connection at one of the extremities.

In order to enable to connect the intermediary pieces of the female members, there is provided a linking member 20 as illustrated in Figure 14. The linking member comprises two C shaped curved legs 21 attached to each other. Figure 23 shows another embodiment of a linking member 20 having the shape of two male members attached to each other. This linking member is provided for being positioned between a pairs of female members from a first element and a pair of female members from another element. A combination of Figures 14 and 23 is also conceivable, comprising one C shaped curved leg and one male member attached to each other.

The male and female members according to the invention may further be used in a CD holder box 22 as shown in Figure 15. Two opposite sides of the box comprise each two pairs of female members at their extremities whereas the other opposite sides comprises notches 23 for receiving releasable male members 24. In Figure 15, only one releasable male member 24 has been shown in two positions, i.e. the mounted position and a storage position. It will be understood that a CD box contains four releasable male members.

Figures 16 and 17 show another application of the male and female members according to the invention forming a frame 25 for a photograph. Such as in the embodiment of Figures 3 to 5, the construction element comprises base plates 2 and 5 connected to each

- 13 -

other to form a closed object. The base plates are further connected by a connection plate 11. In order to protect a photograph from dust, a cover 26 of transparent material, for example polystyrene, is provided as illustrated in Figure 17. The cover 26 is formed by a plate 32 with edges 33. In the position shown in Figure 17, the plate is in contact with the photograph in order to protect it from dust. In another position, wherein the edges 33 are in contact with the connection plate 11, a closed area is formed which may be used for holding objects. Figure 16 shows that the frame is held in a vertical position by connecting it to a support member 34 comprising corresponding male and female members. The support member may also be formed by connecting two construction elements of Figures 3 to 5 to one another.

Figures 20 to 22 show two embodiments of a tool 29 in connection with the construction elements of Figures 3 to 5. The tool 29 comprises two spaced apart lever legs. Each lever leg is provided for being positioned between two female legs of a female member for tilting said female member out of said male member, as shown in Figures 20 and 22 by the arrows. If the tool comprises a curved free end 30 as shown in Figures 20 and 21, the female member can also be pulled out of the male member, as indicated by the arrow in Figure 21.

LIST OF REFERENCE NUMERALS

	1	male leg
	2	base plate
25	3	protrusion
	4	female member
	5	further base plate
	6	through hole
	7	female leg
30	8	intermediary piece

WO 98/30808

PCT/BE98/00001

- 14 -

	9	offset
	10	imaginary square
	11	connection plate
	12	pyramidal element
5	13	squared base
	14	enlarged base
	15	plate
	16	screw
	17	locking member
10	18	locking leg
	19	release leg
	20	linking member
	21	curved linking leg
	22	CD holder box
15	23	notch
	24	releasable male member
	25	photograph frame
	26	cover
	27	cap
20	28	bottom of the container
	29	tool
	30	curved end of the lever
	31	washer
	32	cover plate
25	33	cover edges
	34	support member
	35	female legs connection plate

- 15 -

CLAIMS

1. A hinge connection comprising a male member applied on a base plate, said male member having protrusions provided to be hingedly and resiliently fitted between a pair of female members applied on a further base plate, said male member being formed by two parallel male legs, wherein each leg comprises one of said protrusions, and each of said female members comprising a through hole for engaging one of said protrusions, characterised in that each of said female members is formed by two parallel female legs connected by an intermediary piece and said through hole extends through said female legs and said intermediary piece.

2. A hinge connection according to claim 1, wherein said intermediary pieces are mounted offset from said further base plate.

3. A hinge connection according to claim 1 or 2, wherein said intermediary pieces are cylindrical pieces and said through holes and protrusions are cylindrical.

4. A hinge connection according to any one of the preceding claims, wherein said male and female members are provided with rounded free ends.

5. A hinge connection according to any one of the preceding claims, wherein said legs comprise rounded borders.

6. A hinge connection according to any one of the preceding claims, wherein said legs comprise an enlarged base applied on said base plate, respectively further base plate.

7. A hinge connection according to any one of the preceding claims, further comprising a locking member for locking the connection of said male member to said female member, wherein said locking member comprises a locking leg provided to be placed between said male legs and a release leg extending essentially perpendicularly to said locking leg.

AMENDED SHEET

8. A hinge connection according to any one of the preceding claims, further comprising a linking member for connecting a first female member with a second female member.

5 9. A construction element comprising at least one base plate with at least one male member and at least one further base plate with at least one female member according anyone of the preceding claims.

10 10. A construction element according to claim 9, comprising at least three base plates forming a closed area, wherein said base plates are connected by a connection plate extending in a plane perpendicular to said base plates.

15 11. A construction element according to claim 9 or 10, comprising two parallel base plates and two further parallel base plates forming together a square, wherein the two base plates each comprise said male legs applied symmetrically with respect to the middle of the base plate and wherein the two further base plates each comprise said pair of female members, each female member of said pair extending at an extremity of the further base plate in such a manner that one of said female legs extends in prolongation from an extremity of one of said base plates.

20

25 12. A construction element according to claim 11, wherein the distance between the female legs is equal to L, the distance between the male legs is equal to L, the height of the legs is equal to L, the length of the base plates is equal to 3L and the height of the base plates is equal to L.

13. A construction element according to claim 11 or 12, further comprising a pyramidal member having a squared base fitting in said square and a height essentially equal to $\frac{1}{2}$ of the length of the base plates.

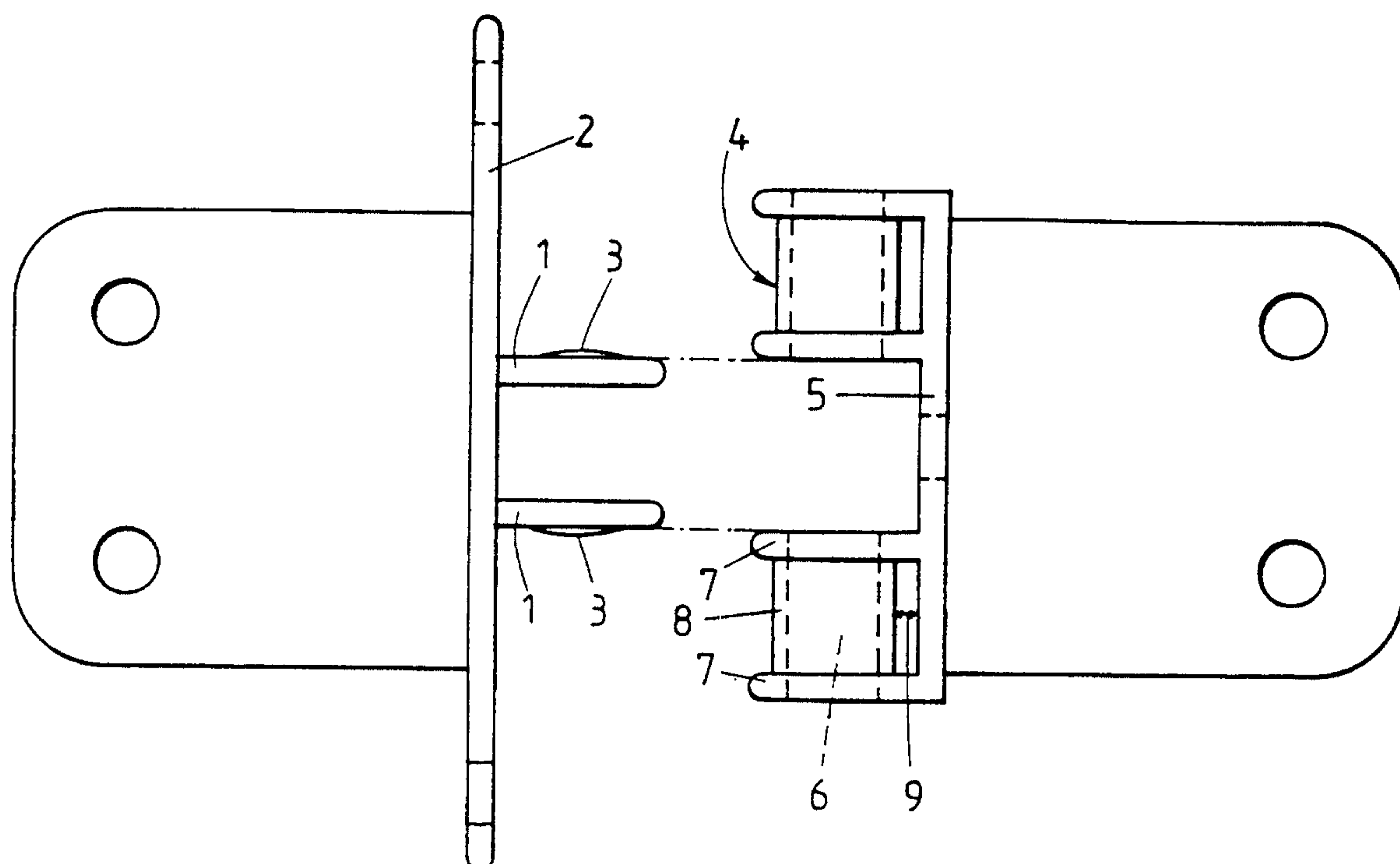
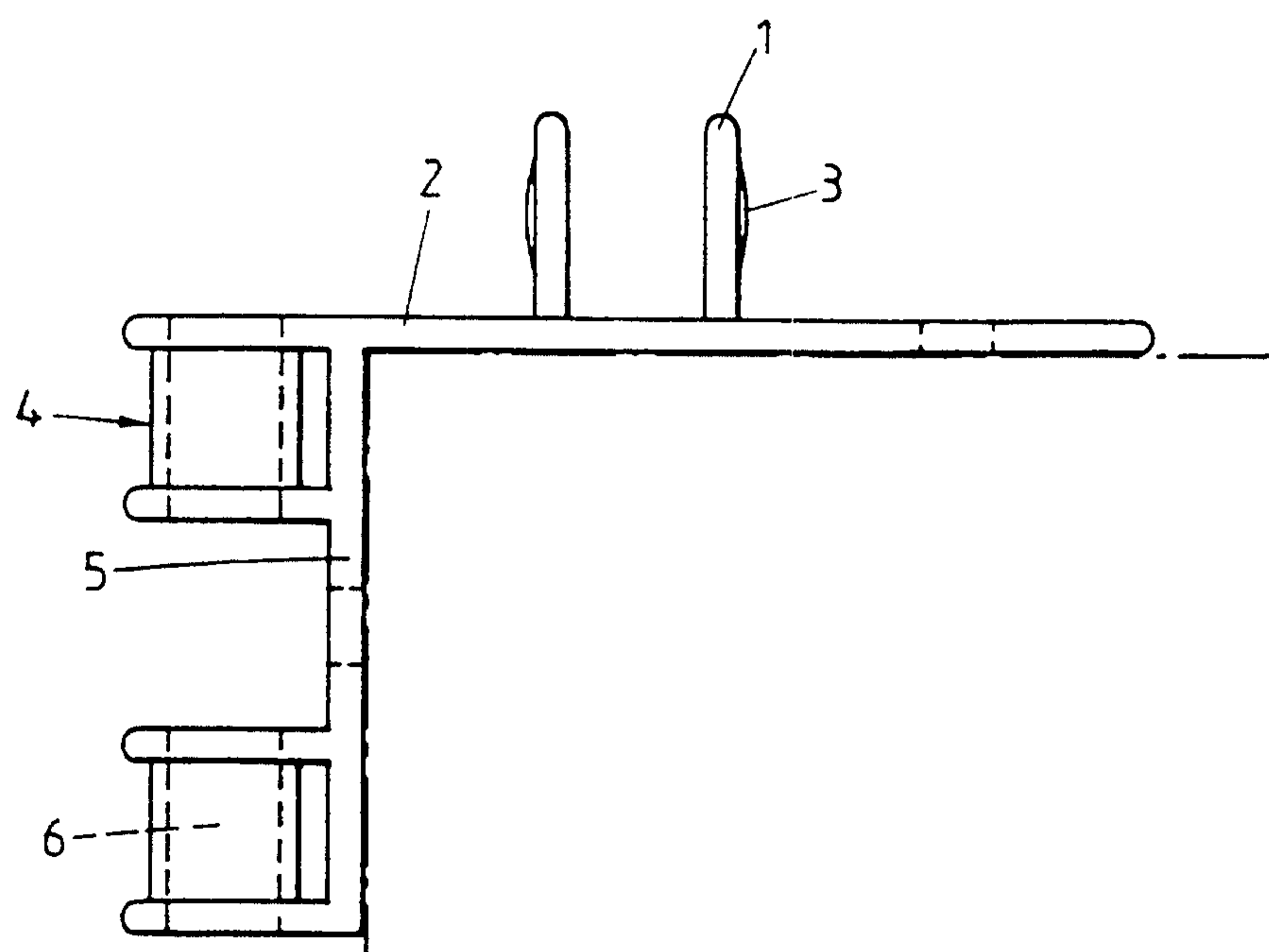
- 17 -

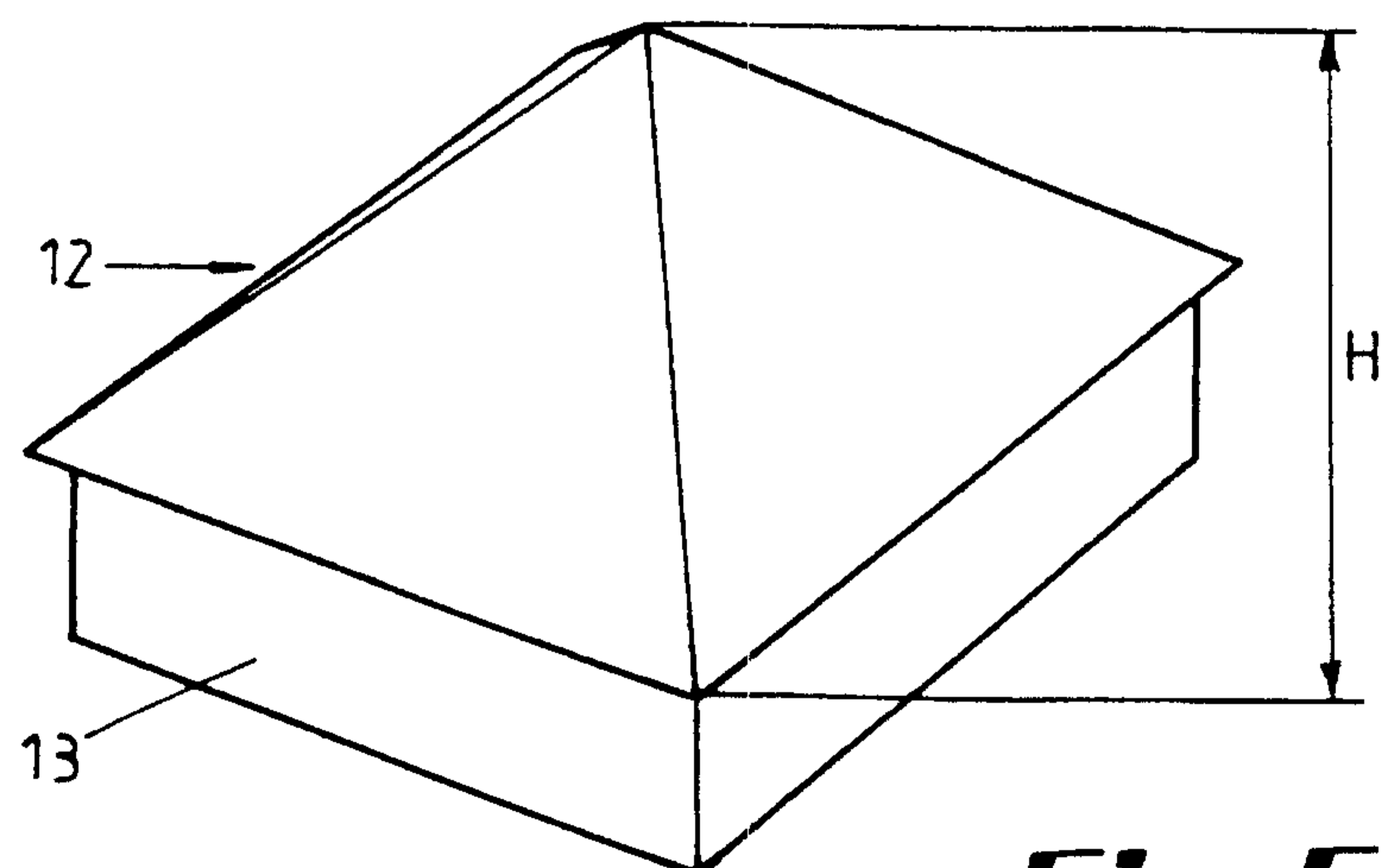
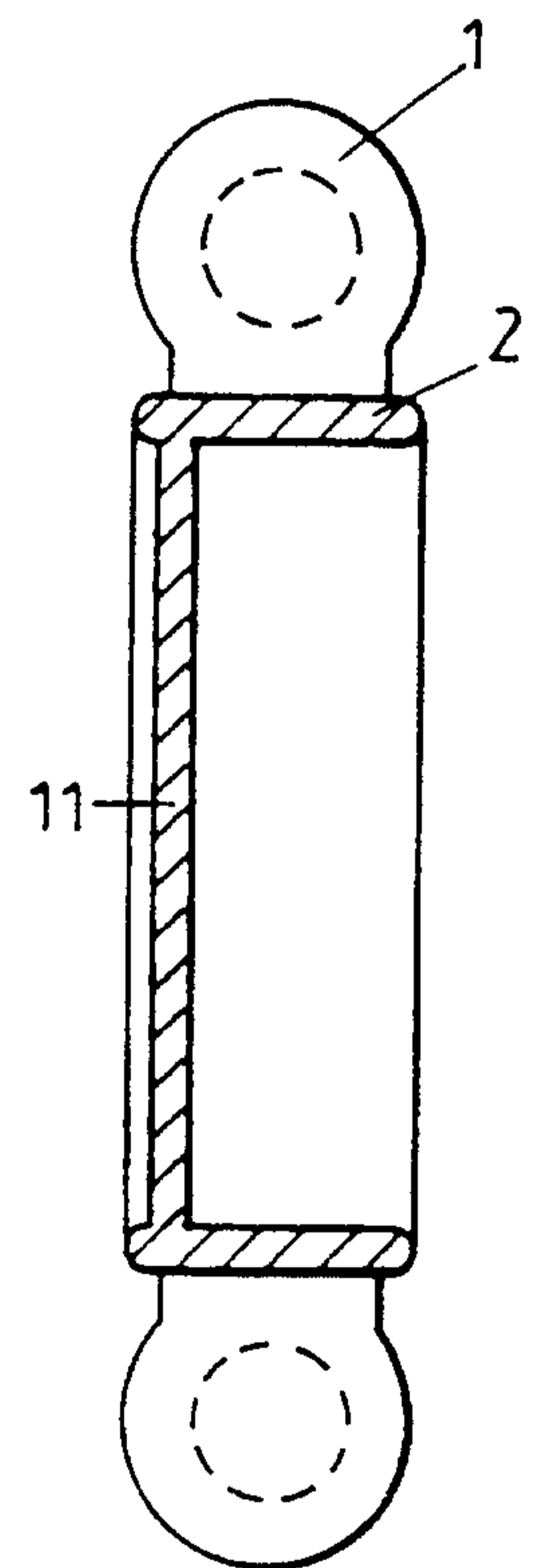
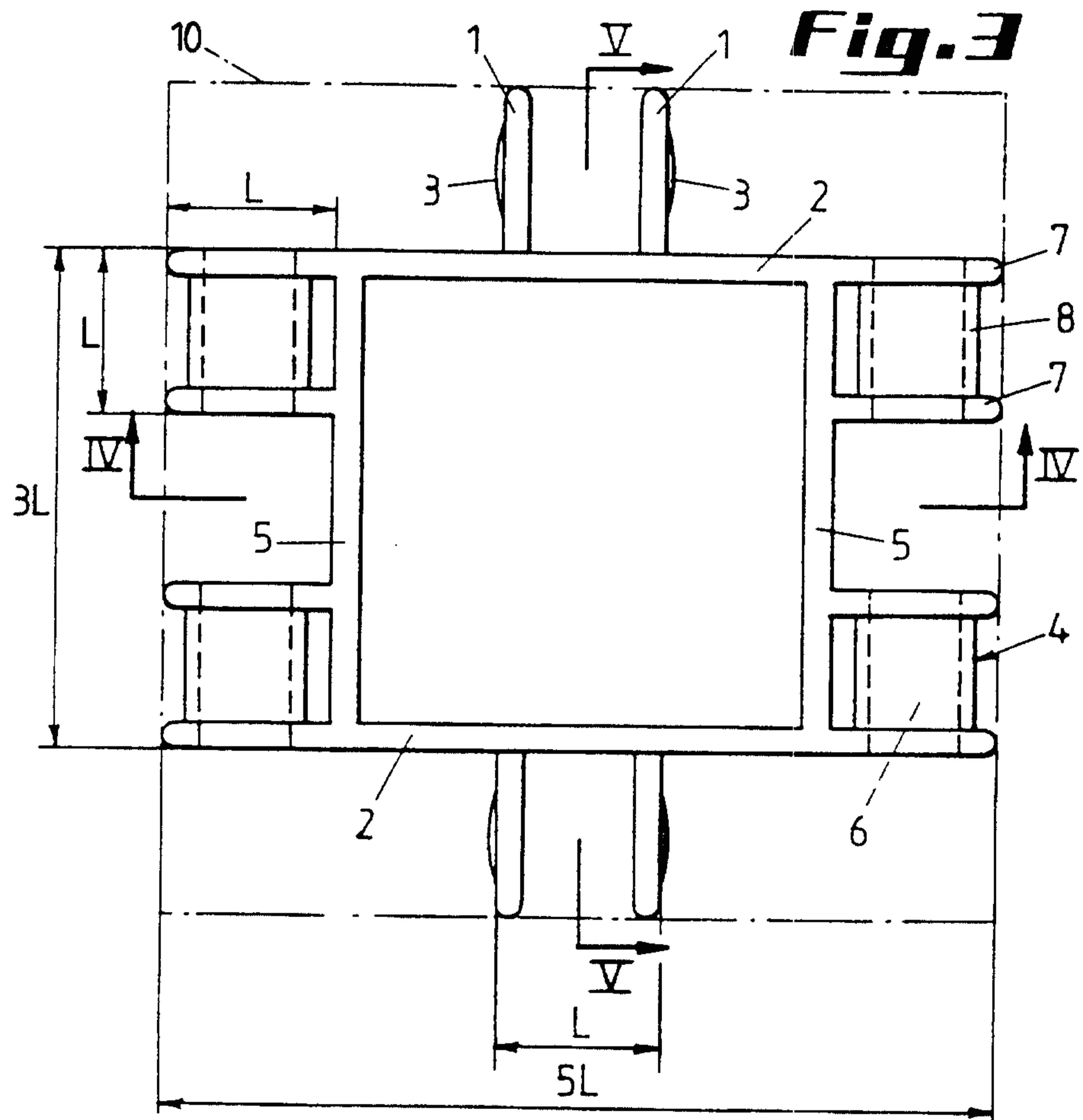
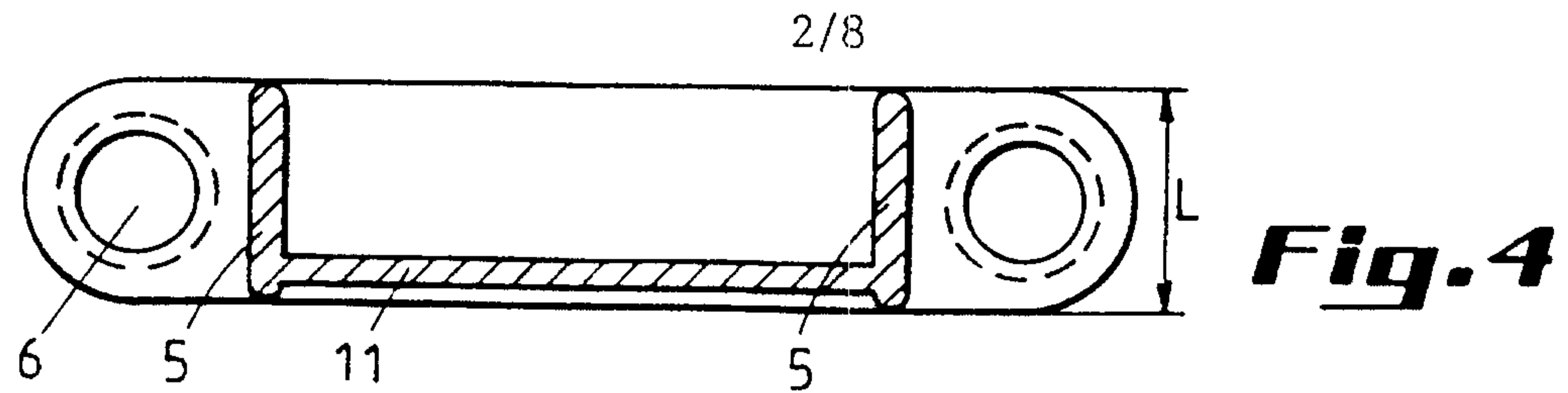
14. Use of said female and male members according to any one of the claims 1 to 4 in a CD holder box.

15. Use of said female and male members according to any one of the claims 1 to 5 in a photograph frame further comprising a cover
5 of transparent material provided for protecting the photograph from dust.

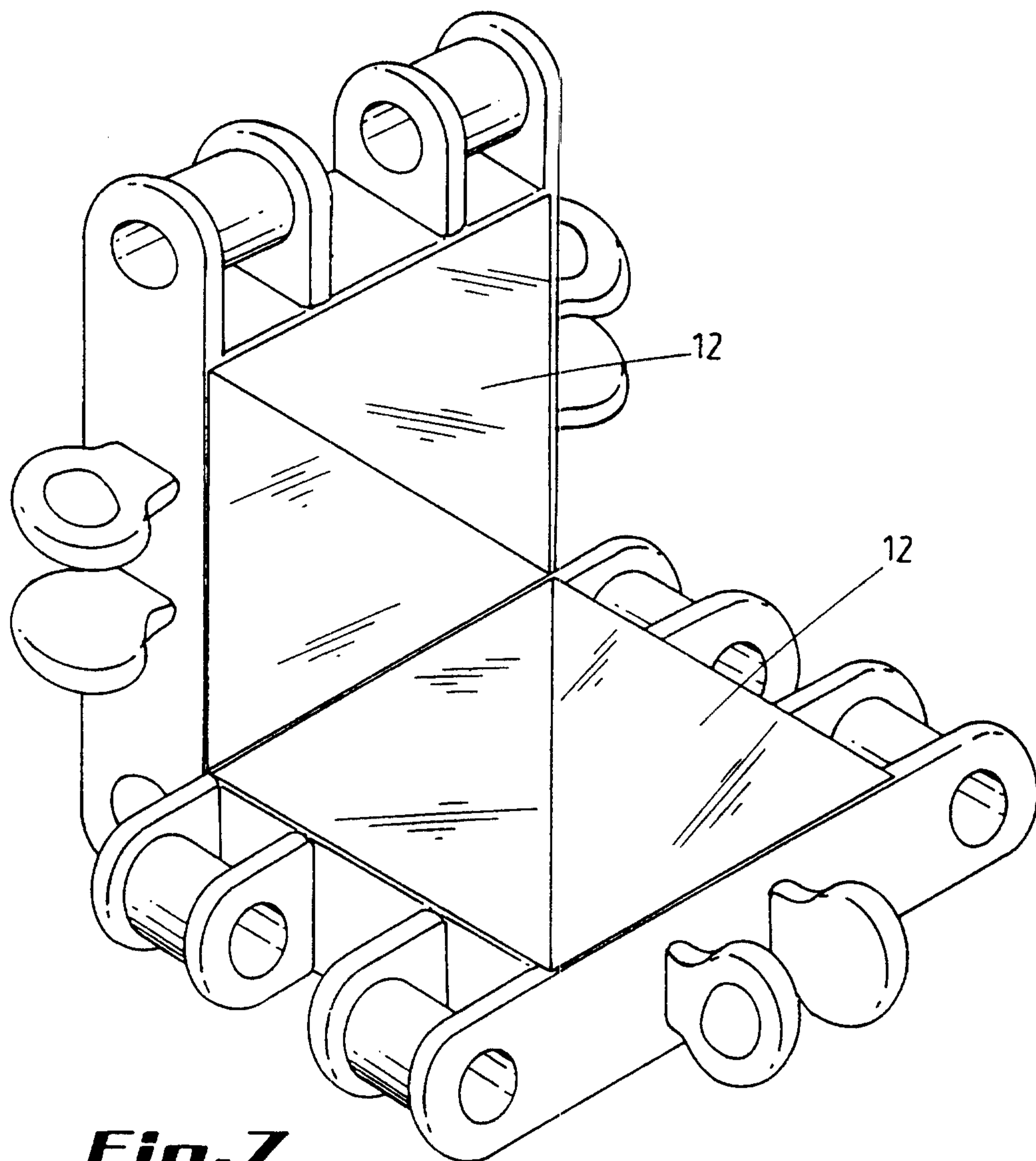
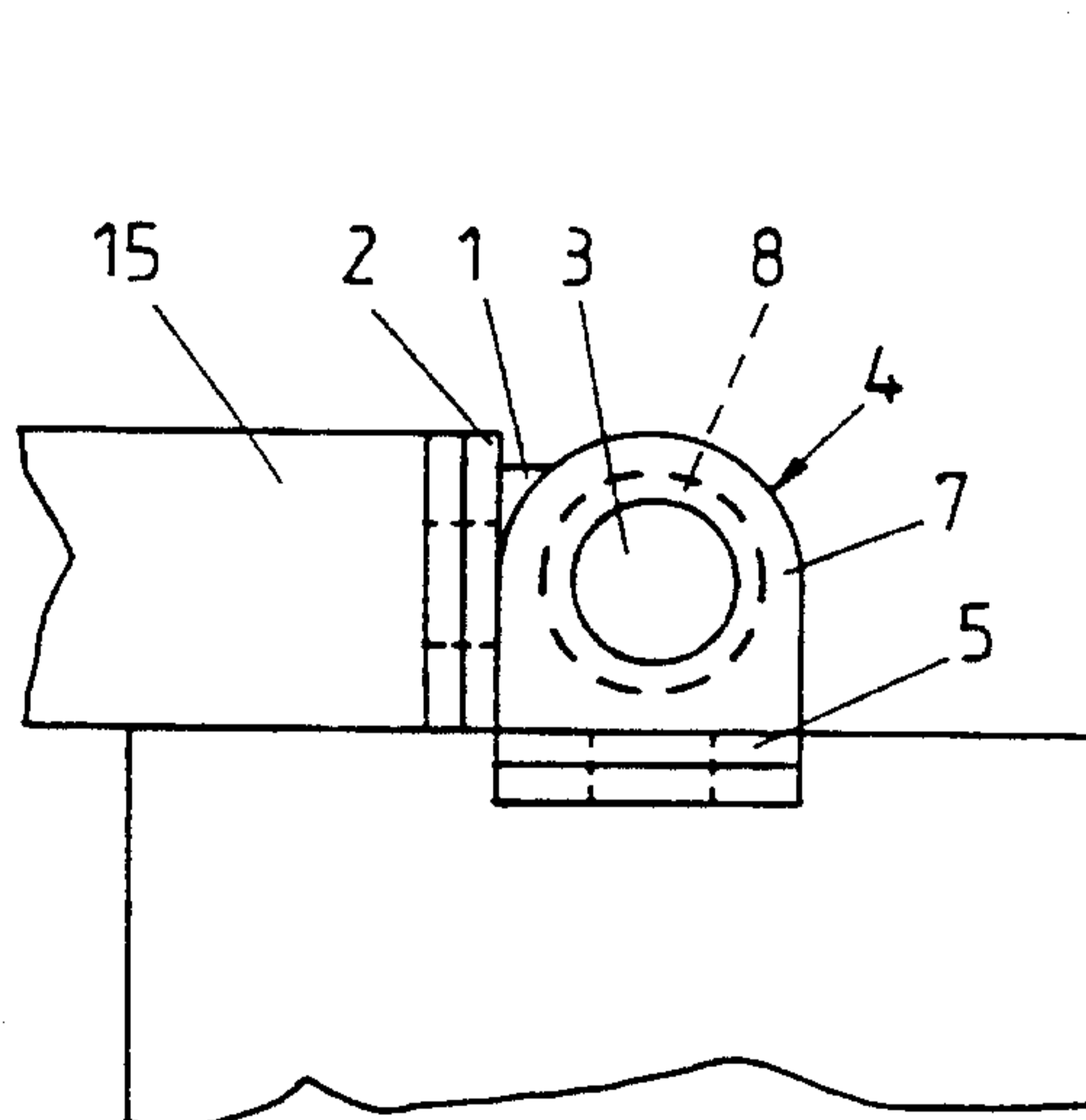
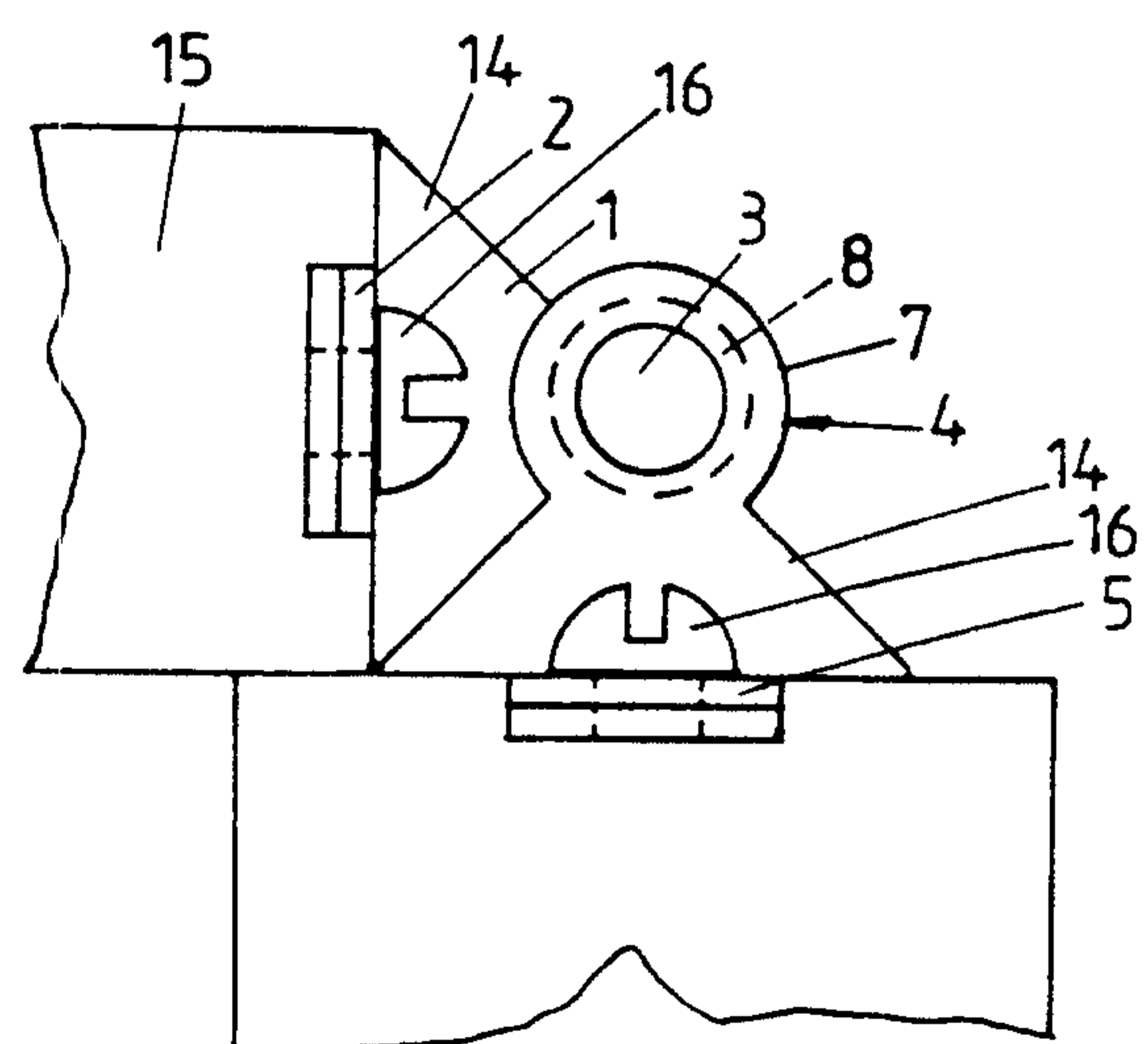
AMENDED SHEET

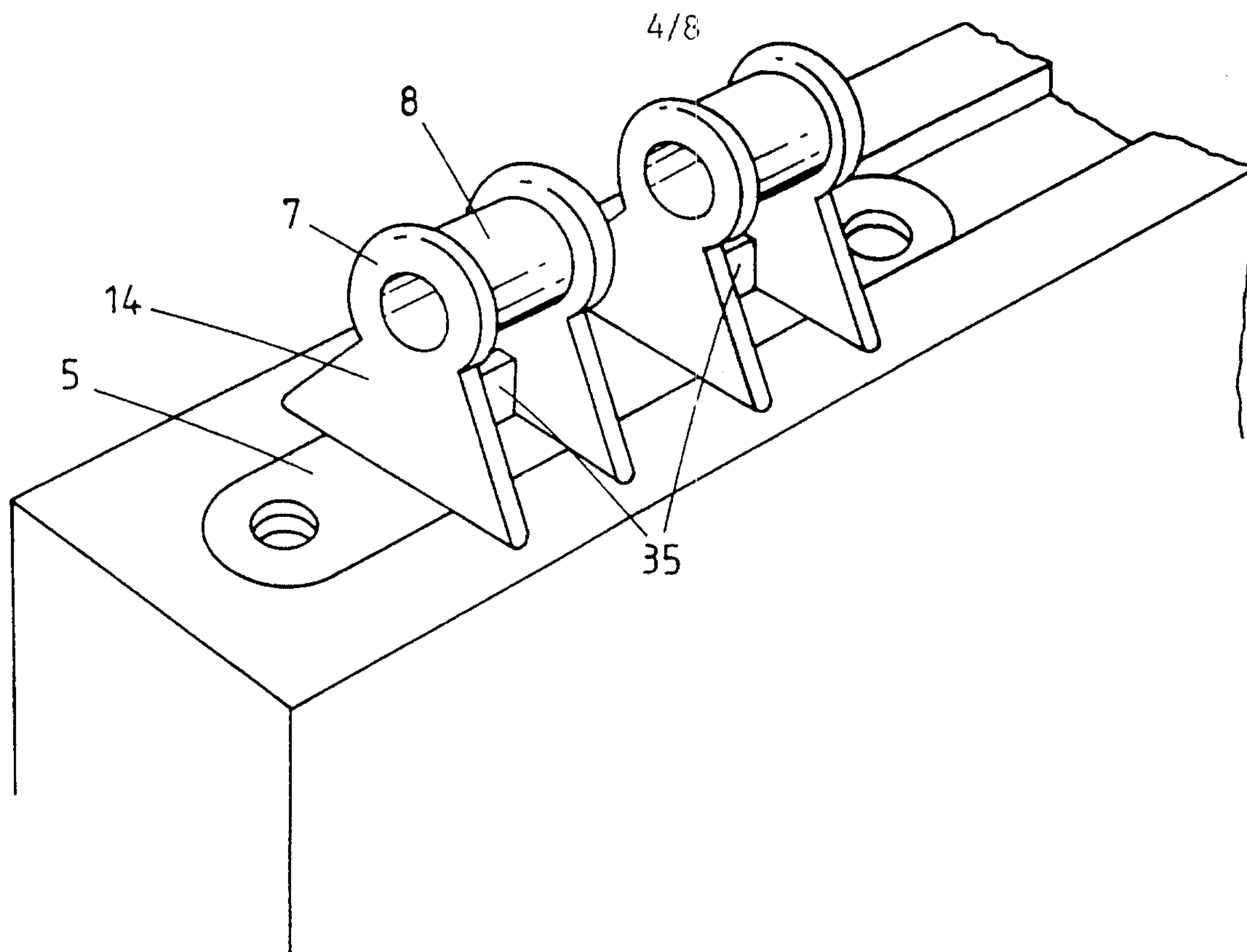
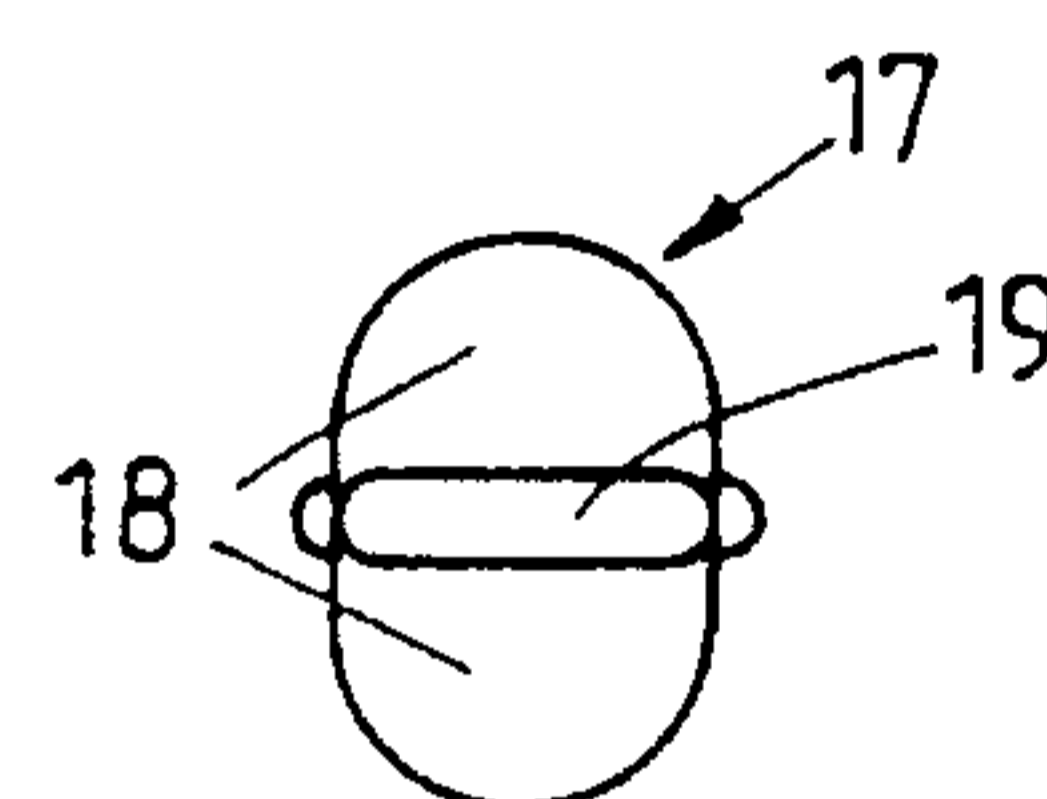
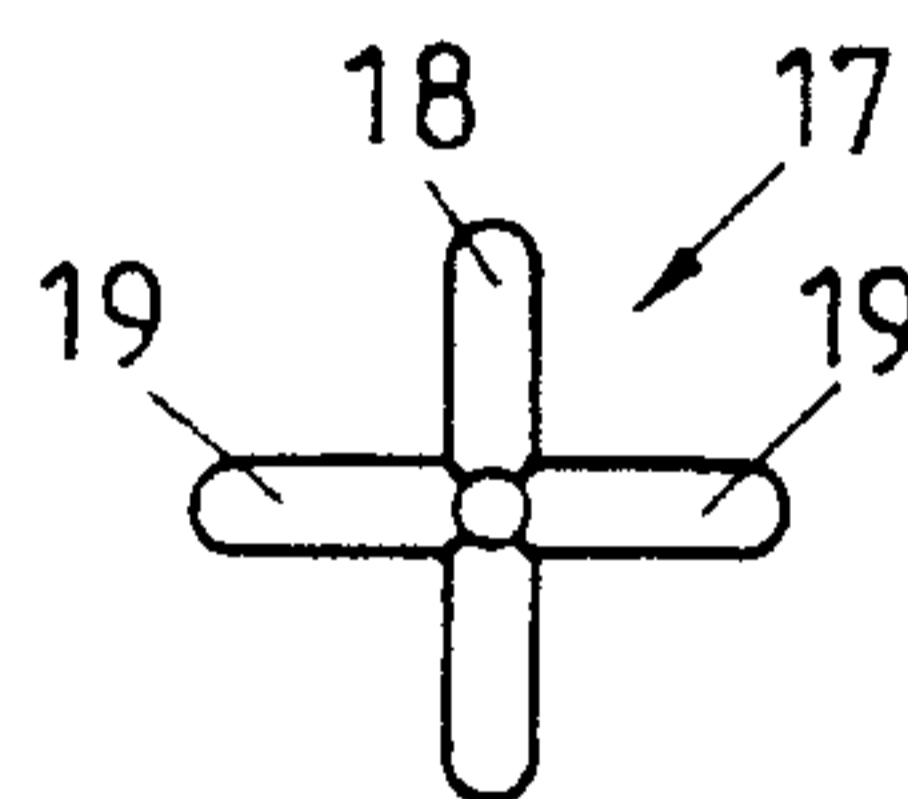
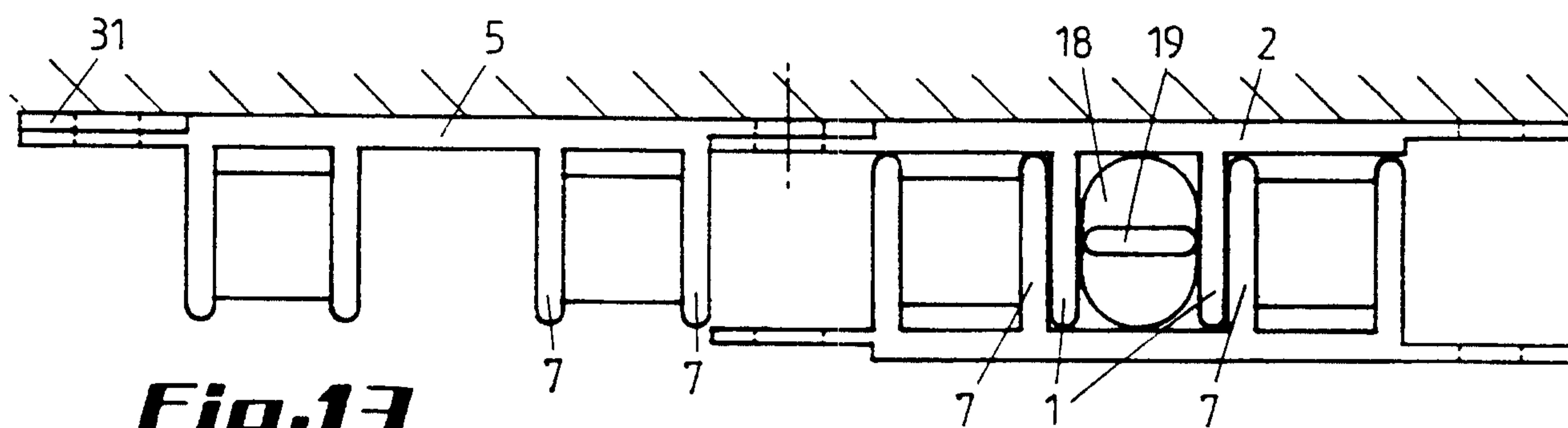
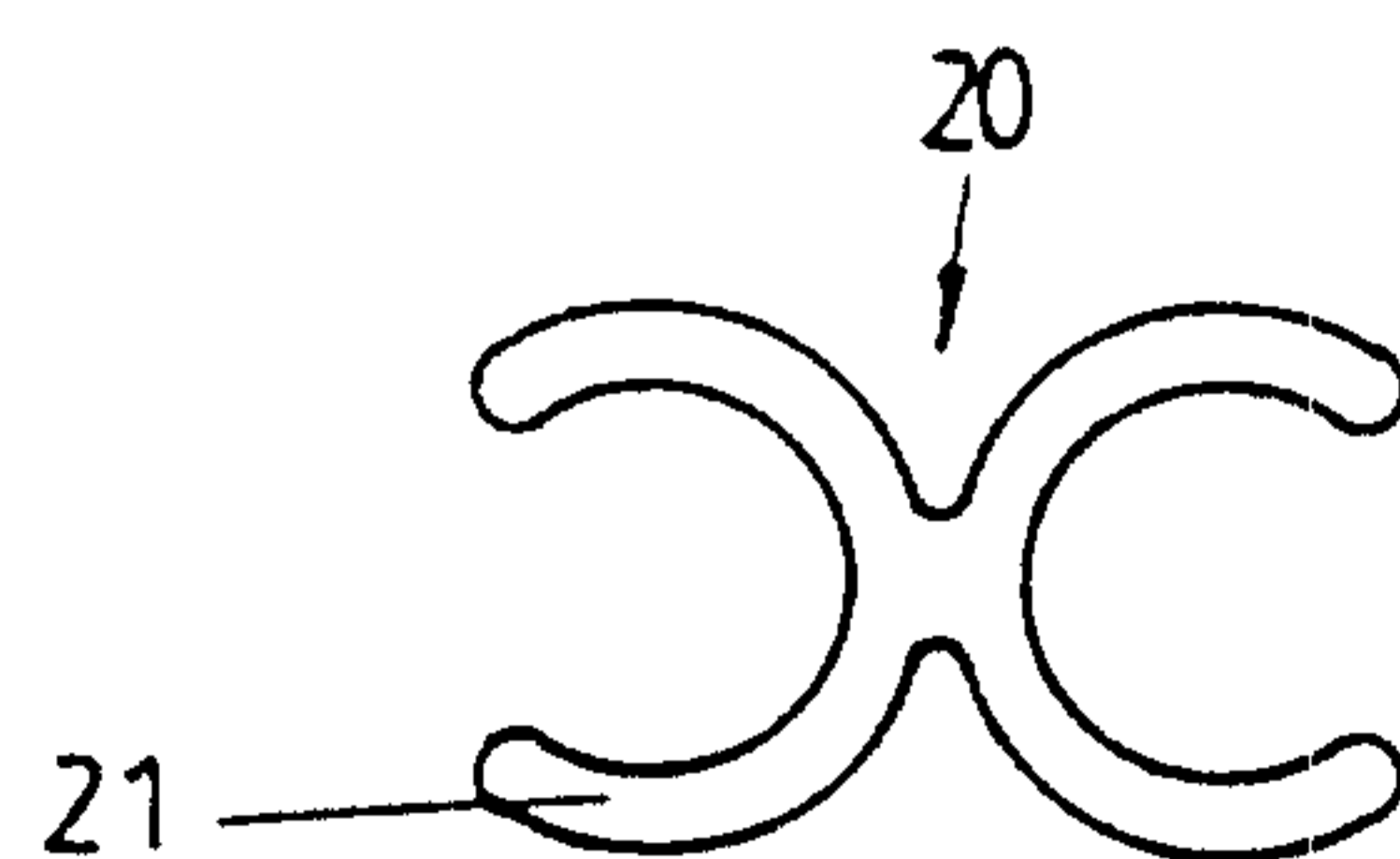
1/8

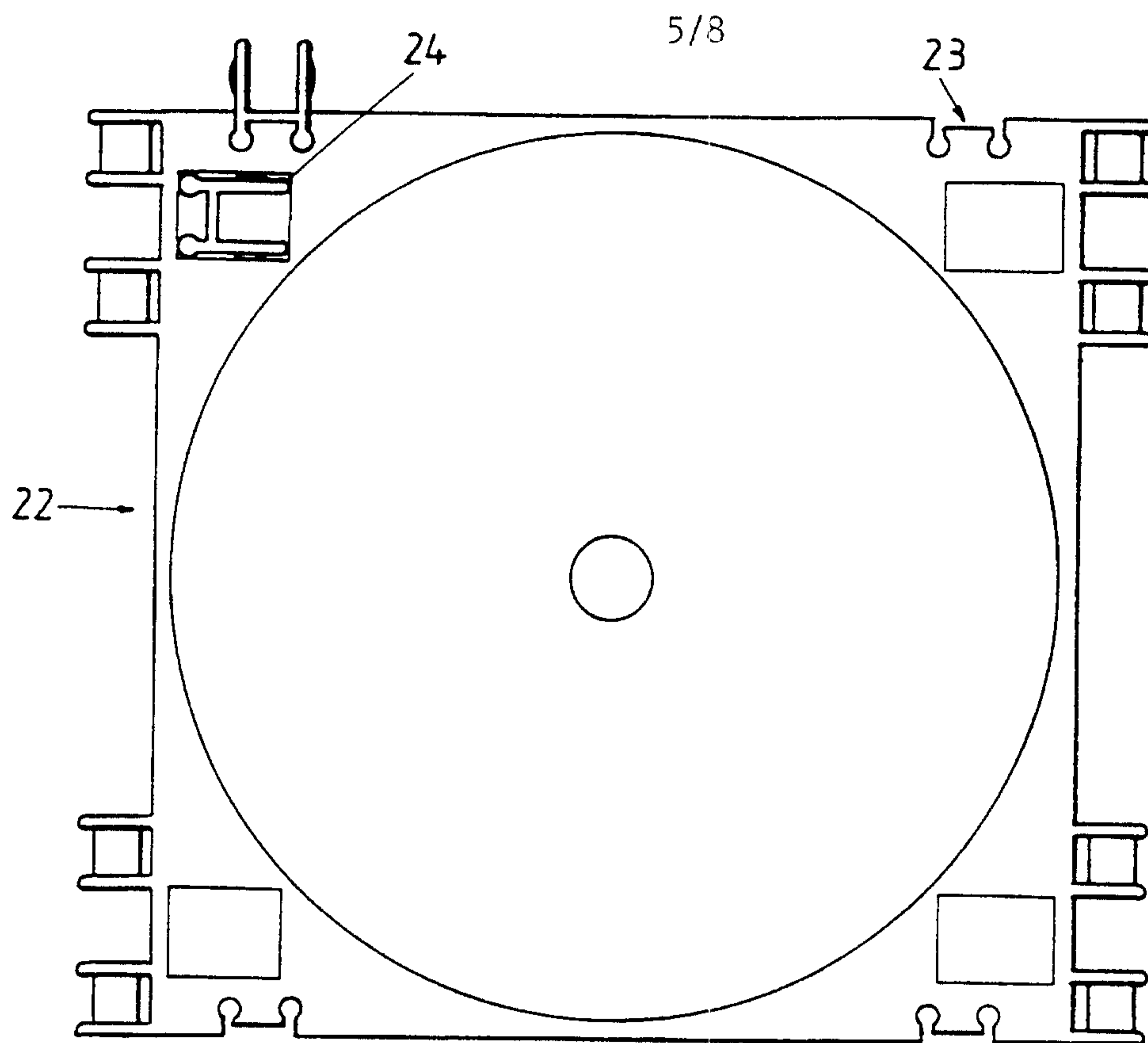
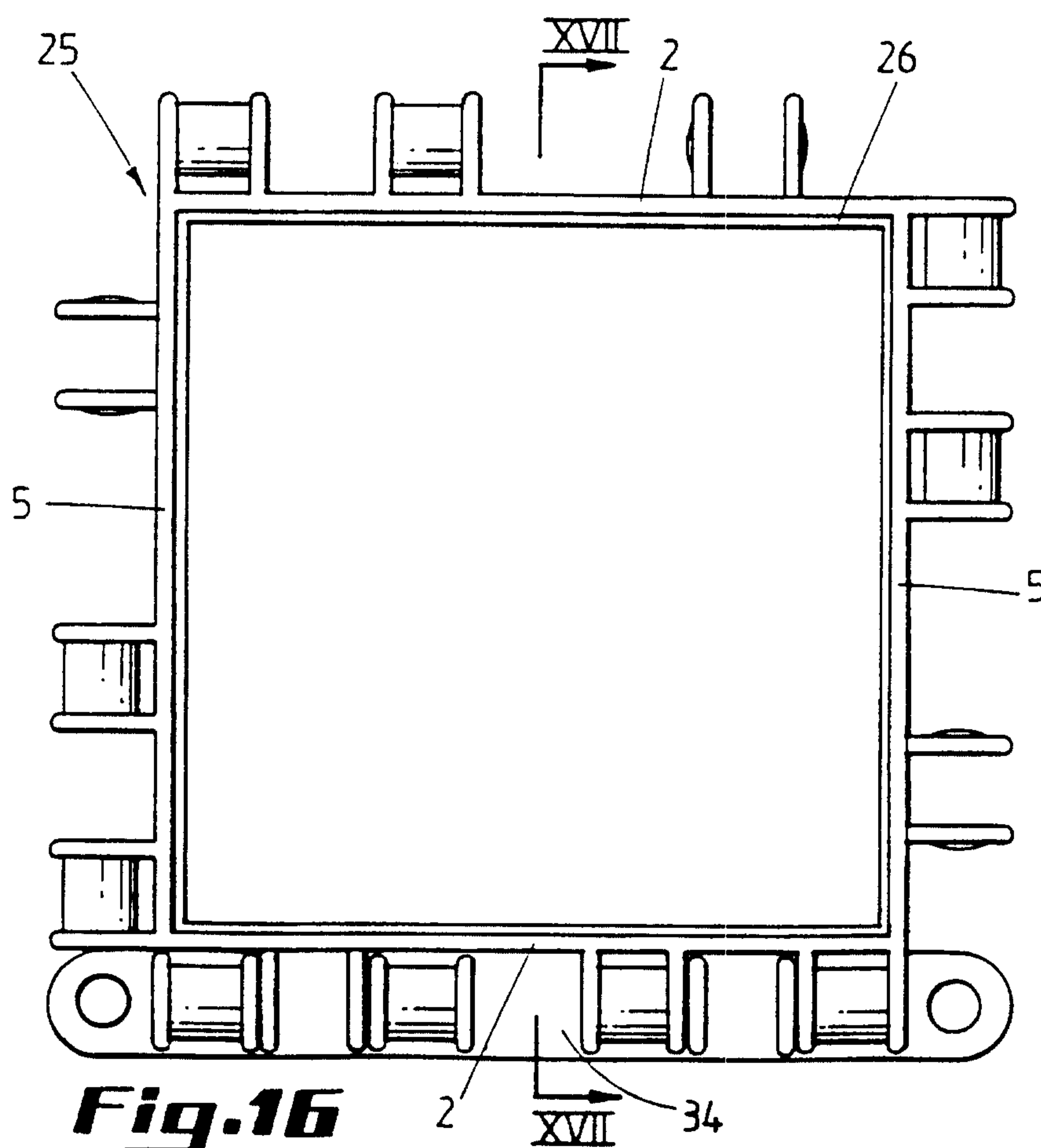
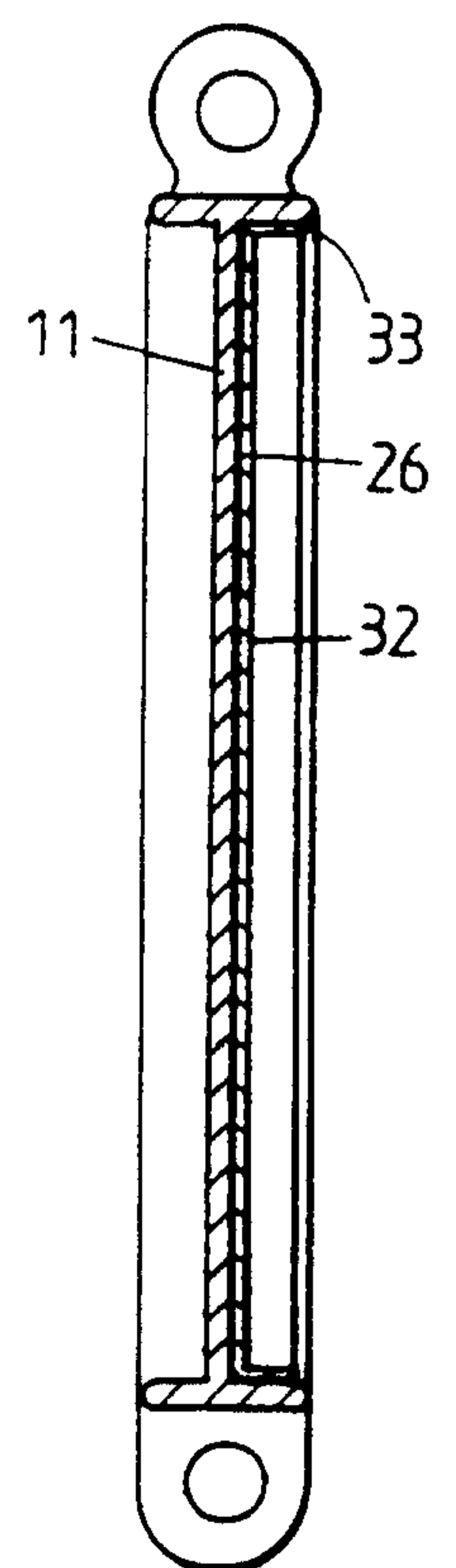
**Fig.1****Fig.2**



3/8

**Fig. 7****Fig. 8****Fig. 9**

**Fig.10****Fig.11 Fig.12****Fig.13****Fig.14**

**Fig. 15****Fig. 16****Fig. 17**

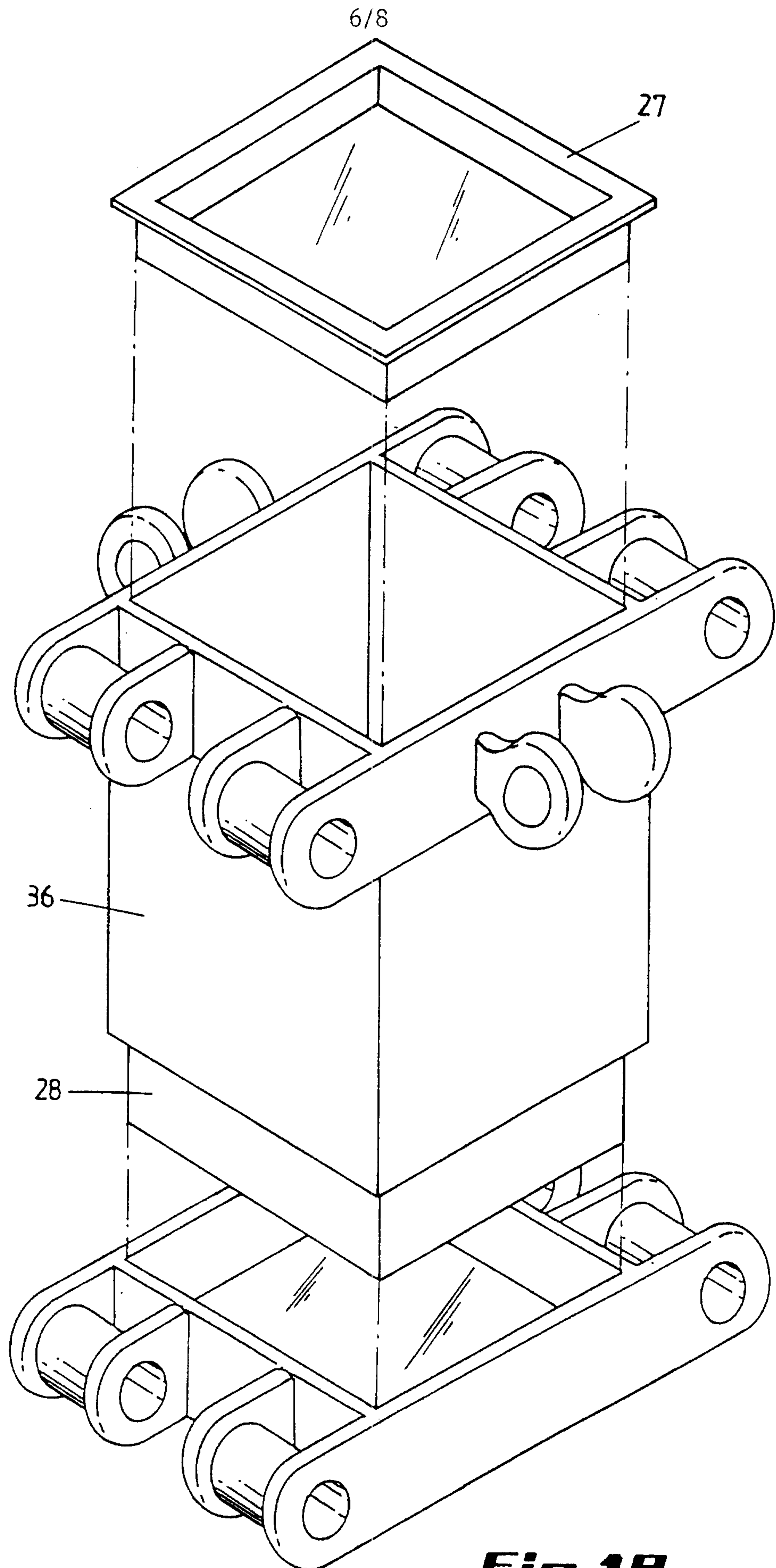


Fig.18

7/8

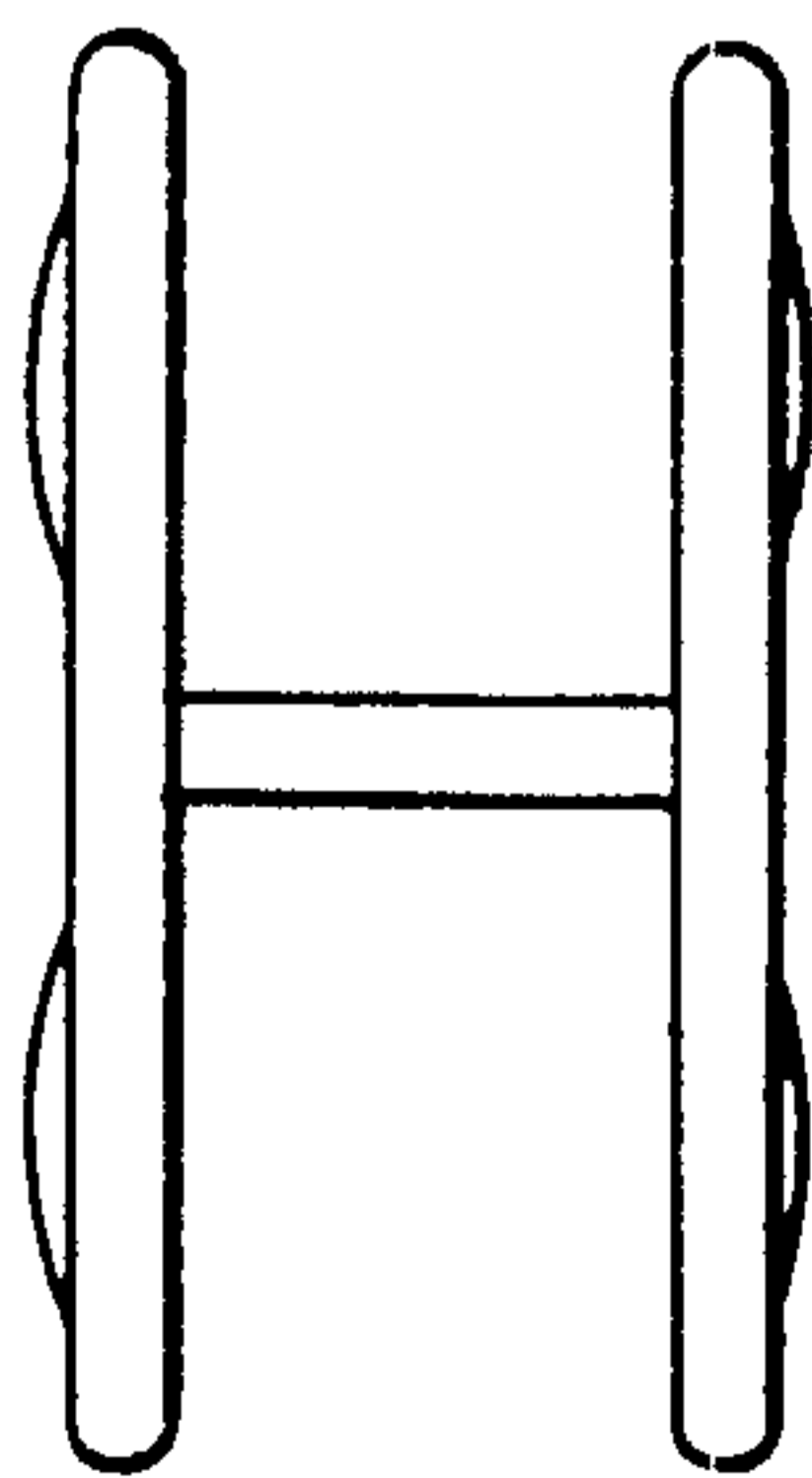
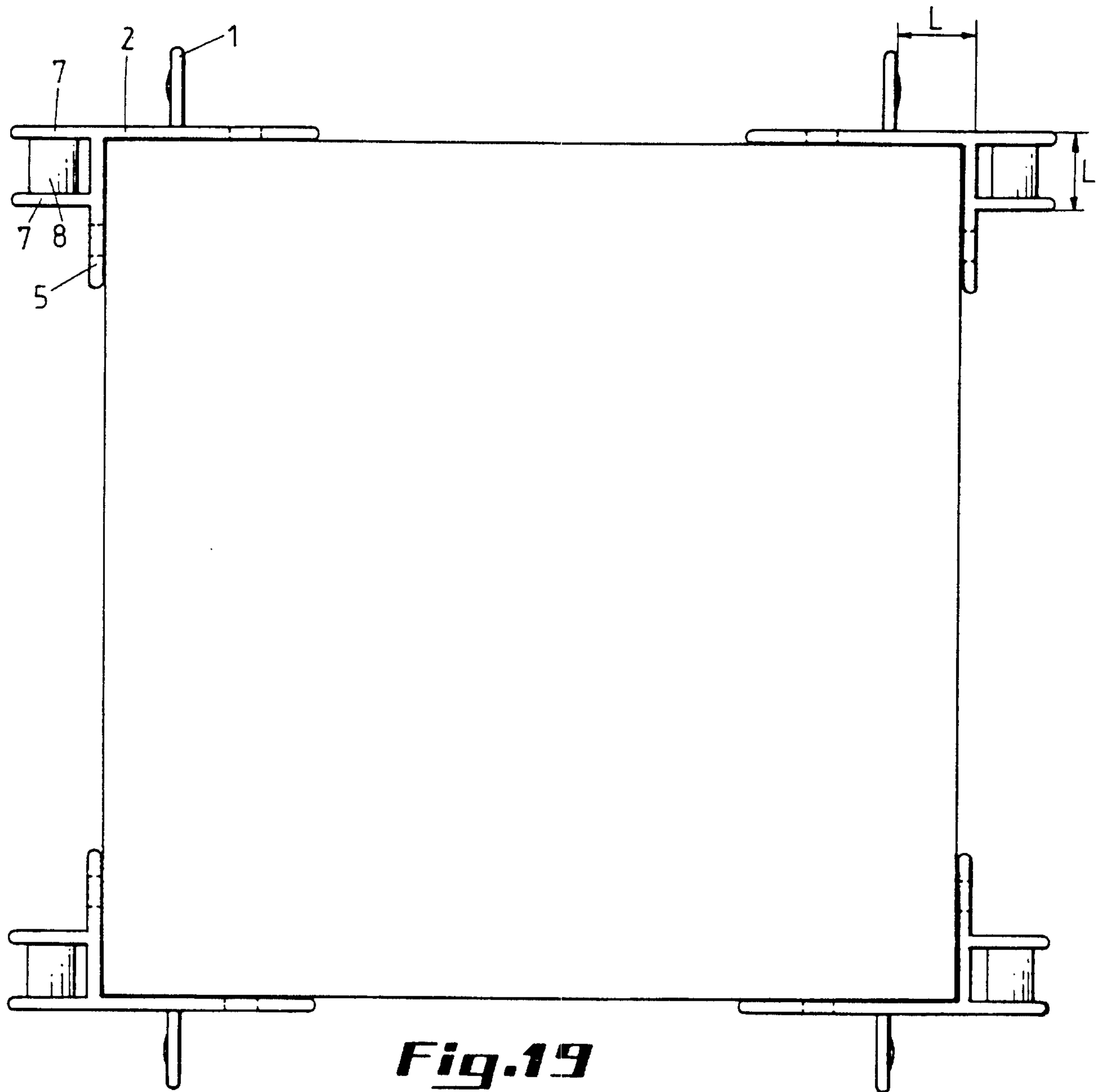
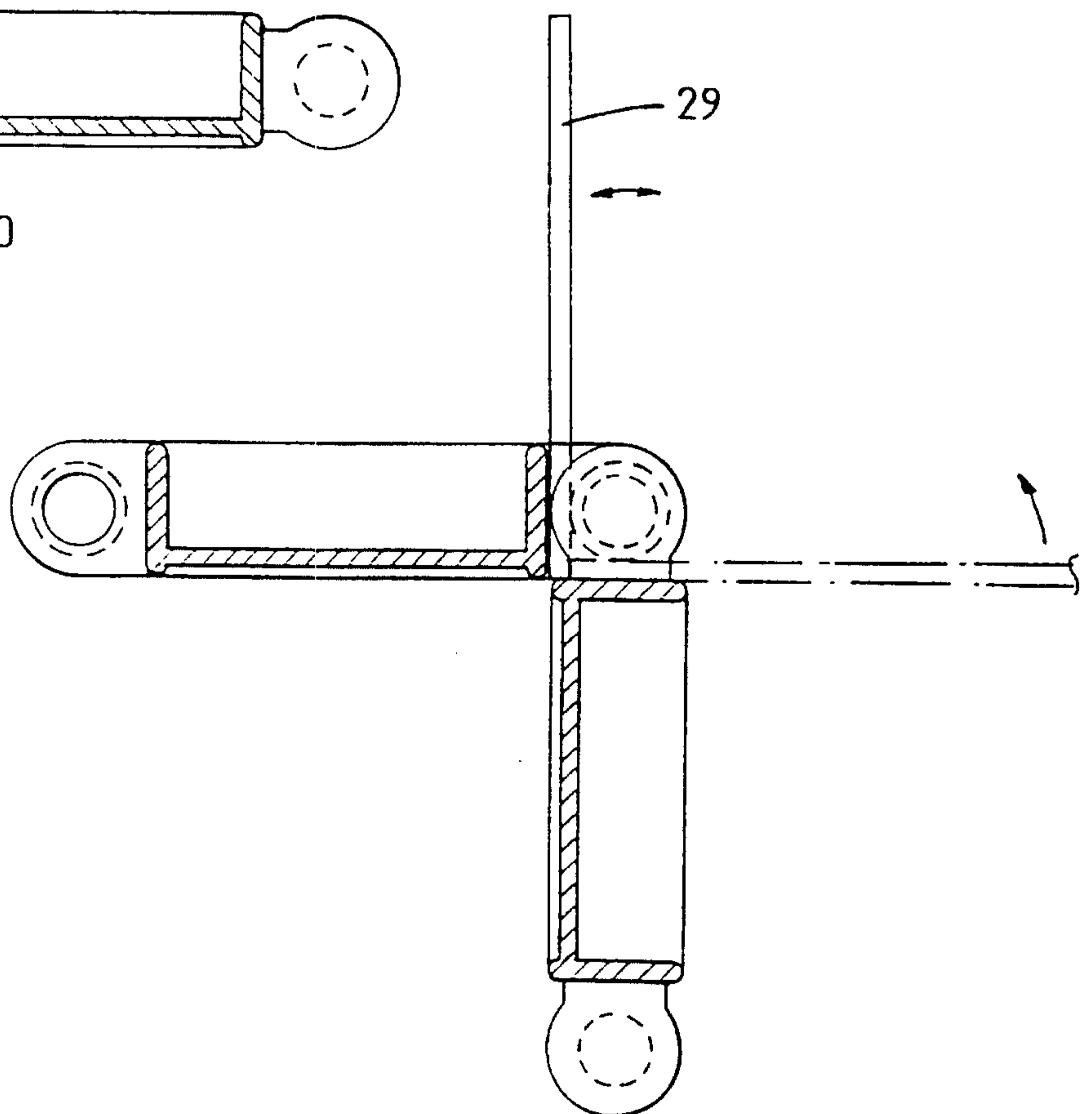
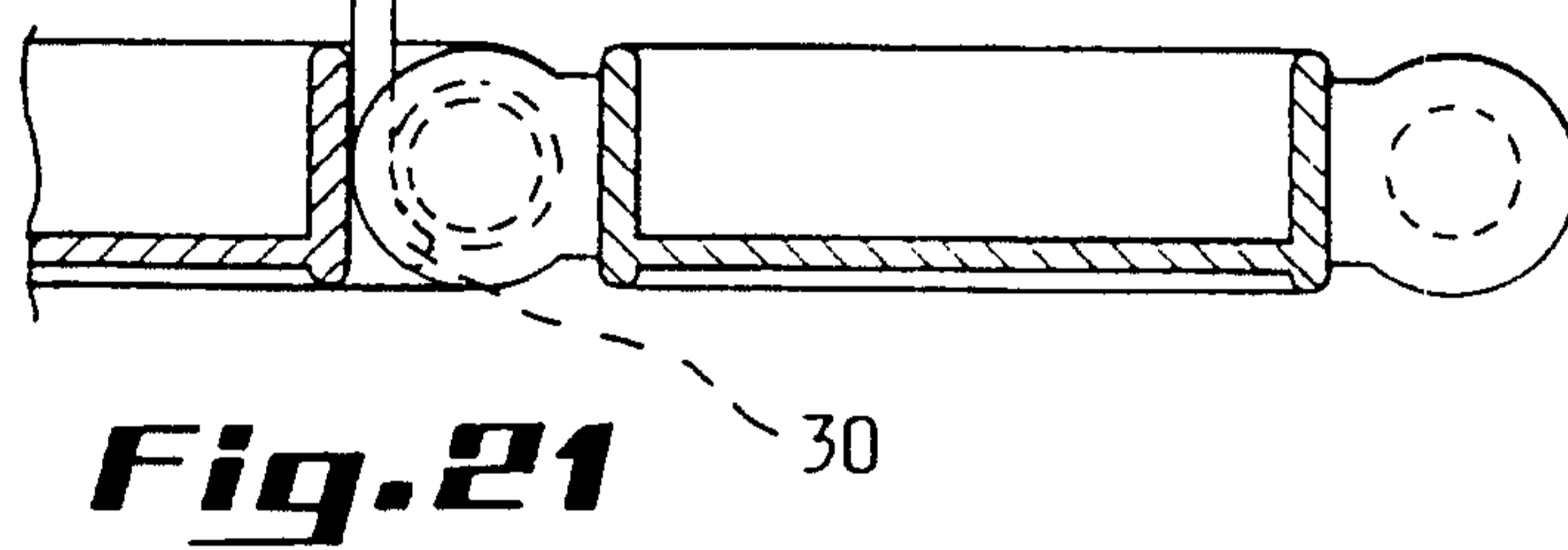
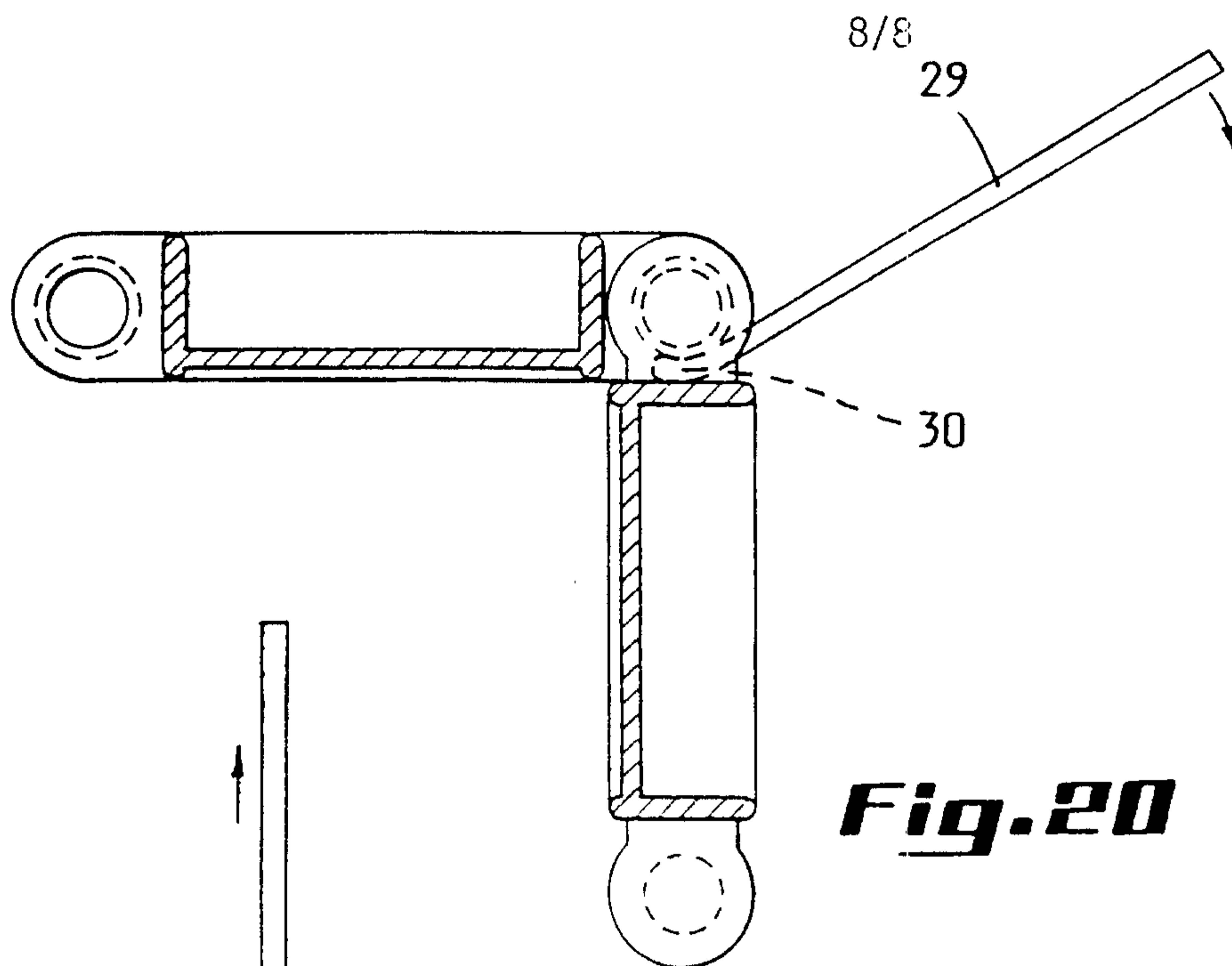


Fig. 23

**Fig. 22**