(12) UK Patent Application (19) GB (11) 2 024 976 A

(21) Application No **7917431**
(22) Date of filing **18 May 1979**
(23) Claims filed **18 May 1979**
(30) Priority data
(31) **2829158**
(32) **3 Jul 1978**
(33) **Fed. Rep. of Germany (DE)**
(43) Application published
16 Jan 1980
(51) **INT CL³**
F16B 13/10
(52) Domestic classification
F2H 17AU
(56) Documents cited
GB 1534840
GB 1249014
GB 861685
GB 775040
(58) Field of search
F2H
(71) Applicant
Hilti Aktiengesellschaft, FL-9494 Schaan, Liechtenstein
(72) Inventors
Armin Herb, Gusztav Lang
(74) Agent
Barlow, Gillett & Percival

(54) Fastening Element

(57) An expansible fastener comprises an anchor rod 1 having an incomplete flange 3 partly embracing an expansion wedge 2. The parts are retained in the illustrated disposition prior to use by the ends of the flange engaging in recesses 7 in the wedge, or by weld spots, or by adhesive. The fastener is inserted through a hole in an element to be secured (not shown) into a bore in a ceiling and the projecting part of the wedge 2 is hammered until the flange 3 abuts the element, and the element abuts the ceiling. Continued striking of the wedge 2 causes it to shift inwards relative to the rod 1, so that the inner end of the fastener expands. When the wedge 2 is flush with the flange 3, adequate expansion of the fastener has been achieved.

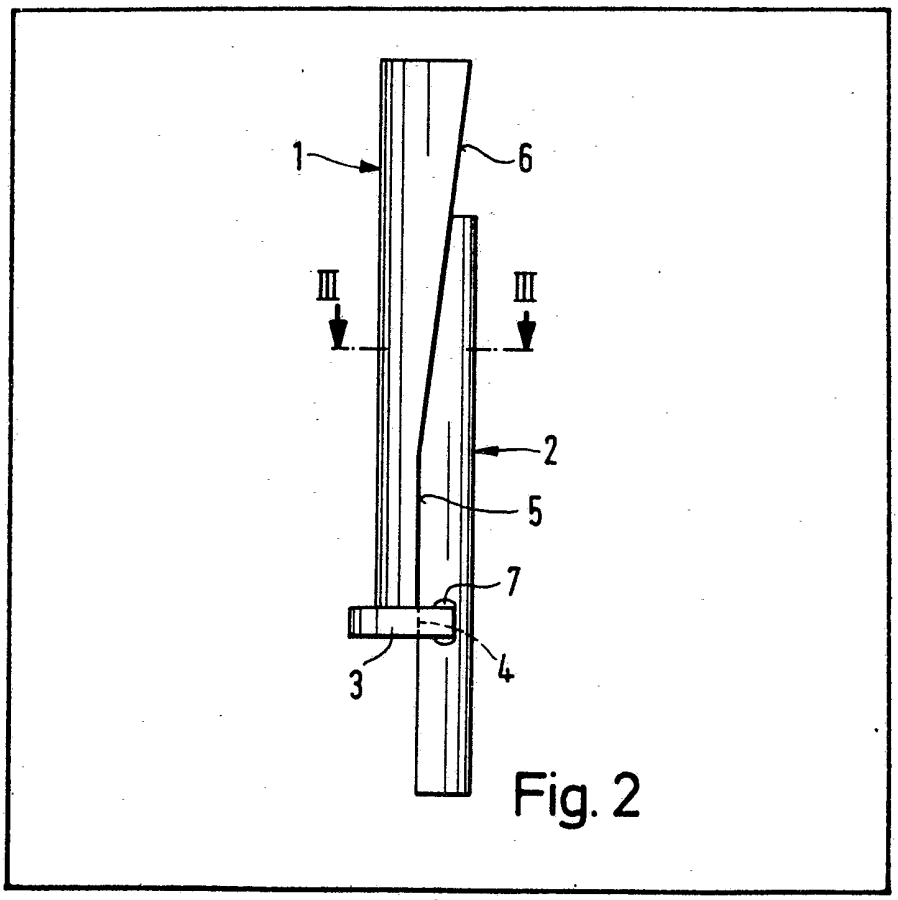

Fig. 2

GB 2 024 976 A

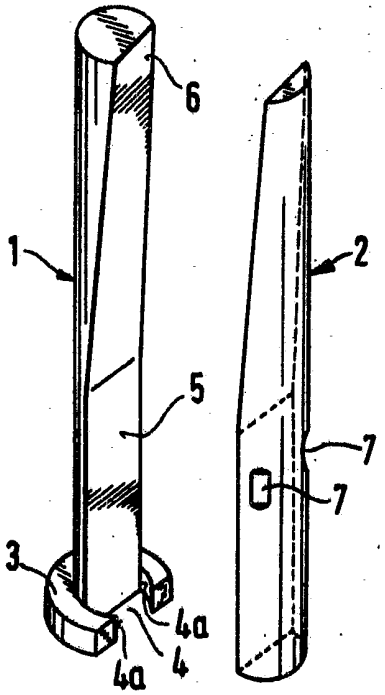

Fig. 1

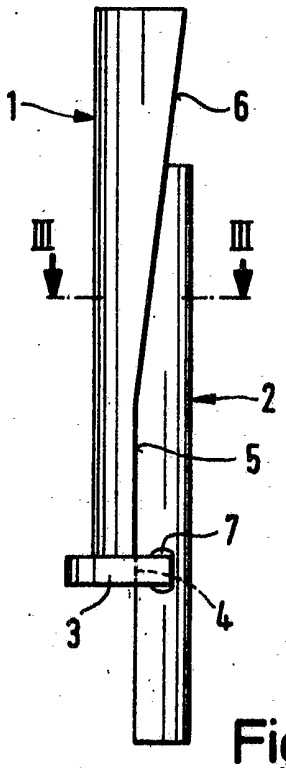

Fig. 2

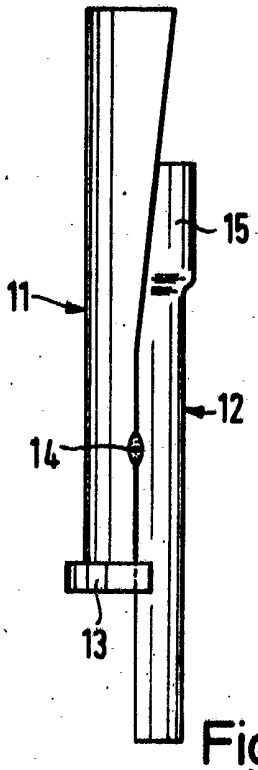

Fig. 5

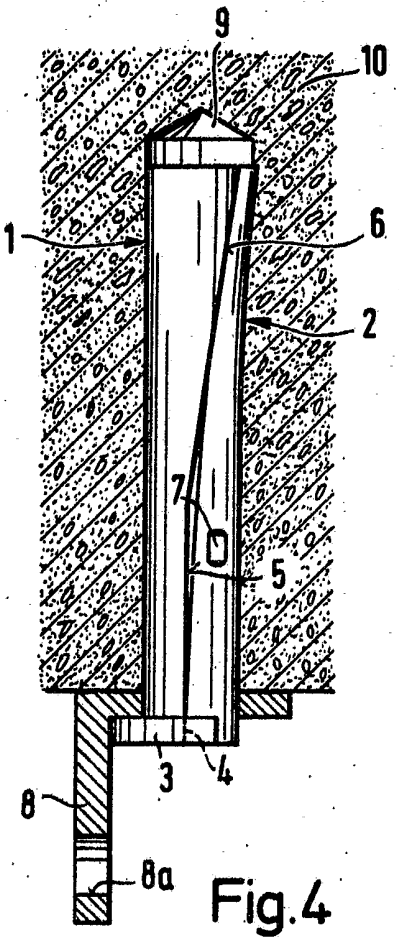

Fig. 4

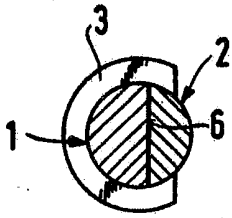

Fig. 3

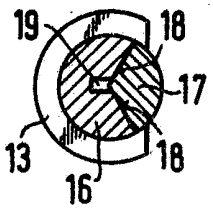

Fig. 6

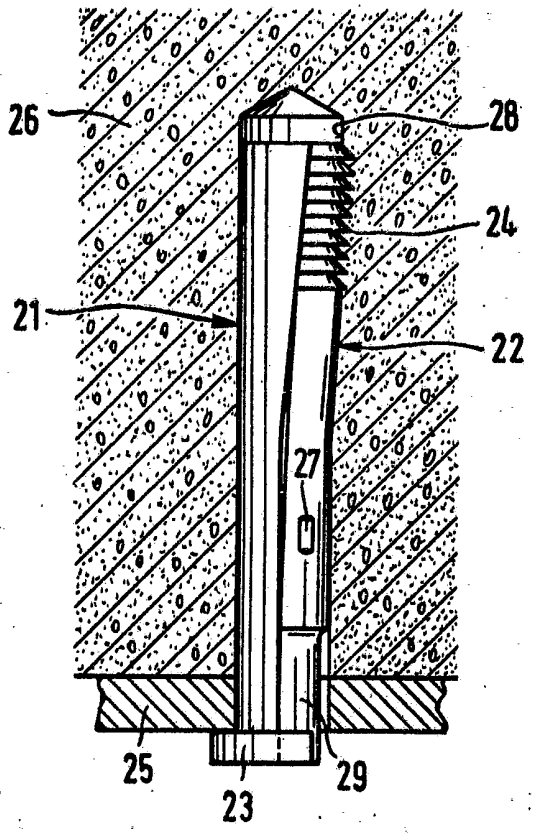

Fig. 7

SPECIFICATION

Fastening Element

This invention relates to a fastening element comprising an anchor rod and an expansion wedge, in which the anchor rod is provided, in the rearward region, with a bearing part, designed as a flange, for load absorption, and has a wedge surface which, towards the front region of the anchor rod, approaches the circumferential contour thereof and along which the expansion wedge is displaceable for the expansion of the fastening element, and the anchor rod and the expansion wedge in the unexpanded state complement one another to form a circular cross-section.

Fastening elements of this kind are used, for example, for the installation of suspended ceilings, claddings, frameworks, pipes, ducts and the like. Various different embodiments are known. Since all of the fastening elements are used in large quantities, it is necessary that they should be economical to produce and that they should be capable of being set with the minimum expenditure of time and without special provision so far as tools are concerned. For safety reasons, furthermore, and to expand further under load is required of the elements.

The fastening elements used for the purposes mentioned above are generally constructed on the wedge/expansion principle. In this respect, one part of the fastening element is generally designed as an anchor rod which is intended to take up the load that is to be suspended. In the known fastening elements, an expansion element, which is generally wedge-shaped, can be displaced along a wedge surface which is provided on the anchor rod. These known fastening elements are usually constructed in such a way that, after a certain pre-expansion has been achieved, at least the element is seated firmly in its reception bore, for example in a ceiling, and that, under further application of force on the anchor rod as a result of connection thereto of the load that is to be suspended, further expansion takes place.

Thus, arranged on the anchor rod of one known fastening element is a compression spring which is stressed by means of a locking part. This known fastening element is, furthermore, provided with an expansion wedge which is displaceable relative to the anchor rod and which is arranged in such a way that, after the locking part has been released, relaxation of the compression spring shifts the expansion wedge and thus brings about pre-expansion when the fastening element is introduced into the reception bore in a ceiling or the like. Compared with certain other known fastening elements, this element has the advantage that adequate pre-expansion is afforded. However, considerable disadvantages cannot be avoided. Thus, on the one hand the construction of the fastening element is so complicated or expensive that economy thereof, more especially in quantity use, is highly questionable. Moreover there is the danger of the locking element being able to loosen prior to introduction of the fastening element into its reception bore, so that the expansion wedge shifts relative to the anchor rod prematurely into its position for pre-expansion. This can bring about considerable risk of injury for the operator. Moreover, the retensioning of the spring and renewed positioning of the locking element cannot be carried out without additional expenditure on tools and special expert knowledge.

A further known fastening element, which is constructed in a simple manner, consists similarly of an anchor rod and an expansion wedge, in which the two parts, in the unexpanded state of the fastening element, complement one another to form a circular cross-section. For application of the load, the anchor rod has an external thread with a hexagonal nut. Whilst this fastening element has constructional advantages, compared with the known element which is pre-expansible by spring force, it is not simple to displace the expansion wedge relative to the anchor rod for effecting pre-expansion, since at the rear the anchor rod projects beyond the expansion wedge and, considered in the axial direction, the expansion wedge is masked by the projection of the hexagonal nut provided for load application. For this reason, this element is highly unsuitable for pure suspensions and is rather used when an article to be fixed is to be clamped between the hexagonal nut and the rearward end face of the expansion wedge, so that, by tightening the hexagonal nut, adequate pre-expansion is achievable.

Underlying the present invention is the problem of providing a fastening element which is suitable more especially for suspensions, which is economical to produce and which can be set without special expenditure on tools and which, moreover, ensures adequate pre-expansion.

In accordance with the invention, the problem is solved in that the bearing part, designed as a flange, of the anchor rod, has a recess which serves to guide the expansion wedge when displaced along the wedge surface, and the expansion wedge projects beyond the rearward end face of the flange when the anchor rod and the expansion wedge, in the unexpanded state of the fastening element complement one another to form a circular cross-section.

The fastening element in accordance with the invention is distinguished more especially by its extremely simple construction. Moreover, the setting thereof is particularly simple, in that the entire fastening element, consisting of the anchor rod and expansion wedge, is merely introduced into the reception bore in the receiving material until the flange of the anchor rod rests on the surface, for example of a ceiling. Then, by means of hammer blows or the like, the expansion wedge is driven in, i.e. it is displaced relative to the anchor rod until the rearward end face of the expansion wedge is flush with the rearward end

face of the flange. The flush position of the two parts is evident to the effect that the fastening element has achieved adequate pre-expansion. By virtue of the parts which in the unexpected state complement one another to form a circular cross-section, the reception bore and the fastening element can be co-ordinated to one another in such a way that as a result of the pre-expansion a high degree of anchorage is achieved. It is possible to keep the play between the fastening element and the wall of the reception bore extremely small, so that even in the expanded state a large contact surface exists between the wall of the reception bore and the fastening element.

The load, acting on the flange, of the anchor rod leads to further expansion. For this purpose, it is possible to arrange hooks, eyes and the like directly on the flange, or to provide reception parts in the form of supporting angles and the like between the flange and the receiving material which may, for example, be a ceiling.

To simplify mounting and storage, it is advantageous if the expansion wedge is releasably connected, in the unexpanded state, to the anchor rod. Then, the complementary parts of the fastening element form a unit prior to introduction into the reception bore. Moreover, the setting of the fastening element is considerably simplified in that light impacts, for example light hammer blows, on the protruding expansion wedge are necessary to provide the element into the reception bore. As soon as the fastening element has been introduced to such an extent into the reception bore that the flange rests on the receiving material or against an intermediately-disposed part, further hammer blows cause release of the connection so that the expansion wedge can shift relative to the anchor rod and in this way the desired expansion effect is achieved.

The connection between the two parts can be effected in various ways. Thus, in accordance with the invention it is for example proposed that the two parts be connected together by way of catch or retainer elements. Suitable as the catch or retainer elements are the flanks of the recess on the flange, which may engage into corresponding depressions on the expansion wedge. Release of this connection is achieved by causing the depressions of the expansion wedge to be disengaged from the region of the flanks of the flange. Further connection possibilities exist, for example, by applying weld spots or adhesion locations between the two parts in question. In these cases, the connecting points are sheared off in known manner upon the application of force to the expansion wedge.

Advantageously the expansion wedge is provided, in its front region, which penetrates deepest in the borehole, with a cross-sectional widening, Then the greatest expansion forces are caused to arise in the region which enters deepest into the borehole, so that greatest stresses occur in that region. Spalling at the ceiling soffit is thereby avoided. The same effect can, for example, also be achieved with a toothed configuration at the front region of the expansion wedge, in which case the possibility exists of the tips of the teeth standing proud of the surface of the expansion wedge. Moreover such a toothed configuration has the advantage that any possible slippage of the expansion wedge is counteracted thereby, which improves the certainty of effective further expansion of the fastener upon application of a load thereto.

In accordance with a further proposal of the invention, the wedge surface of the anchor rod is formed by two longitudinal halves which stand at an obtuse angle to one another. In this respect it is immaterial whether the anchor rod or the expansion wedge forms the concave part. Because of this measure the result is achieved that the part having a concave shape also widens radially, so that the bearing surface against the wall of the reception bore is enlarged under expansion conditions, which leads to a further increase in anchorage value or pull-out resistance. To improve this radial deformability, the part having a concave shape may have, in the apex region, a cross-sectional weakening in the form of a longitudinal slot. Equally, as a result of the concave or convex cross-sectional formation of the expansion wedge, the stiffness thereof against possible buckling upon the knocking-in is increased.

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

Fig. 1 is an exploded perspective view illustrating a first embodiment of the fastening element in accordance with the invention, which consists of an anchor rod and an expansion wedge;

Fig. 2 is an elevation showing the fastening element of Fig. 1 in its unexpanded condition ready for mounting;

Fig. 3 is a section taken along the line III—III of Fig. 2;

Fig. 4 is a part-sectional elevation showing the fastening element of Figs. 1 to 3 in the set condition;

Fig. 5 is a view similar to Fig. 2, but showing a further embodiment of the fastening element of the invention;

Fig. 6 is a section, similar to that shown in Fig. 3, but illustrating a further embodiment of the fastening element of the invention; and

Fig. 7 is a view similar to Fig. 4 but showing yet a further embodiment of the fastening element of the invention, in the set condition.

Referring firstly to Figs. 1 to 4, a first preferred embodiment of the fastening element according to the invention comprises an anchor rod which is designated as a whole by the numeral 1 and an expansion wedge which is designated as a whole by the numeral 1 and an expansion wedge which is designated as a whole by the numeral 2. The anchor rod 1 has, at its rearward end region, a flange 3. This flange 3 has a recess 4 which

serves to guide the expansion wedge 2 which is displaceable relative to the anchor rod 1. From the flange 3 towards the front end, the anchor rod 1 is provided with a flattened portion 5, linking to which is a wedge surface 6. This wedge surface 6 is inclined in such a way that, towards the front end of the anchor rod 1, it approaches the circumferential contour thereof. The expansion wedge 2 is flattened in its rearward region and tapers towards the front end. As shown more especially in Figs. 2 and 3, the expansion wedge 2 is flattened and tapered in such a way that the anchor rod 1 and the expansion wedge 2, in the unexpected state, supplement one another to form a circular cross-section.

As has already been said, Fig. 2 shows the fastening element in its unexpanded condition, that is to say in its pre-mounted condition. For the purpose of this pre-mounting, the expansion wedge 2 has depressions 7 into which the flanks 4*a* of the recess 4 can engage.

Fig. 4 shows the fastening element of Figs. 1 to 3 in the set condition, a supporting angle 8 having been fastened with the element. The fastening element has, accordingly, been introduced in its pre-mounted condition through a hole in the supporting angle 8 into a reception bore 9 in a ceiling 10. This introduction can be effected, for example, by the action of light hammer blows on the expansion wedge 2 which, in the unexpanded condition of the fastening element (see Fig. 2) projects beyond the rearward end face of the flange 3. Upon the flange 3 of the anchor bolt 1, through the intermediary of the supporting angle 8, having come into abutment against the ceiling 10, further hammer blows have brought about a shifting of the expansion wedge 2 relative to the anchor rod 1 so that the depressions 7 have moved relative to the recess 4. As a result of the relative displacement of the two parts 1 and 2, pre-expansion has occured. The application of a load to the supporting angle 8, for example utilising aperture 8*a* thereof results in further expansion of the fastening element, thereby reliably resisting withdrawal of the fastening element.

Fig. 5 shows a further embodiment of the fastening element, having an anchor rod which is designated as a whole by the reference numeral 11 and an expansion wedge which is designated as a whole by numeral 12. The anchor rod 11 has, in its rearward region, a respective flange 13, in which is a recess (not visible in the figure) which serves to guide the expansion wedge 12. For the pre-mounting, the anchor rod 11 and the expansion wedge 12 are connected together, for example, by means of a weld spot 14. This connecting point, which in accordance with a further proposal can alternatively be an adhesive connection, is released when setting of the fastening element is carried out, this being effected similarly to the previously-described embodiment. As Fig. 5 further shows, the expansion wedge has, at the front end, a cross-sectional widening 15. This cross-sectional widening 15 has the effect of ensuring that the greatest expansion forces arise in the depth of the borehole. For the rest, the fastening element of design corresponding to that of the previously-described embodiment.

Fig. 6 shows the cross-section through a further embodiment of the fastening element, which comprises an anchor rod 16 and an expansion wedge 17. In this embodiment, the wedge surface of the anchor rod 16 is not flat in configuration, but consists of two longitudinal halves 18 which are directed at an obtuse angle to one another. Upon the displacement of the expansion wedge 17 relative to the anchor rod 16, because of this special design of the wedge surface, a radial widening of the anchor rod 16 is also achieved. This widening can be facilitated by a cross-sectional weakening, for example in the form of a longitudinal slot 19. Of course, it is also possible to align the longitudinal halves 18 of the wedge surface of the anchor rod 16 to one another in such a way that the expansion wedge 17 expands radially. In this case, too, the expansion can be facilitated by cross-sectional weakenings.

Fig. 7 shows a fastening element in accordance with a further proposal of the invention in the set condition, in which a strap 25 has been fastened to a ceiling 26 with the element. The fastening element again comprises an anchor bolt which is designated as a whole by numeral 21 and an expansion wedge which is designated as a whole by numeral 22. To retain the strap 25, the anchor bolt 21 has a flange 23 at its rearward end. The flange 23 is provided with a recess, not shown in the drawing, for guiding the expansion wedge 22. This expansion wedge 22 has in its front end region, toothing 24. On the one hand this toothing 24 can serve to prevent any possible slippage of the expansion wedge 22. With a suitable design, the individual teeth of the toothing can deflect slightly, so that on the other hand the toothing 24 yields to compensate for dimensional tolerances in the diameter of reception bore 28. The toothing 24 can, as the figure shows, be designed for example as a saw-toothing, or it can consist merely of a single projection. Pre-mounting of the fastening element can be effected for example making use of a catch or detent device in the manner described above. For this purpose, the expansion wedge 22 has depressions 27 into which parts of the flange 23 can engage. As the figure further shows, the rearward region of the expansion wedge 22 is provided with a taper 29. This taper 29 prevents any jamming of the expansion wedge 22 with the strap 25 or with the anchor bolt 21, so that re-expansion of the fastening element is not effected in a disadvantageous manner. The fact that the guidance of the expansion wedge 22 is cancelled when the taper 29 is disposed in the region of the flange 23 is immaterial, since upon the expansion procedure in this phase the expansion wedge 22 is already adequately guided in the reception bore 28.

Claims

1. A fastening element comprising an anchor rod and an expansion wedge, in which the anchor rod is provided, in its rearward region, with a bearing part, designed as a flange, for load absorption, and has a wedge surface which, towards the front region of the anchor rod, approaches the circumferential contour thereof and along which the expansion wedge is displaceable for expansion of the fastening element, and the anchor rod and the expansion wedge, in the unexpanded state, complement one another to form a circular cross-section, characterised in that the flange of the anchor rod has a recess which serves to guide the expansion wedge when displaced along the wedge surface, and the expansion wedge projects beyond the rearward end face of the flange when the anchor rod and the expansion wedge, in the unexpanded state of the fastening element, complement one another to form a circular cross-section.

2. A fastening element as claimed in claim 1, characterised in that, for expanding the fastening element, the expansion wedge is displaceable at least to such an extent that the rearward end face of the expansion wedge is flush with the rearward end face of the flange.

3. A fastening element as claimed in claim 1 or 2, characterised in that, in the unexpanded state of the fastening element, the expansion wedge is connected releasably to the anchor rod.

4. A fastening element as claimed in claim 3, characterised in that the expansion wedge is connected to the anchor by means of catch or retainer elements.

5. A fastening element as claimed in claim 3, characterised in that the expansion wedge is connected to the anchor rod by one or more weld spots.

6. A fastening element as claimed in claim 3, characterised in that the expansion wedge is connected to the anchor rod by means of adhesive locations.

7. A fastening element as claimed in any of claims 1 to 6, characterised in that the front region of the expansion wedge has a cross-sectional widening.

8. A fastening element as claimed in any preceding claim, characterised in that the front region of the expansion wedge has a toothed configuration.

9. A fastening element as claimed in any preceding claim characterised in that the wedge surface of the anchor rod is formed by two longitudinal halves which stand at an obtuse angle to one another.

10. A fastening element substantially as hereinbefore described with reference to and as illustrated in Figs. 1 to 4, in Figs. 5 and 6, or in Fig. 7 of the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.