

SPECIFICATION

A fastening device for a housing closure

5 The invention relates to a fastening device for a housing closure, for example for a box containing electrical control equipment such as switches. Generally, such a device consists of a screw element adapted to be threadedly engageable with the

10 housing and has a stop member which keeps the screw element captive on the closure.

Fastening devices of this kind are for example known in electronic entertainment equipment for the fastening of the rear wall of a housing to the chassis,

15 or for engineering apparatus for the fastening of a housing cover to the open side of the lower part of the housing. The stop, which is usually in the form of a securing ring, is in such cases mounted frictionally or positively on the stem of the screw element on

20 that side of the closure part which is remote from the head.

The problem underlying the invention is that of providing a fastening device which can be handled simply and without complications and which not

25 only ensures non-tilting fastening of the closure part on the housing in the plane of separation but at the same time also ensures accurate fastening of a constructional part on the housing in the course of the closing of the housing by means of the closure

30 part.

According to the invention there is provided a fastening device for a housing closure, said device comprising at least one screw element which is adapted to be screwed to the housing and which is

35 made captive on the closure part by means of a stop on its stem passing through the closure part, wherein the or each screw element extends through a depression in the closure part surface, in which depression a prestressed compression spring is

40 disposed between a shoulder on the screw element and the bottom of the depression, and the stem of the screw element, passing through the bottom of said depression, is provided outside the depression with a pressure surface which, when the closure part

45 is supported against the housing and when the screw member is screwed up against the force of the compression spring, bears against a centred constructional part which is supported against an abutment fastened to the housing.

50 This development of the fastening device has the effect that when the screw element is tightened the constructional part to be fastened on or in the housing - particularly a circuit board - is clamped against an abutment fastened to the housing. At the

55 same time, by means of the screw element and the compression spring which is disposed between its head and the closure part, and which has a residual spring tunnel even in the stressed state and which possesses a high degree spring stiffness, the surrounding edge face of the closure part is pressed resiliently but firmly, and without tilting, against the housing which is to be closed. Additionally to the orientation of its position in the housing, which is effected perpendicularly to the main plane of the

60 circuit board, centring is effected in the sense of at

least one fastening to the housing in the direction of the two coordinates in the main plane of the circuit board, on the associated peripheral surface of the screw element in question, which passes through a

70 hole in the circuit board.

In one embodiment of the invention, the device comprises a threaded pin fastened to the housing with a centring member opposite the abutment and a freely projecting threaded pin, the device also

75 having a threaded element having a hollow cylindrical opening receiving the centring member in the region of the pressure surface and which has a threaded hole associated with the threaded pin.

The threaded element may have an external

80 cylindrical head, the diameter of which is less than the corresponding diameter of the depression. The distance between the stop on the stem and the closure part may be less than the distance between the outer surface of the closure part and the side of the depression facing the interior of the housing.

85 In one embodiment of the invention, the closure part is not threaded and the distance of the screw thread from the upper side of the structural part is greater than the distance of the beginning of the thread on the pin from the upper side of the

90 constructional part.

When released, the distance from the pressure surface and the facing surface of the upper side of the constructional part is less than the distance

95 between the start of the thread on the threaded pin and the upper side. The distance between the screw threaded element and the facing surface of the depression is greater than the length of the spring in the compressed condition.

100 An embodiment of the invention will now be described by way of example and with reference to the accompanying drawing, which shows in cross-section, partly broken away, a control box which is fastened parallel to the longitudinal axis on a motor housing and which is provided with a fastening device constructed in accordance with the invention, this device being shown in the released state above its longitudinal axis and in the fastened state below its longitudinal axis.

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110 The housing 2 of a control box 3 is fastened at the side of and below a motor housing 1, which is shown in end elevation in the drawing, the control box 3 serving to receive electro-mechanical or electronic switches and electrical control and regulation circuits, and also the appertaining power supply system for controlling a motor. On the bottom 4 of the control box 3, which is shown in end elevation or cross-section, are fastened bulky components and switch units 5, such as transformers, rectifier

115 assemblies, and capacitors. The electronic circuits themselves are formed on a circuit board 6 for wiring as a printed circuit. The circuit board 6 lies on the end faces of supports 7 and/or supporting ribs 8, which project from the floor 4 and/or from the side walls 9 of the housing 1, being in particular integrally cast therewith.

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For the sake of simplicity of access of the components or functional circuit testing points, and also in the interest of obtaining a spacious interior of the

130 housing 2 for the purpose of receiving bulky units 5,

the circuit board 6 extends parallel to the dividing plane 10 between the housing 2 and a closure part 11, which serves as cover and which has edges 12 extended in the direction of the dividing plane 10 to form a hood engaging over components 13 disposed on the circuit board 6 and projecting beyond the dividing plane 10.

A fastening device 14 serves both for centring and for fastening a constructional part, in the present case the circuit board 6, to the housing 2, and for closing by a simple operation the opening of the housing 2 by means of the hood-shaped closure part 11. The fastening device 14 consists essentially of a screw element 15, which is similar to a stem nut and which has a cylindrical head 16 with a screwdriver depression 17 at one end of the stem 18, and of an associated threaded pin 19, which is screwed approximately half way into the end face of the support 7 serving as abutment 20 for the circuit board 6. A limited axial region, adjoining the abutment 20, of that portion of the threaded pin 19 which projects out of the support 7 serves as centring member 21 for adjustment of the circuit board 6 radially in relation to the longitudinal axis of the fastening device 14 and carries no screw-thread, being for example in the form of a smooth cylinder or of a truncated cone tapering slightly in the direction of the closure part 11. A threaded pin 22 adjoins this centring member 21. In the screw element 15 which is similar to a stem nut, at the end of the stem 18 remote from the head 16 a coaxial blind hole 23 is provided which is associated with the said threaded pin 22, and which in the end face region is in the form of a hollow cylindrical opening 24 of larger cross-section than corresponds to the cross-section of the centring member 21; the blind hole 23 is provided in the direction of the interior of the stem 18 with a screwthread corresponding to the screwthread of the threaded pin 22.

The screw element 15, similar to a stem nut, together with the head 16, is disposed in a cylindrical depression 26 in the surface 27 of the closure part 11, in which depression is disposed, between the bottom 28 of the said depression and the shoulder 29 formed by the screwthread 16 in relation to the adjoining stem 18, a compression spring surrounding the stem 18, preferably in the form of a coil spring 30. The coil spring 30 is under initial stress, so that it has a tendency to push the screw element 15 of the fastening device 14 away from the surface 27 of the closure part, as long as the said screw element is not in engagement with the threaded pin 19. This axial displacement is limited by a securing ring which serves as a stop 31, and which is disposed on that side, 28', of the bottom 28 of the depression in the outer peripheral wall, of the stem 18 which faces the interior of the housing 2.

For correct adjustment of the circuit board 6 in the housing 2 it is sufficient to provide a centring member 21, which optionally has a cross-section with unequal sides, and also a correspondingly profiled aperture 32 in the circuit board 6. It is however, more expedient to provide at least two such centring members 21 over abutments 20 fastened to the housing, with simple geometry -

such as cylindrical or frusto-conical shape of the centring members 21, on the threaded pins 19, and for the aperture 32 in the circuit board 6 to be in each case a correspondingly dimensioned hole. When the circuit board 6 is installed in the housing 2, support on the end faces of supporting ribs and supports 7 ensures correct positioning in relation to the housing 2, given the presence of at least two threaded pins 19 with regions acting as centring members 21, in both coordinate directions of the main plane of the circuit board.

After being pressed manually against the corresponding abutments 20, in order to improve mechanical stability the side edges of the circuit board 6 can be joined, either directly or for example with the interposition of heat sinks carrying power electronics components, to supporting ribs 8 - for example formed on the side walls 9 - by means of screws 34; since in the direction of the main plane of the circuit board correct fixing in position is already ensured, it is then no longer possible for distortion, which would entail the risk of hair cracks in the printed circuit, to occur in the circuit board.

Simultaneously with the mounting and fastening of the hood-shaped closure part 11 on the dividing plane 10 of the housing 2, the circuit board 6 is also fastened in a defined position against each abutment 20, that is to say in the direction of the longitudinal axis 35 of the fastening device 14. In order to ensure fastening on the circuit board 6 in defined positions on each abutment 20 in the direction of the longitudinal axis 35 of the fastening device 14, the device is so designed that when the circuit board 6 is clamped fast between the abutment 20 on the one hand and the associated pressure surface 36 of the stem 18 on the other hand, and when at the same time the closure part 11 is mounted in position on the housing 2, the coil spring 30 is not yet firmly compressed, so that the shoulder 29 is still pressed elastically, and not semi-rigidly, by the coil spring 30 against the bottom 28 of the depression 26 in the closure part 11. In this position the outer end face 37 of the cylindrical head of the screw element 15 lies roughly flush with the surface 27 of the closure part 11.

As the illustration of the upper half of the screw element 15 in the drawing shows, the distance between that side 28' of the depression bottom 28 which faces the interior of the housing 2 and the surface 27 of the closure part 11 is slightly greater than the distance between the securing ring 31 serving as the stop and the shoulder 29 on the screw element 15. As a result, the head 16 of the screw element 15 is still guided in the cylindrical depression 26, at least to a slight extent, even in the unscrewed, that is to say released state, whereby handling is facilitated.

Since in addition the inside diameter of the cylindrical depression 26 is only slightly greater than the outside diameter of the cylindrical head 16 of the screw element 15, the head 16 is effectively guided radially in the depression 26, which in turn has the consequence that the fastening device 14 can also be used for centring the closure part 11 relative the housing. It is therefore unnecessary to provide a

centring edge on the end face 38 of the edge 12 of the closure part 11 on the one hand, and on the end face 39 of the housing 2 on the other hand, in the dividing plane 10.

- 5 Moreover, when the fastening device 14 is in the unscrewed state, that is to say in the position of the said device shown in the upper half of the drawing, the distance a between the beginning of the screw-thread 25 and the facing upper side of the circuit board 6 is slightly greater than the distance a' of the screwthread on the threaded pin 22. It is thus possible for the closure part 11 to be secured in its final position on the housing 2 before starting to screw the fastening device 14. On the other hand, in 15 this position the distance a'' between the pressure surface 36 and the facing upper side of the circuit board 6 is slightly shorter than the previously mentioned distance a' , so that in this position the hollow cylindrical opening 24 in the stem 18 is 20 already precentred for engaging over the threaded pin 22.

CLAIMS

- 25 1. A fastening device for a housing closure, said device comprising at least one screw element which is adapted to be screwed to the housing and which is made captive on the closure part by means of a stop on its stem passing through the closure part, 30 wherein the or each screw element extends through a depression in the closure part surface in which depression a prestressed compression spring is disposed between a shoulder on the screw element and the bottom of the depression, and the stem of 35 the screw element passing through the bottom of said depression is provided outside the depression with a pressure surface which, when the closure part is supported against the housing and when the screw member is screwed up against the force of the 40 compression spring, bears against a centred constructional part which is supported against an abutment fastened to the housing.

2. A fastening device according to Claim 1, wherein the device comprises a threaded pin which 45 is fastened to the housing and has a centring member situated directly opposite the abutment and also has a freely projecting threaded pin, and also comprises a screw element that has a hollow cylindrical opening axially engaging with play over 50 the centring member in the region of the pressure surface and which also has an adjoining bore provided with a screwthread and associated with the threaded pin.

3. A fastening device according to Claim 1 or 55 Claim 2, wherein the screw element is provided on its outer side with a cylindrical head, the diameter of which is only slightly smaller than the diameter of the depression which at least in the associated region is cylindrical in shape.

- 60 4. A fastening device according to any one of Claims 1 to 3, wherein the distance between the stop on the stem and the closure part is shorter than the distance between the outer surface of the closure part and the side of the depression bore which faces 65 the interior of the housing.

5. A fastening device according to any one of Claims 1 to 4 and comprising a closure part mounted on the housing but which is not screwthreaded, wherein the distance of the screwthread from the 70 facing upper side of the constructional part is slightly greater than the distance of the associated beginning of the screwthread of the threaded pin from the upper side of the constructional part.

6. A fastening device according to any one of 75 Claims 1 to 5, which comprises a closure part mounted on the housing but is unscrewed, wherein the distance between the pressure surface and the facing upper side of the constructional part is slightly shorter than the distance between the beginning of 80 the screwthread of the threaded pin and the upper side of the constructional part.

7. A fastening device according to any one of Claims 1 to 6 which comprises a closure part 85 mounted on the housing and also a screw element, wherein the distance between the shoulder on the screw element and the facing side of the bottom of the depression is slightly greater than the compressed length of the compression spring.

8. A fastening device for a housing closure 90 substantially as hereinbefore described with reference to the accompanying drawings.

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centring edge on the end face 38 of the edge 12 of the closure part 11 on the one hand, and on the end face 39 of the housing 2 on the other hand, in the dividing plane 10.

- 5 Moreover, when the fastening device 14 is in the unscrewed state, that is to say in the position of the said device shown in the upper half of the drawing, the distance a between the beginning of the screwthread 25 and the facing upper side of the circuit board 6 is slightly greater than the distance a' of the screwthread on the threaded pin 22. It is thus possible for the closure part 11 to be secured in its final position on the housing 2 before starting to screw the fastening device 14. On the other hand, in this position the distance a'' between the pressure surface 36 and the facing upper side of the circuit board 6 is slightly shorter than the previously mentioned distance a' , so that in this position the hollow cylindrical opening 24 in the stem 18 is already precentred for engaging over the threaded pin 22.

CLAIMS

- 25 1. A fastening device for a housing closure, said device comprising at least one screw element which is adapted to be screwed to the housing and which is made captive on the closure part by means of a stop on its stem passing through the closure part, wherein the or each screw element extends through a depression in the closure part surface in which depression a prestressed compression spring is disposed between a shoulder on the screw element and the bottom of the depression, and the stem of the screw element passing through the bottom of said depression is provided outside the depression with a pressure surface which, when the closure part is supported against the housing and when the screw member is screwed up against the force of the compression spring, bears against a centred constructional part which is supported against an abutment fastened to the housing.

- 45 2. A fastening device according to Claim 1, wherein the device comprises a threaded pin which is fastened to the housing and has a centring member situated directly opposite the abutment and also has a freely projecting threaded pin, and also comprises a screw element that has a hollow cylindrical opening axially engaging with play over the centring member in the region of the pressure surface and which also has an adjoining bore provided with a screwthread and associated with the threaded pin.

- 55 3. A fastening device according to Claim 1 or Claim 2, wherein the screw element is provided on its outer side with a cylindrical head, the diameter of which is only slightly smaller than the diameter of the depression which at least in the associated region is cylindrical in shape.

- 60 4. A fastening device according to any one of Claims 1 to 3, wherein the distance between the stop on the stem and the closure part is shorter than the distance between the outer surface of the closure part and the side of the depression bore which faces the interior of the housing.

5. A fastening device according to any one of Claims 1 to 4 and comprising a closure part mounted on the housing but which is not screwthreaded, wherein the distance of the screwthread from the facing upper side of the constructional part is slightly greater than the distance of the associated beginning of the screwthread of the threaded pin from the upper side of the constructional part.

- 70 6. A fastening device according to any one of Claims 1 to 5, which comprises a closure part mounted on the housing but is unscrewed, wherein the distance between the pressure surface and the facing upper side of the constructional part is slightly shorter than the distance between the beginning of the screwthread of the threaded pin and the upper side of the constructional part.

- 80 7. A fastening device according to any one of Claims 1 to 6 which comprises a closure part mounted on the housing and also a screw element, wherein the distance between the shoulder on the screw element and the facing side of the bottom of the depression is slightly greater than the compressed length of the compression spring.

- 85 8. A fastening device for a housing closure substantially as hereinbefore described with reference to the accompanying drawings.

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