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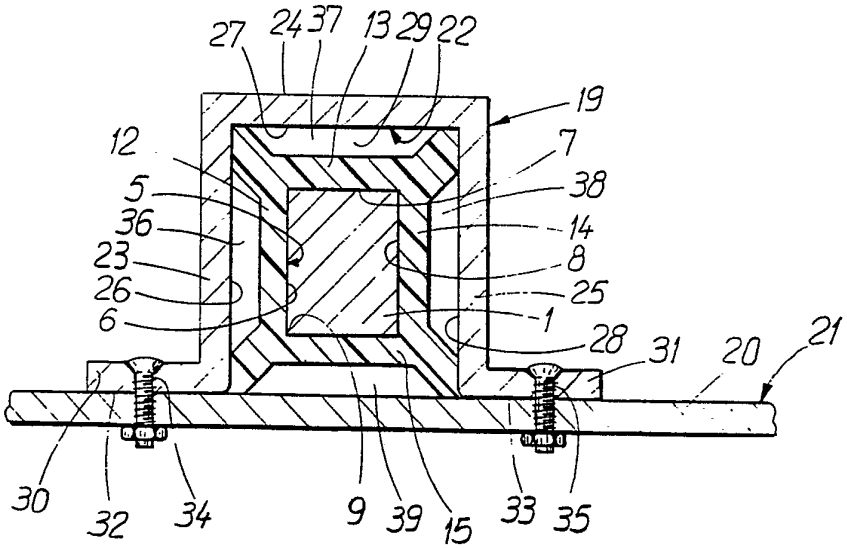

(57) Abstract

Vibration damper for damping vibrations in a surface (20) of an object (21). The damper consists of an oscillating body (1) which is movably connected to the surface such that it is brought to oscillate so that the oscillating body transmits forces to the object which are principally oppositely directed to the forces which, through vibration, act on the object. The vibration damper displays a locating part (19) made from a shaped permanent material and intended to be fixedly attached to said surface (20) of the object (21). The locating part displays one or several inwardly-directed vibration-transmitting support walls (26-29). The oscillating body (1) is at least partially enclosed in a damping body (10) made from an elastic material, and the damping body is held in the locating part through cooperation with the inwardly directed walls (26-29).

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VIBRATION-DAMPING DEVICE

Technical field:

The present invention relates to a vibration damper for damping vibrations in a surface of an object, which damper comprises at least one oscillating body which is movably connected to said surface such that it is brought to oscillate so that the oscillating body transmits forces to the object which are principally oppositely directed to the forces which, through vibration, act on the object.

Background:

For damping vibration in a surface of an object, it has been previously known to employ a principle according to which a relatively heavy body is resiliently supported such that the body is brought to oscillate due to the object's vibrations, whereby the body and its support are so adapted in relation to the vibrations' parameters, that the body is brought to oscillate principally in opposition and thereby generates force components which are oppositely directed to the force components which produce the vibrations. Up until now, however, no satisfactory technical device has emerged which can be manufactured to achieve desired damping properties.

The object of the present invention is to provide a simple and effectively functioning device with easily adaptable damping properties and a long life span.

Solution:

Said object is achieved by means of a vibration damper which is characterized in that the vibration damper

presents a locating part made from a shape-permanent material and intended to be fixedly attached to said surface of the object, that the locating part displays one or several inwardly facing vibration-transmitting support walls, that the oscillating body is supported at a distance from the support walls via damping elements of an elastic material, and that said damping elements are held in position in the locating part through cooperation with said inwardly facing wall or walls.

Brief description of the drawings:

The invention will be more closely described in the following with several embodiments and with reference to the attached drawings in which

Fig. 1	shows in a partly sectioned perspective view a part of the vibration damper according to the invention,
Fig. 2	shows a cross-section through a complete vibration damper according to the first embodiment shown in Fig. 1,
Figs 3 and 4	show the vibration damper in a second and a third embodiment.
Figs 5 and 6	show a fourth embodiment of the vibration damper in partly sectioned views.

Preferred embodiments:

As is evident from the embodiment according to Figs 1 and 2, the vibration damper is formed with an oscillating body 1 made from a material of high specific weight, such as steel, copper, tungsten or similar. In the shown example, the oscillating body 1 is formed as a parallelepiped, i.e. with six plane surfaces 2, 3, 4 at right angles to each other. The oscillating body is located in a cavity 5 adapted to the shape of the oscillating body with a plurality of, in the shown

example 6, support surfaces 6, 7, 8, 9 inwardly directed towards the oscillating body 1. The cavity is formed in a damping body 10 which is made from an elastic, suitably highly elastic material, for example rubber, such as natural rubber or synthetic rubber or silicon rubber. The damping body is formed as a housing for the oscillating body 1, in which the latter is suitably moulded. The damping body accordingly completely envelops the oscillating body 1 in the shown example, though in Fig. 1 this is partially sectioned in order to show the location of the oscillating body in the damping body. In the shown example this has enclosing wall parts 12, 13, 14, 15, 16, one wall part for each side surface 69 of the oscillating body. Outwardly projecting spacing elements from the damping body's wall parts, which in the example shown in Figs 1 and 2 are made as circumferentially extending inclined flanges 17, 18, more accurately, an upper and a lower flange, which extend all the way around the damping body's two opposed wall parts 13, 15.

The vibration damper further comprises a locating part 19 which is shown in Fig. 2. The locating part 19 is adapted to be held against a surface 20 of the object 21 whose vibrations are to damped with the vibration damper according to the invention. In its mounted state, together with the surface 20 of the object 21, the locating part 19 is adapted to enclose the damping body 10 and thus the oscillating body 1 such that these parts cannot work loose and be thrown off due to the forces of the vibrations. The damping body 10 and thus also the oscillating body 1 are, more accurately, enclosed by the locating part 19 in a cavity 22 in the locating part. In the shown example this is made in a cup-shaped form with a main shape of a parallelepiped or cube having five plane wall parts 23, 24, 25, each of which presents a rectangular or square support surface 26, 27, 28, 29

facing the cavity 22, whilst the sixth side of the parallelepiped or cube is missing and is substituted by a region of the surface 20 which is to be damped. The locating part 19 is provided with flanges 30, 31 which can be two in number and directed away from each other or extend outwardly from each of the vertical wall parts of the locating part shown in the drawing. The flanges 30, 31 form locating flanges with support surfaces 32, 33 to lie against the surface 20 which is to be damped. The locating flanges 30, 31 are provided with screw-holes 34, 35 for fixing means for attachment to the surface 20. In the shown example the fixing means are screws which are guided through holes in a wall section of the object 21 whose vibrations are to be damped. Alternatively, attachment can be achieved through riveting or welding, gluing or similar. What is important is that the attachment is rigid so that the vibrations are transmitted from the object to the locating part 19 so that its inwardly facing support surfaces 26-29 vibrate together with the object. These support surfaces form namely support surfaces for the damping body 10, more accurately its spacing elements 17, 18 which in the shown example are diagonally directed towards the cavity's horizontal upper edge part and corresponding lower edge part respectively. As is evident from the figures, the flanges are bevelled, the purpose of which being to maintain good surface contact with the cavity's inwardly facing support surfaces.

By means of the spacing elements 17, 18, the wall parts 12, 13, 14, 15 surrounding the oscillating body 10 are maintained at a distance from the inwardly facing support surfaces of the cavity 22 of the locating part 19, whereby interstices 36, 37, 38, 39 are accordingly formed between the wall parts and the inwardly facing support surfaces which facilitate movement of the damping body

and thereby also of the oscillating body 1 even if the cavity 22 were to be totally filled with damping material. The spacing elements 17, 18 place the damping body symmetrically in the cavity 22 of the locating part 19 since the spacing elements are advantageously the same size and accordingly create equally large interstices between the inwardly facing support surfaces of the cavity and the wall parts of the damping body. Advantageously the damping body as well as the oscillating body can be symmetric with respect to an imaginary vertical symmetrical line in the drawing as well as to a symmetrical horizontal line through the damping body. Although not shown in Fig. 2, the oscillating body 1 as well as the damping body can be substantially cubic.

In Fig. 3 there is shown an example of a second embodiment of the active parts of the vibration damper, i.e. the oscillating body and the damping body which are denoted by 40 and 41 respectively. The locating part is not shown but can in principal be formed as an omega, i.e. with a contour adapted to the damping body's shape and with one or two attachment flanges. It is also imaginable that the locating part has an angular cross section, similar to that in Fig. 2 so that line contact between the attachment part's inwardly facing surfaces and the damping body is created in order to give airspace on the side of the contact regions. As can be seen from the drawing, in this example the oscillating body 40 is cylindrical and placed in a hollow cylinder 42 in the damping body 41 which similarly is cylindrical. Other shapes are of course also imaginable, such as a vibration damper with an elliptical cross section. The embodiment shown in Fig. 3 can for example be used for vibration situations where the vibrations produce force components which are principally parallel with a plane, preferably a

plane radial to the vibration damper's longitudinal axis. It is also feasible that vibration damping can occur in an axial direction, whereby care has to be taken that the oscillating body's 40 ends do not come into contact with support surfaces of the locating arrangement. This is achieved by for example, the oscillating body 40 having both its ends terminate a short way before the end surfaces of the damping body or, alternatively, by the locating arrangements not having support surfaces directed towards the cylinder's end surfaces.

Fig. 4 shows a variation of the vibration damper shown in Fig. 1 and 2, whereby the locating part can be of the same design as that in Fig. 2, but in which the spacing elements are instead formed from a plurality of local spacing elements which are designated by 43. These are provided in the shown example by blister-like projections which are evenly distributed over the damping bodies 42 side surfaces and are intended to contact with point or a small surface contact the inwardly facing support surfaces of the locating part. In this way the side surfaces 45, 46, 47 of the damping body 44 are brought to be normally located with interstices at the inwardly facing support surfaces of the locating means.

Figs 5 and 6 show a further variation of the vibration damper. This has similar principal constructional features to the first embodiment according to Fig. 1 and 2. The locating part 21 can be unchanged, as can the oscillating body 1, whilst the vibrating body 10 is split up and forms four corner pieces 48 which offer the same function as in Figs 1 and 2, but provides a simpler assembly and material savings.

In the vibration damper according to the invention a heavy body, i.e. the oscillating body, is accordingly

elastically supported in a damping body which is positioned in a locating part so that the oscillating body and the damping body are permitted certain movability within a restricted region. The movement of the oscillating body and the damping body is dependent on the vibrations which the object to which the vibration damper is attached is subjected to. Due to the shape permanence and the relative rigidity of the locating arrangement 19, said locating arrangement is brought to chiefly vibrate with the object, whereby the oscillating body, via the damping body, is similarly brought to perform an oscillating movement. Optimal vibration damping is achieved by a suitably balanced spring constant of the damping body, depending on the shape of, particularly, the spacing elements 17, 18 and the choice of material for the damping body, and also by the well chosen mass of the oscillating body, which parameters are suitably chosen depending on the parameters of the vibrations to which the surface 20 of the object is subjected, i.e. the frequencies, amplitudes, directions of movement. Due to the inertia of mass of the oscillating body 1 and the elastic properties of the damping body, the oscillating body will not in fact oscillate in phase with the vibration oscillations in the object 21, but through well balanced parameters for the damping body and the oscillating body, it is assured that the oscillating body is brought to oscillate principally in opposition and thereby counteract the vibrational forces influencing the object 21, whereby these vibrations are dampened. Thanks to the movement of the vibration damper in three dimensions, vibrations in all imaginable directions are dampened since, due to its inertia of mass, the oscillating body is brought to oscillate with a phase shift in the same force directions as the vibrations, though in opposition.

The invention is not restricted to that which is described above and to the embodiments shown in the drawings, but can be varied in a number of ways within the scope of the appended claims. For example, the spacing elements may be formed as a plurality of parallel, longitudinally extending ribs on surfaces of the damping element facing the locating part. The blisters shown in Fig. 4 can be of many different shapes, such as cylindrical, pyrimid-like or cube-like projections. The vibrating body and the damping body can be totally spherical, shaped as a pyramid or cone. Alternatively, the damper can be formed as a sandwich construction with a plurality of damping layers with intermediate metal plates which form oscillating bodies. Hereby the metal plates are for example perforated so that the connection between the damping bodies and the oscillating bodies is assured.

The locating part can for example be provided with ventilation holes in order to avoid problems with vacuum in the interstices. The locating part can also be provided with cooling fins for drawing off the heat energy which is formed in the damping body due to its continuous deformation. The cavity in the locating part can be selected to be smaller than that in the shown example and, as such, a precompression and pre-tension of the damping parts is achieved, by which the frequency and amplitude in the various directions can be given suitable quantities in relation to corresponding parameters of the object's vibrations. The size of the cavity in the damper can be varied for example by the insertion of baseplates which project into the cavity in the housing to various depths. Alternatively, the damping body can be provided with exchangeable spacing elements which can be chosen from a selection with various sizes.

The corner pieces 48 according to Figs 5 and 6 can be elongated so that they reach each other and thereby present a divided version of Figs 1 and 2. The oscillating body can be spherical or can have totally different shapes and be enclosed in a housing which has the shape according to Fig. 2. Various other alternatives to Figs 1 and 2 are imaginable, for example tetrahedron-shaped housing, etc.

Claims

1. Vibration damper for damping vibrations in a surface (20) of an object (21), which damper comprises at least one oscillating body (1) which is movably connected to said surface such that it is brought to oscillate so that the oscillating body transmits forces to the object which are principally oppositely directed to the forces which, through vibration, act on the object,
c h a r a c t e r i z e d i n that the vibration damper presents a locating part (19) made from a shape-permanent material and is intended to be fixedly attached to said surface (20) of the object (21), that the locating part presents one or several inwardly facing vibration-transmitting support walls (26-29), that the oscillating body (1) is supported at a distance from the support walls via damping elements (10) of an elastic material, and that said damping elements are held in position in the locating part via cooperation with said inwardly facing wall or walls (26-29).

2. Vibration damper according to claim 1, c h a r a c t e r i z e d i n that the locating part (19) forms a casing with a cavity (22) in which the damping body (10) and the oscillating body (1) are enclosed, that the oscillating body is enclosed in the damping body (3) and that the damping body is formed with spacing elements (17, 18) which receive support from the casing's support walls (26-29) and form interstices (36-39) between the oscillating body and said support walls.

3. Vibration damper according to claim 2, characterized in that the casing presents an opening through which the damping body (10) with the encased oscillating body (1) can be inserted into the cavity (22) of the casing before the casing is attached to said surface (20) of the object (21).

4. Vibration damper according to claim 3, characterized in that said opening is closed in the casing's mounted state by means of the casing's fit against the object's (21) surface (20).

5. Vibration damper according to claim 2, characterized in that, in the damper's mounted state, the cavity (20) is delimited by said support walls (26, 27, 28) which consists partially of an inner support wall nearest the object (21) which may be formed by the object's surface, partially of one of several side-directed side support walls (26, 28) and partially of an outer support wall (27) facing the object's surface, the damping body and the oscillating body being situated between the outer support wall and the object.

6. Vibration damper according to claim 5, characterized in that said spacing elements (17, 18) are arranged to project against the corner regions of the cavity (22) to maintain said interstices (36-39) on all support walls in the casing.

7. Vibration damper according to claim 6, characterized in that the oscillating body (1) is moulded into the damping body (10) and accordingly occupies a cavity (5) in the damping body.

8. Vibration damper according to claim 6, c h a r a c t e r i z e d i n that both said cavity (22) in the casing and the damping body (10) are predominantly parallelepiped-shaped.

9. Vibration damper according to claims 6 and 8, c h a r a c t e r i z e d i n that the spacing elements (17, 18) are formed partially as outer circumferentially extending flanges and partially as inner circumferentially extending flanges which outwardly extend from the parallelepiped edge regions.

10. Vibration damper according to claim 1, c h a r a c t e r i z e d i n that said damping element (10) is several in number and is formed as corner pieces (48) encircling corner regions of the oscillating body (1) and extending up to corner regions of the locating part (21).

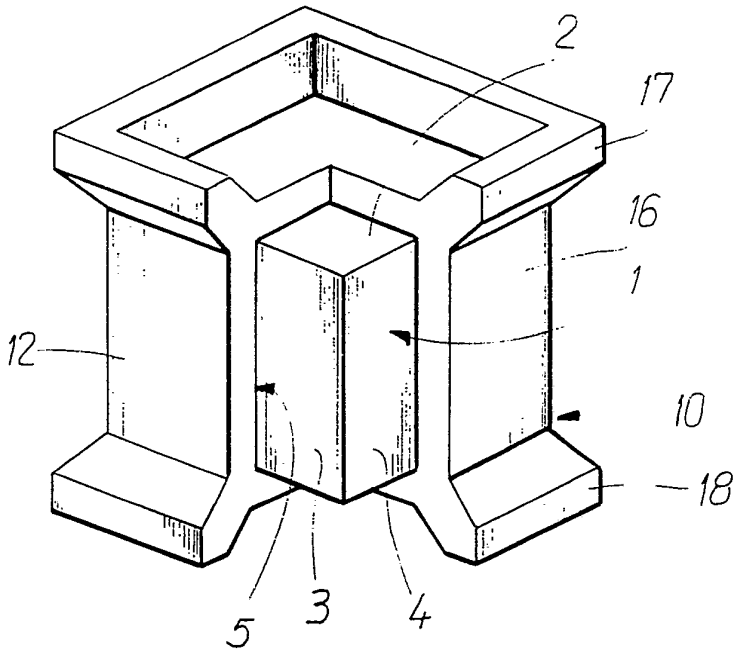
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FIG 1

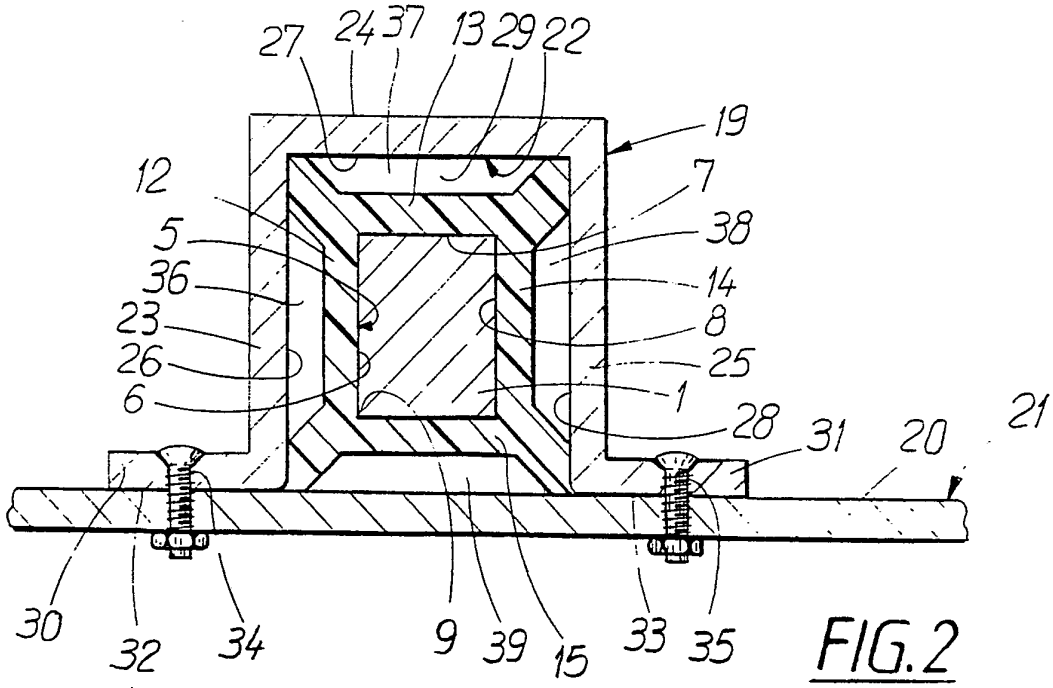
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FIG.2

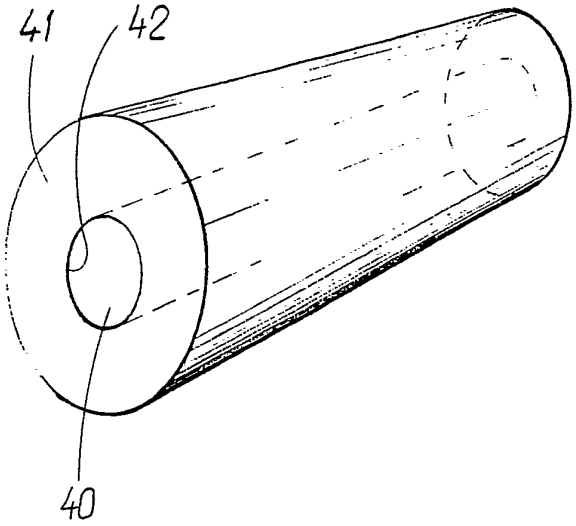

FIG. 3

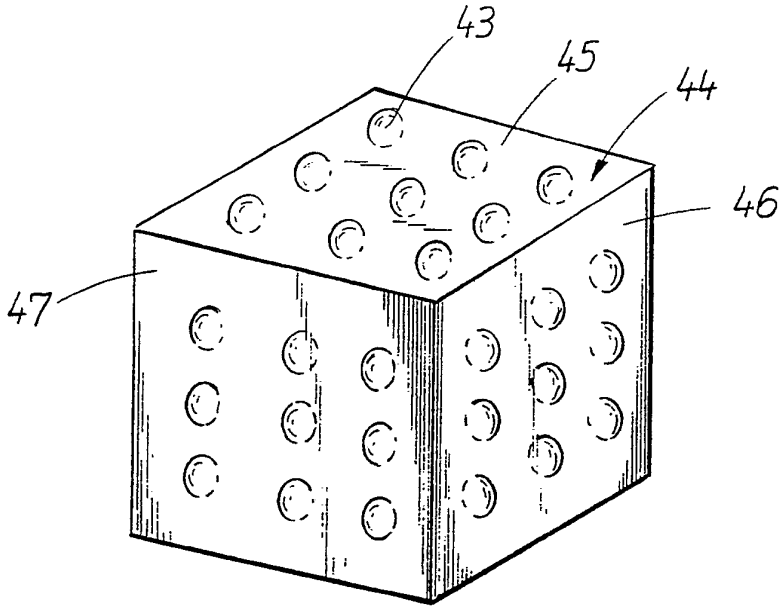

FIG. 4

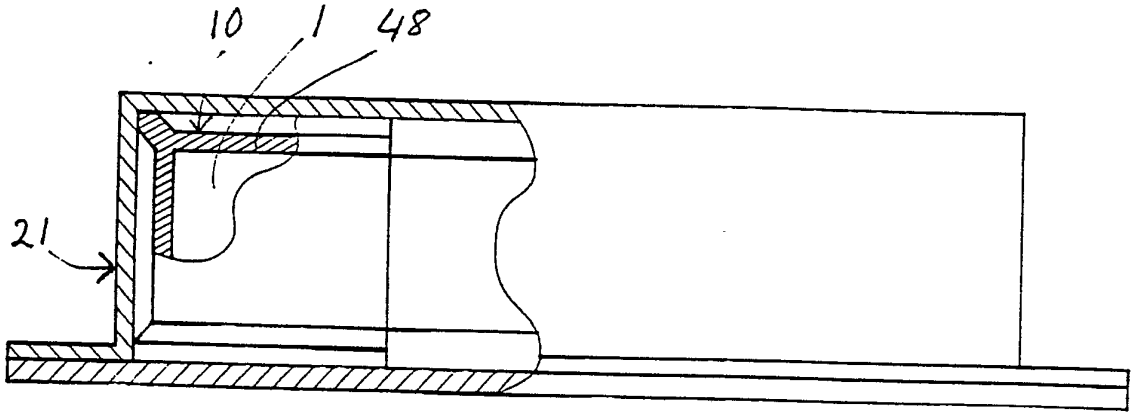

Fig. 5

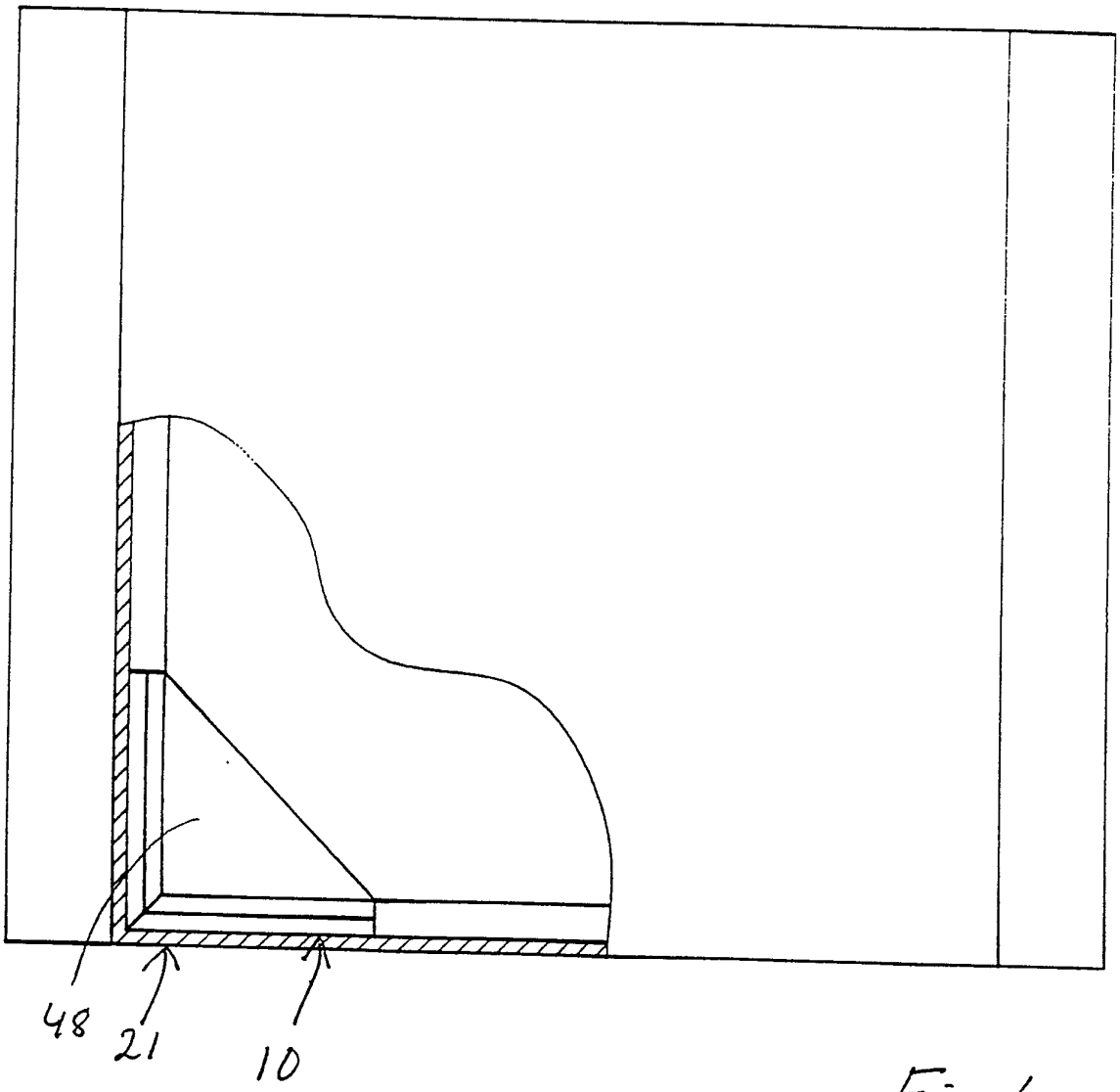

Fig. 6

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 90/00488

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: 16 F 15/08, F 16 F 15/28

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	F 16 F

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
Y	FR, A, 1050638 (LICENTIA PATENT-VERWALTUNGS GMBH) 8 January 1954, see the whole document --	1-5, 10
Y	DE, A, 2139192 (ANDREAS STIHL, MASCHINENFABRIK) 15 February 1973, see figures 6,8 --	1-5, 10
Y	DE, A1, 2807160 (CONTINENTAL GUMMI-WERKE AG) 30 August 1979, see figures 1,3 --	1
Y	DE, A1, 3415571 (STEYR-DAIMLER-PUCH AG) 31 October 1984, see figures 1,4 --	1
Y	FR, A, 1004768 (M RENÉ ANCELLE) 2 April 1952, see detail 9 --	2

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
9th October 1990	1990 -10- 11
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Marianne Dickman

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
Y	SE, C, 201928 (SCHWITZER CORP) 15 February 1966, see details 27 and 51 --	2
A	GB, A, 2165918 (THE TOYO RUBBER INDUSTRY CO LTD ET AL) 23 April 1986, see the whole document --	

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.PCT/SE 90/00488

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 90-08-28
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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
FR-A- 1050638	54-01-08	NONE		
DE-A- 2139192	73-02-15	CA-A-	966396	75-04-22
		FR-A-	2149919	73-03-30
		SE-B-C-	391888	77-03-07
		US-A-	3845827	74-11-05
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SE-C- 201928	66-02-15	NONE		
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