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(54) Integrated guide and clamping unit with hydrostatic bearings for hydraulic press.

(57) An integrated guide and clamping unit with hydrostatic bearing, for the cross-head (13) movable along columns (12) of a hydraulic press for moulding plastic materials. The guide unit (17) comprises a clamping device (18) to brake and lock the movable cross-head (13) to a column (12) of the press, and is provided with hydrostatic bearing means (30) mounted on opposite sides of the clamping device (18), which frees from a rigid connection between a movable cross-head (13) of the press and the same clamping device (18) allowing tilting and balanced adjustments without causing traverse forces upon closing and opening of the mould (15, 16).

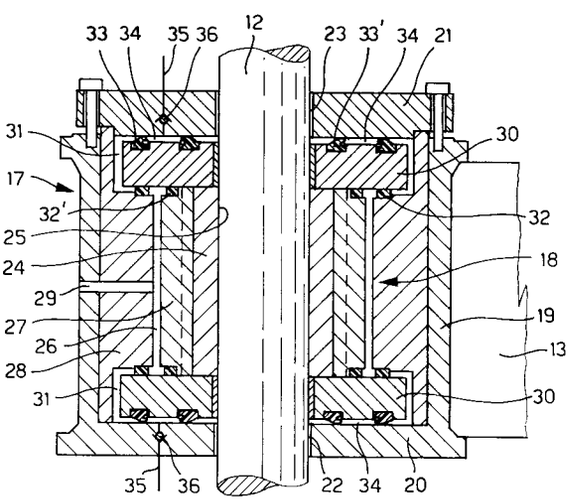

FIG. 3

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The present invention relates to the field of the hydraulic presses for press-moulding of plastic materials and more particularly relates to hydraulic presses for moulding fiber-reinforced or sheet plastic materials. More precisely, the invention relates to improvements to the clamping devices for locking the upper or movable platen or cross-head to the guidance columns of a short-stroke press, so as to ensure correct closing and opening of the mould.

Hydraulic presses for press-moulding of plastic materials, in particular presses of short-stroke type, are generally known for example from W-A-88/07447 and US-A-4,470,787. These hydraulic presses substantially comprise a lower base for a platen supporting a first mould member, from which four guidance columns extend for the sliding of a movable upper cross-head supporting a second mould member or cover to close the lower one.

The upper cross-head of the press is generally made to move vertically along guidance columns by means of suitable hydraulic actuating cylinders: furthermore in a short-stroke press it is locked in a predetermined working position before final closing of the mould which is performed for example by a further relative movement towards each other of the lower and upper mould members.

In presses of the kind mentioned above, in particular large-size presses, mould closing and opening operations give rise to considerable stresses and reaction forces which are transmitted, via the clamping devices for the upper platen, to the guidance columns. These stresses and the reaction forces may be constant during the entire moulding operation or may vary, depending from uncontrollable working conditions.

Opening and/or closing operations of mould, in presses of the kind mentioned, represent the most critical moments during which it is necessary to ensure that the mating surfaces of the two mould members are perfectly parallel, in order to prevent the occurrence of uncontrollable stresses and/or cross forces or torques which could damage both the clamping devices for the movable upper cross-head of the press, and the two mould members.

In hydraulic presses of the type referred above in which the clamping devices are rigidly connected to the upper cross-head, in order to ensure that the mating surfaces are parallel during closing and/or opening of the mould, in general it is necessary to ensure extremely careful construction and assembling of the entire press, in particular the guidance columns and clamping devices for the upper mobile platen which in general are rigidly connected together.

However, extremely careful designing, construction and assembling of the press is not sufficient per se to ensure, under actual operating conditions, that the mating surfaces of the mould are perfectly parallel since there are external factors which may negatively affect the closing and opening operations of the mould or produce anomalous stresses during the same moulding of the plastic articles. These stresses may arise for example as a result of the different thicknesses which the plastic sheet materials to be moulded may have with respect to each other, or which may exist in a same sheet, or on account of the reaction forces which arise inside the closed mould during each moulding operation.

In hydraulic presses of the abovementioned kind there exists, therefore, the problem of preventing the occurrence of traverse forces and ensuring under any working conditions that the mould members, or their mating surfaces, are perfectly parallel with each other, irrespective of the variable operating conditions, design and constructional characteristics of the press itself.

From US-A-4457787 a hydrostatic press is known in which hydrostatic bearings are disposed between the lower platen and actuator assemblies causing the compression forces to react on an upper platen rigidly connected to the upper movable cross-head. Therefore in this arrangement a control is required to control the degree of freedom of the bearing cylinders during the closure of the mould; furthermore the rigid connection of the upper cross-head to the columns of the press causes stresses on the columns and negatively affect parallelism conditions, during closing and opening of the same mould.

From US-A-4954068 a hydraulic press is known in which hydrostatic bearing assemblies are arranged on a surface of the lower press plate between the latter and piston rod of power cylinder; in this arrangement furthermore no positive or self-balancing control of parallelism conditions between mating surfaces of the mould exists during closing and opening of the mould.

Therefore the main object of the present invention is to provide an integrated guide and clamping unit for the movable cross-head of a hydraulic press, which is able to overcome the abovementioned problems.

A further object of the present invention is to provide a hydraulic press for moulding plastic materials, of the short stroke type, comprising hydrostatic bearings to automatically compensate for any defects in the parallelism of the mould members which could result in misalignment of the mating surfaces and in arising dangerous cross-stresses, during either closing and opening of the same mould.

These objects are achieved by means of an integrated guide and clamping unit for the movable

upper cross-head of an hydraulic press, comprising hydrostatic bearing according to main claims 1 and 6. The invention will be illustrated in greater detail hereinbelow with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of a hydraulic press incorporating the guide and clamping unit for the upper cross-head according to the present invention;

Figure 2 is an enlarged cross-sectional view of a guide and clamping unit along the line 2-2 of Figure 1;

Figure 3 is a longitudinal sectional view along the line 3-3 of Figure 2.

With reference to Figure 1, a description is given hereinbelow of the use of hydrostatic bearings in a guide and locking unit for the movable cross-head of a hydraulic press for moulding plastic materials; however it is understood that the use of hydrostatic bearings in a guiding and locking device according to the invention may be provided for other uses or applications in which there is a body sliding along a guide column and subject to significant external loads and/or stresses which may give rise to cross-components.

As shown in Figure 1, the press 10 substantially comprises a base 11 from which there extend four columns 12, only two of which are shown, for the sliding and guidance of a movable cross-head 13 actuated for example by a hydraulic cylinder 14. In Figure 1, 15 denotes the lower member of a mould suitably fixed to the platen of the base 11, while 16 denotes the upper mould member or closing cover fixed to the platen of the movable cross-head 13.

The cross-head 13 of the press is vertically movable between an upper or retracted position where the mould is open, shown in Figure 1, and a lower or advanced position where the mould is closed, being guided during its movement along the guide columns 12, by guiding units indicated in the drawings by 17.

Each guiding unit 17 for the movable cross-head 13 of the press, in a manner known per se comprises clamping means 18 which may be of varying design and which are actuated for example by a suitable hydraulic control system for locking the cross-head 13 to the columns 12, of the press in a desired closing position; in the case of a dual-stroke press for moulding plastic material, the upper movable cross-head 13 is stopped and locked to columns 12 before the two mould members 15 and 16 are moved closer together during the moulding operation, until shouldering surfaces of the mould are brought almost into contact with each other.

As previously referred to, during moulding operation or final closing of the mould, as well as during the subsequent opening operation of the mould, it is important that no stresses or cross-forces should arise in the upper mould member 16, which could negatively influence and affect both the parallel alignment of the mould mating surfaces and the guide and clamping units of the cross head 13.

In order to overcome this drawback, according to the invention, a self-balancing hydrostatic bearing system is provided for bearing the cross-head 13, designed to freely allow small relative floating displacements, in a plane perpendicular to the guide columns 12, between the cross-head 13 and each clamping device, thus preventing stresses or traverse forces from arising both during the closing, moulding operations and during opening of the same mould; this results in automatic self-centering action of the upper mould member 16 with respect to the lower mould member 15, which ensures in any working condition perfect parallel alignment of the mould shouldering surfaces.

The use of independent and self-balancing hydrostatic bearing devices for the movable cross-head 13 of a plastic-moulding press is shown by way of example in the remaining Figures 2 and 3, in combination with a guidance and hydraulically actuated clamping device, provided for each column 12 of the press.

As shown in said Figures, at each corner of the cross-head 13 there is provided a guide device 17 comprising a hollow cylindrical body 19 closed by a bottom wall 20 and by an upper cover 21; the bottom wall 20 and the cover 21 are provided with axially aligned holes 22, 23 through which the column 12 passes, the diameter of the holes being slightly greater than the external diameter of the column, for example of the order of few millimetres, so as to allow small relative movements of the entire cross-head 13 and thermal expansion of the same.

Inside the hollow body 19 there is provided an axial clamping device 18 comprising, for example, a sleeve clamping element 24 surrounding the column 12 and which axially extends inside the hollow body 19. The sleeve element 24 may have a varying configuration consisting of one or more parts and is provided with an internal frictional surface 25 designed to achieve a braking and locking action against the external surface of the column 12; therefore this sleeve element 24 is acted on so as to be elastically biased, in a radial direction, by means of a hydraulic pressure created in an annular chamber 26 formed between tubular elements 27 and 28 surrounding said clamping element 24, inside the tubular body 19.

The annular chamber 26 may be supplied from the exterior with a pressurised hydraulic fluid via a duct 29 or by other suitable means. The design of

the hydraulic clamping device shown in Figures 2 and 3 is supplied here purely and solely by way of example, without this restricting the innovative principle of the present invention.

In fact, as shown in the enlarged sectional view in Figure 3, according to the present invention, the connection between the clamping device 18 and the external body 19 of the guiding device is effected on upper and bottom sides by means of hydrostatic bearings able to transmit high forces axially to the columns 12, thus allowing a floating or relative displacement, without friction, or with transverse forces which are entirely negligible, in a plane perpendicular to the axis of the abovementioned columns.

As shown in Figure 3, the hydrostatic bearing means are provided in the form of flat hydrostatic bearings at both ends of the clamping device 18 so as to perform a bidirectional self-balanced hydrostatic bearing action, depending on the direction of the forces generated when the mould is closed or opened.

According to the example shown, each hydrostatic bearing means is substantially defined by an annular element 30 which slidably surrounds the column 13 and which is accommodated in a corresponding annular seat 31 at each of the two ends of the clamping device, between the latter, the upper closing cover 21 and the bottom wall 20 of the hollow body 19, respectively.

The dimensions of the annular seat 31 are slightly greater than the corresponding dimensions of the annular element 30, so as to form around the ring 30 an annular gap which in conjunction with annular gaps 23 allow the desired relative movement. The rings 30 rest directly, without any constraint, against the tubular elements 24 and 27 of the clamping device 18, with the disposition of suitable sealing gaskets 32 and 32' between the ring 30 and the tubular elements 27, 28 at each end of the annular chamber 26; additional sealing gaskets 33 and 33' are arranged on the opposite side between the ring 30 and the corresponding end closing walls 21,20 of the hollow body 19, keeping the annular seals 33 and 33' suitably spaced apart from one another in a radial direction so as to define between them a hydrostatic chamber 34 lying in a plane perpendicular to the axis of the corresponding column 12. A pressurised hydraulic fluid is supplied into the hydrostatic chamber 34 via a supply duct 35 provided with a check valve 36, as shown in the drawings. In this way, between the external body 19 of each guidance device for the cross-head 13 and the associated clamping device 18, or thrust ring 30, there is provided a hydrostatic bearing 34 able to transmit high axial forces while allowing a relative floating displacement of the cross-head 13 and hence of the upper mould member 16 with respect to the columns 12 and the lower mould member 15, resulting in a self-balancing action and in constant automatic and controlled alignment of the shouldering surfaces of the mould itself.

The value of the hydrostatic pressure of the fluid supplied to each of the chambers 34 may vary from case to case, depending on the specific applications; in general, the hydrostatic pressure of the fluid inside the chambers 34 must be such as to create a fluid film sufficient to prevent direct contact between the opposing surfaces of the ring 30 and the end closing walls 20 and 21 when acted upon by high loads which are transmitted to the head 13 in both the axial directions of the guide columns 12, upon closing and opening of the mould, without causing any force in the cross direction, and allowing to automatically compensate any misalignment in the three main directions between columns 12 and the integrated guide and clamping units of the cross-head 13, and therefore between the mould members.

From the above description and the illustrations it is therefore clear that the invention provides an integrated guide and clamping unit for an hydraulic press, provided with hydrostatic bearing means able to withstand high loads, while allowing a self-balancing and floating action to automatically compensate for any misalignment of the mould-shouldering surfaces, without causing damaging during closing and opening operation.

Claims

1. Integrated guide and clamping unit for guiding and locking a movable member (13) along a guide column (12), characterised by comprising: a hollow body (19) having closed ends provided with axially aligned holes through which the said guide column (12) passes, and a clamping device having clamping means (18) inside said hollow body (14), said clamping means (18) being actuable to lock and free the sliding movement of said hollow body (19) with respect to the said guide column (12), said clamping means (18) surrounding the guide column (12) and axially extending inside the hollow body (19), and in that hydrostatic bearing means (34) are provided between the closed ends of said hollow body (19) and the axial locking means (18), and annular gap means (23, 31) between the aligned holes in the closed end of the hollow body (19) and guide column (12), respectively between said hollow body (19) and thrusting members (30) of said hydrostatic bearing means (34), to allow a relative free movement between said column (12) and said hollow body 19 in the

locked condition of the clamping device.

2. Integrated guide and clamping unit according to Claim 1, characterised in that said hydrostatic bearing means comprise an annular trust element (30) inside a hydraulic chamber in said hollow body (19), said chamber having dimensions greater than those of said annular element (30), said annular thrust element (30) being freely movable in said chamber and resting in direct contact against a corresponding end of the clamping device (18), and radially spaced annular sealing means (33, 33') between said annular thrust element (30) and each end (20, 21) of the hollow body (19), said sealing means (33, 33') defining a hydrostatic annular chamber (34) encircling said column and lying in a plane perpendicular to the guide column (12) of the guide and clamping unit.

3. Integrated guide and clamping unit according to Claim 2, characterised in that the said hydrostatic chamber (34) is connected to an external hydraulic fluid source via a duct (35) comprising a check valve (36).

4. Integrated guide and clamping unit according to Claim 1, characterised in that said clamping means (18) are of the type comprising at least one sleeve locking element (24, 27) axially extending with respect to the guide column (12), an annular chamber encircling said sleeve element (24, 27) as well as conduit means (29) for supplying a pressurised hydraulic fluid into said annular chamber (26) to clamp the aforementioned locking element (24, 27) against said guide column (12).

5. Hydraulic press, in particular a press for moulding plastic material, of the type comprising a base (11) from which guide columns (12) extend, a movable upper cross-head (13) sliding on said guide columns (12), and hydraulic power means (14) for moving said upper cross-head (13) from advanced and retracted conditions, and in which said cross-head (13), comprises guide and clamping means (18) having a friction element (24, 27) surrounding each guide column (12) of the press, characterised in that said guide and clamping means define an integrated unit comprising hydraulic bearing means (30) arranged between the cross-head structure (13) and each of a frictional element (24, 27) of said clamping means and gap means (23, 31) between a thrust member of said hydrostatic bearing means said cross-head structure and said guide column (12) to freely support said cross-head (13) in a plane perpendicular to the guide columns (12) in respect to the same column, the locking device and the hydrostatic bearing means.

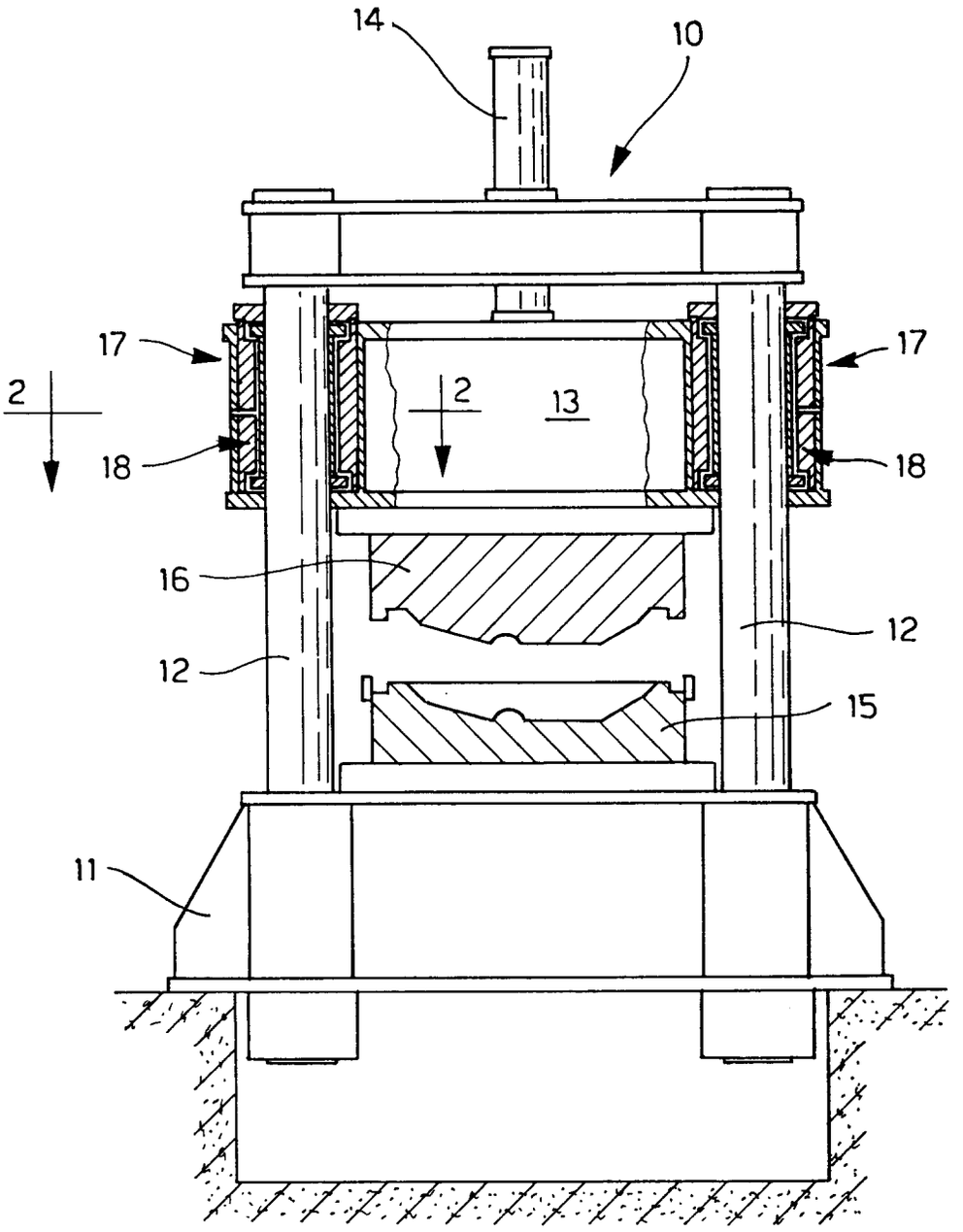

FIG. 1

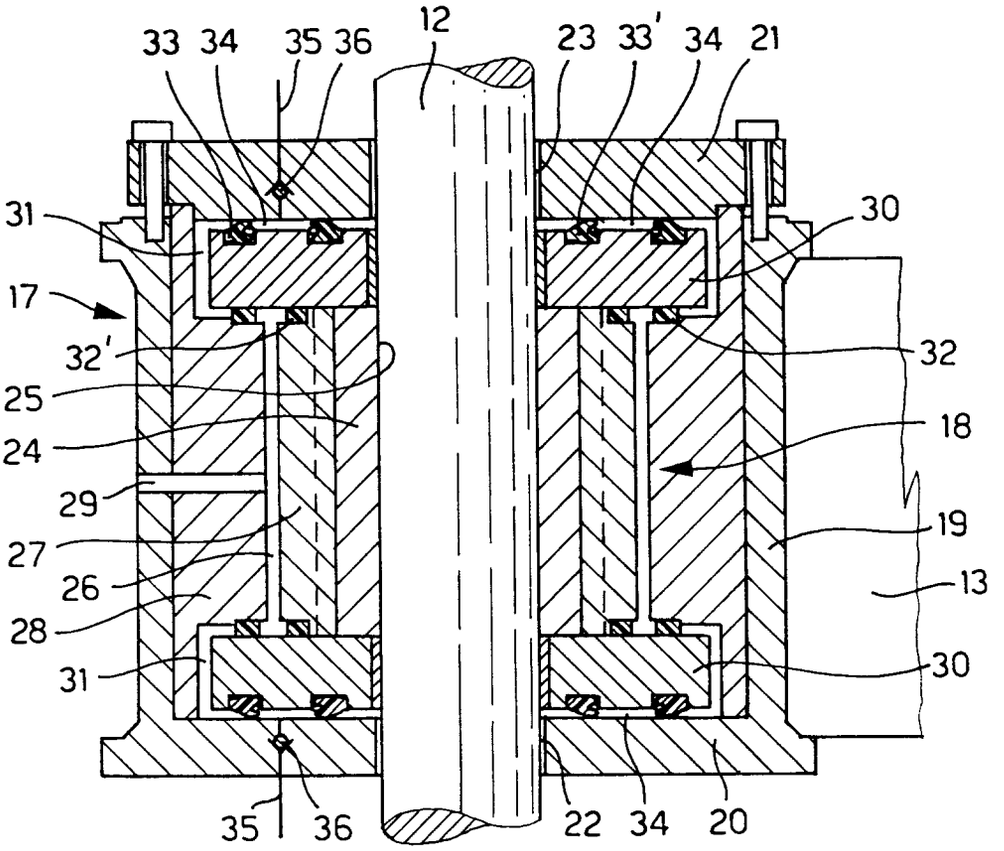
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FIG. 3

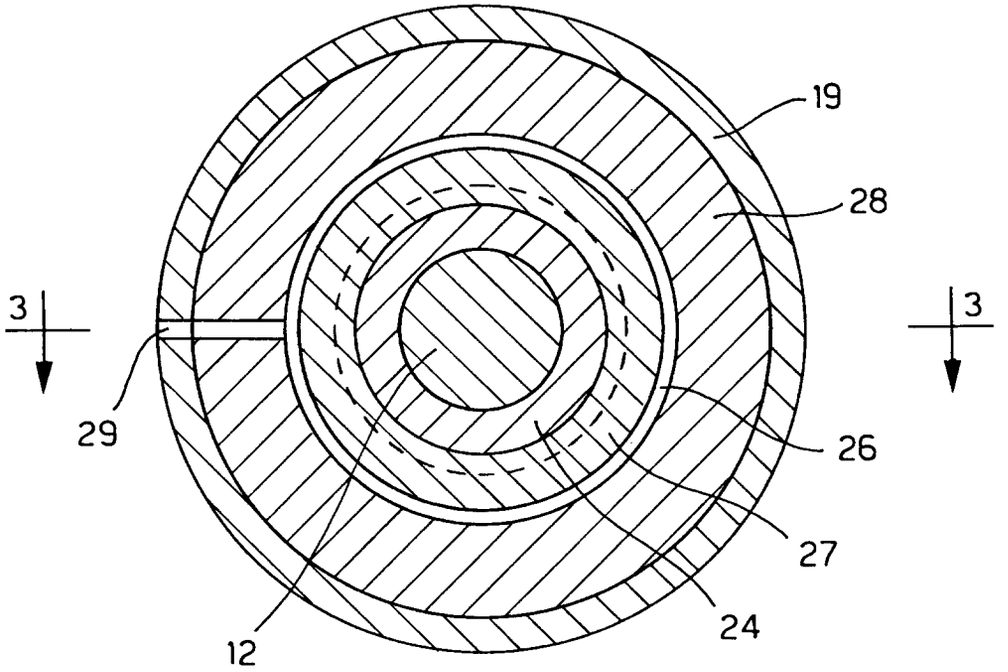
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FIG. 2

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EUROPEAN SEARCH REPORT

Application Number

EP 93 10 4073

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-0 326 980 (FRIED. KRUPP) * abstract; claims; figures *	1,5	B30B1/32 B30B15/04
A	DE-B-1 136 574 (THE LOEWY ENGINEERING CO.) * the whole document *	1,5	
D,A	US-A-4 470 787 (M.M. GRAM) * abstract; figures *	1,5	
A	EP-A-0 220 634 (MASCHINENFABRIK HENNECKE GMBH) * abstract; figures *	1,5	
D,A	WO-A-8 807 447 (MTS SYSTEMS CORPORATION) * abstract; figure 7 *	1,5	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B30B
B29C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	04 MAY 1993	VOUTSADOPOULOS K.

CATEGORY OF CITED DOCUMENTS

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