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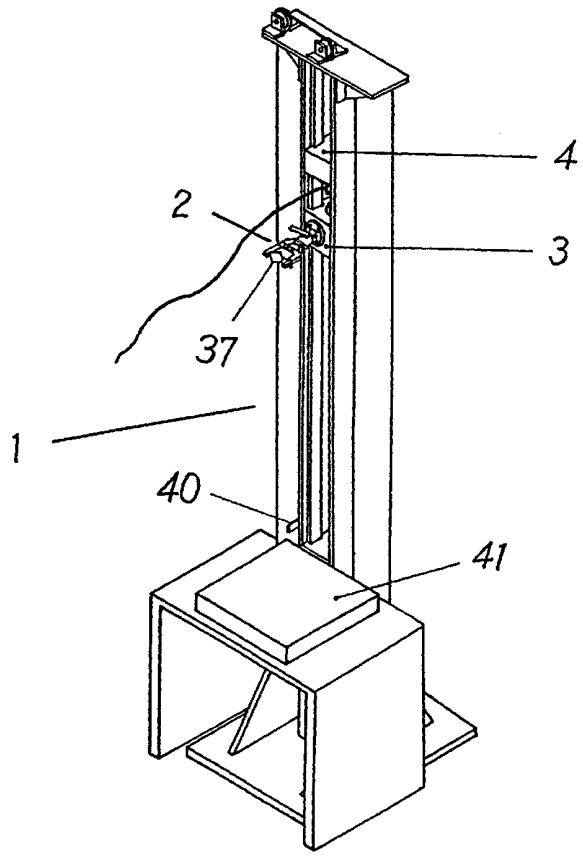
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(54) Title: IMPACT DROP TESTER FOR PORTABLE CONSUMER PRODUCTS



(57) Abstract: A drop tester (1) including a gripper mechanism (2) for holding a product (37) to be tested, a guide track, a slider block (3) which is mounted to slide along the guide track and advance the mechanism toward a target location (41) and a release device (40) for triggering release of the product from the mechanism to impact at the target location, characterised in that the gripper mechanism includes gripper arms (15, 16) coupled to the slider block, the gripper arms being rotatable relative to the slider block to enable the orientation of the product to be varied, relative to the target location. The slider block is preferably releasably coupled to a hoisting block (4) which is positionable at a predetermined location along the guide track. More preferably, the gripper arms are pivotally mounted to a housing (23) and coupled to a piston (22) provided within the housing, the arms pivoting between a gripping position and a release position upon advancement of the piston through the housing.

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IMPACT DROP TESTER FOR PORTABLE CONSUMER PRODUCTS

FIELD OF THE INVENTION

This invention relates to mechanical-shock fragility testing of portable consumer products such as portable mobile phones, pagers, etc.

BACKGROUND OF THE INVENTION

To assess physical robustness of portable consumer products, manufacturers subject these products to impact and subsequently test their continued function and reliability. Currently, many manufacturers conduct such tests by dropping the product by hand. However, such a drop test is not suitable for controlled repeatability and therefore poses a major problem in verifying test data. To overcome this problem, various drop test devices have been suggested. For example, Japanese Patent No. 1-239465 discloses a mechanical device for elevating a product and dropping it onto a target surface and U.S. Patent No. 4910995 discloses repeat drop tests of a compact disc using a string. An impact testing machine is also disclosed in U.S. Patent No. 3412598, where a test package is propelled at high velocity via a horizontal rail and is disengaged by a quick release mechanism, allowing it to continue its motion towards an impact receiving surface. Although the prior art discloses repeatable drop testing of products there is no disclosure of a generally versatile mechanism which allows for the orientation of the product to be specifically manipulated and controlled for repeat testing.

OBJECT OF INVENTION

It is a primary object of the invention to facilitate drop testing of a portable consumer product at any desired orientation and drop height, to allow assessment of damage to the product when it is subjected to impact at different orientations and from various drop heights.

Other objects, features and advantages of the present invention will become apparent from the detailed description which follows, or may be learned by practice of the invention.

SUMMARY OF INVENTION

In accordance with the invention, there is provided a drop tester including a gripper mechanism for holding a product to be tested, a guide track, a slider block which is mounted to slide along the guide track and advance the mechanism toward a target location and a release device for triggering release of the product from the mechanism to impact at the target location.

Preferably, the gripper mechanism includes gripper arms coupled to the slider block, the gripper arms being rotatable relative to the slider block to enable the orientation of the product to be varied, relative to the target location.

In another aspect, there is provided a gripper mechanism for use in the above drop tester.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWINGS

The accompanying drawings which are incorporated into and constitute a part of the description of the invention, illustrate embodiments of the invention and serve to explain the principles of the invention. It is to be understood, however, that the drawings are designed for purposes of illustration only, and not as a definition of the limits of the invention for which reference should be made to the claims appearing at the end of the description.

Figure 1 is an isometric view of an embodiment of a drop tester constructed according to the present invention;

Figure 2 is a sectional side view of a quick release mechanism used in the drop tester;

Figure 3 is a sectional front view of the quick release mechanism;

Figure 4 is an exploded isometric view of a gripper mechanism of the drop tester;

Figure 5 is a plan view of the gripper mechanism, with a piston housing partially sectioned to expose the piston for the purpose of clarity;

Figure 6 is a sectional view along line A-A in Figure 5;

Figure 7 is an isometric view of the left gripper;

Figure 8 is an isometric view of the right gripper;

Figure 9 is a plan view of the piston housing and piston housing support;

Figure 10 is a sectional view of the piston housing, taken along line A-A in Figure 9; and

Figure 11 is a sectional view of the piston housing support, taken along line B-B in Figure 9.

DESCRIPTION OF A PREFERRED EMBODIMENT OF INVENTION

A drop tester 1 is shown in Figure 1 as comprising a gripper mechanism 2, which is mounted onto a slider block 3. The slider block 3 is coupled to a hoisting block 4 via a quick release connector 5. This hoisting block 4 can be raised to the desired drop height via the hoisting cable 6. Both the slider block 3 and hoisting block 4 are adapted to slide between a vertical guide track formed by column supports 7. When the coupled hoisting block 4 and slider block 3 are raised to the desired drop height, the slider block 3 can be uncoupled by a quick release connector 5 which is activated by pulling on the release cable 8.

The quick release connector 5 is shown in more detail in Figures 2 and 3. A connecting rod 10 is screwed into the slider block 3 and kept in position by a lock nut 9. The connecting rod is in turn attached to a quick-release fixture 11 by a retaining pin 10a resting on a release pin 12. The quick-release fixture 11 is attached to the base of the hoisting block 4 by two screws 13. When the release cable 8 is pulled, the release pin 12 is disengaged from supporting the retaining pin 10a, thus releasing the slider block 3. The slider block 3 then falls freely under gravity, guided by the two vertical column supports 7.

Referring now to Figures 4 to 8, the gripper mechanism 2 comprises a first gripper arm 15 and a second gripper arm 16 pivotally mounted to a respective flange of a piston housing 23. Inner ends of the gripper arms 15, 16 are coupled to a piston 22 via a pin and slot type engagement such that linear movement of the piston effects pivotal movement of the gripper arms relative to the respective flange, from a gripping position to a release position for releasing a product 37. The gripper arm 16 is provided with a gripper jaw 17, with a rubber pad 18 affixed to it, and the jaw is adjustable relative to the arm via a screw thread 19. The

gripper arm 15 is also formed with a jaw 21, with a rubber pad 20 affixed thereto.

The piston housing 23 is provided with a piston retainer 24 affixed to it via screws 25 to prevent the piston 22 from sliding completely out of the piston housing. The piston housing 23 is connected to a piston housing support 26 by screws 27. A locking bar support 28 is also mounted on the piston housing support 26 via two bolts 29. The locking bar support 28 is mounted to a pin 31 and held on the pin 31 by locking pin 32, to allow for rotation of the locking bar 30 about the pin 31. The locking bar engages with a slot 39 of the piston 22 to releasably hold the piston in a retracted position, against the bias of spring 38. The piston housing support 26 is itself mounted onto the slider block 3.

Figure 9 shows the piston housing 23 as being provided with connection flange 34 which connects the housing to the piston housing support 26 via a mating connection flange 36. Figure 10 shows the connection flange 34 of the piston housing 23, with two curved slots 33 machined into it. This allows the piston housing 23 to rotate to any angle before it is fastened to the mating connection flange 36 of the piston housing support 26. Fastening is effected via bolting through eight of the mounting holes 35 shown in Figure 11. The ability to rotate the piston housing 23 means that the gripper arms 15, 16 are also rotatable to any angle before the piston housing 23 is fastened to the piston housing support 26, to thereby allow the test product 37 to assume a desired orientation at impact.

With reference to Figure 5 again, when the gripper jaws 17, 21 are clamped to the product 37, the piston 22 is pushed into the piston housing 23, thus compressing the helical spring 38. To retain the piston 22 within the piston housing 23, the locking bar 30 is pushed into the slot 39 as indicated in Figure 4. The gripper mechanism 2 is then primed, ready to execute a drop test.

To conduct the test, the coupled slider block 3 and hoisting block 4 are raised to the required drop height, and the release cable 8 connected to the release pin 12 is pulled. This uncouples the slider block 3 with its attached gripper mechanism 2, allowing it to fall freely and slide between the column supports 7. When the slider block descends to the level of a stationary release bar 40, located close to the target impact location/surface 41, contact between the release bar 40 and the locking bar 30 pushes the latter into an unlocked position. This disengages the spring-loaded piston 22, which fires forwardly to rotate the grippers 15, 16 and

release the product 37. The product 37 then continues its motion unrestrained for a momentary period before it strikes the target impact surface 41 at the orientation with which it was gripped prior to release. The motion of the slider block 3 is arrested by the shock absorber 14 shown in Figure 1.

As can be appreciated from the above, many modifications and variations may be made to the drop tester without departing from the spirit and scope of the invention, as described. For example, the slider block and hoisting block may be connected via any suitable means such as electromagnetic coupling, the hoisting block itself may be elevated mechanically such as by a motor and the locking bar and release lever may be replaced with any other appropriate release device suitable for releasing the gripper arms at a predetermined location. The specific form of the gripper arms may also be modified, as desired.

CLAIMS

1. A drop tester including a gripper mechanism for holding a product to be tested, a guide track, a slider block which is mounted to slide along the guide track and advance the mechanism toward a target location and a release device for triggering release of the product from the mechanism to impact at the target location.

2. A drop tester as claimed in claim 1, characterised by the gripper mechanism including gripper arms coupled to the slider block, the gripper arms being rotatable relative to the slider block to enable the orientation of the product to be varied, relative to the target location.

3. A drop tester as claimed in claim 1, characterised by the slider block being releasably coupled to a hoisting block which is positionable at a predetermined location along the guide track.

4. A drop tester as claimed in claim 3, wherein the blocks are coupled by a connecting rod which is releasably held in the hoisting block by a retaining pin which is arranged to be retracted to release the slider block from the hoisting block.

5. A drop tester as claimed in claim 2, characterised by the gripper arms being pivotally mounted to a housing and coupled to a piston provided within the housing, the arms pivoting between a gripping position and a release position upon advancement of the piston through the housing.

6. A drop tester as claimed in claim 5, characterised by the housing including a spring therewithin and the piston being held against the spring bias in a retracted condition, when the arms are in the gripping position.

7. A drop tester as claimed in claim 5, characterised in that the mechanism includes a lock to hold the piston in the retracted condition, the lock being released by the release device.

8. A drop tester as claimed in claim 7, characterised in that the lock is in the form of a pivotal arm mounted relative to the housing and adapted to releasably engage a slot in the piston.

9. A drop tester as claimed in any one of claims 5 to 8, wherein the housing is mounted to a support provided on the slider block and is adapted to rotate relative to the support to effect the rotation of the gripper arms.

10. A drop tester as claimed in claim 9, characterised in that the housing and support are provided with respective connection flanges, one of the flanges having arcuate slots and the other of the flanges having mounting holes for receipt of fastening bolts arranged to pass therethrough, to clamp the flanges together once the housing is rotated to a desired position.

11. A gripper mechanism for use in the drop tester as claimed in any one of the preceding claims characterised in that the mechanism includes gripper arms arranged to rotate relative to a support coupling the arms to a slider block of the drop tester.

12. A gripper mechanism as claimed in claim 11, wherein the gripper arms are pivotally mounted on a housing and coupled to a piston provided within the housing, the arms pivoting between a gripping position and a release position upon advancement of the piston through the housing.

13. A gripper mechanism as claimed in claim 12, characterised by the housing including a spring therewithin and the piston being held against the spring bias in a retracted condition, when the arms are in a gripping position.

14. A gripper mechanism as claimed in claim 13, characterised in that the mechanism includes a lock to hold the piston in the retracted condition.

15. A gripper mechanism as claimed in claim 14, characterised in that the lock is in the form of a pivotal arm mounted relative to the housing and adapted to releasably engage a slot in the piston.

16. A gripper mechanism as claimed in any one of claims 12 to 15, wherein the housing is mounted to a support and is adapted to rotate relative to the support to effect the rotation of the gripper arms, wherein the housing and support are provided with respective connection flanges, one of the flanges having arcuate slots and the other flange having mounting holes for receipt of fastening bolts arranged to pass therethrough to clamp the flanges together, once the housing is rotated to a desired position.

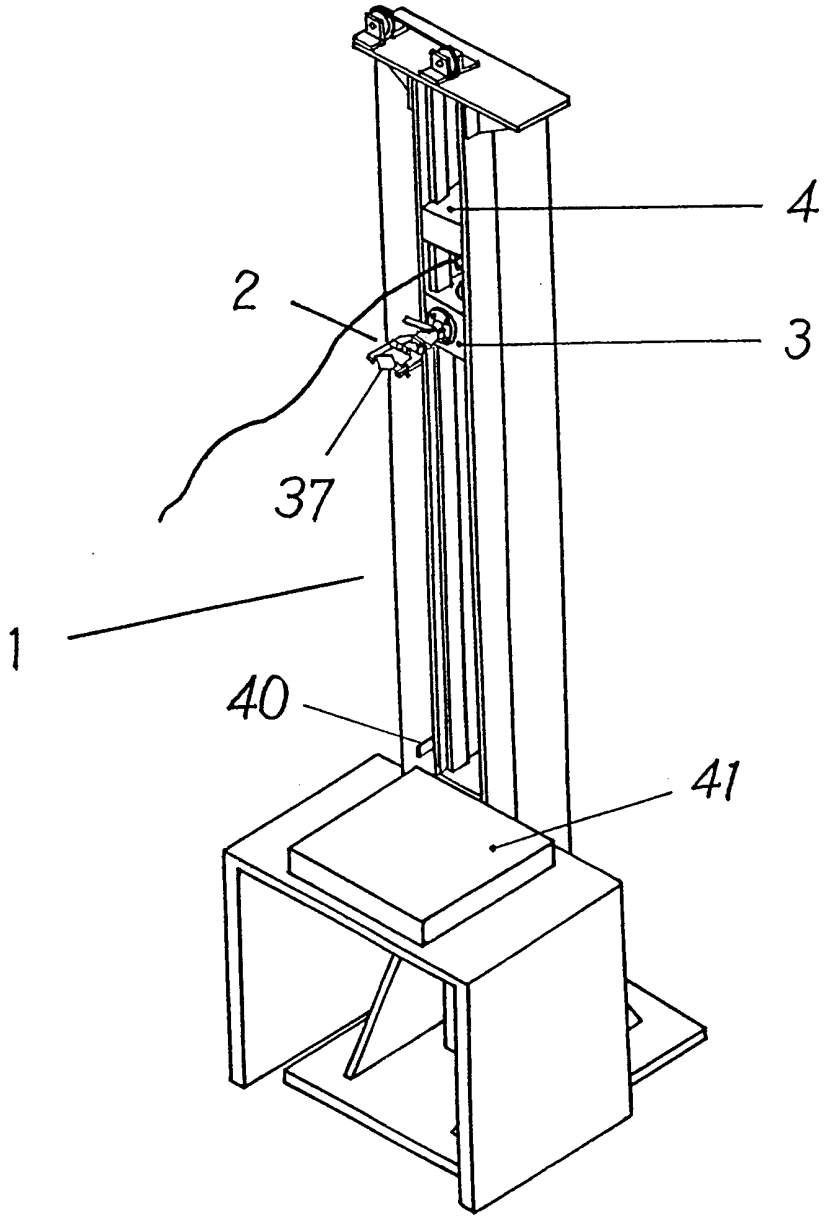


Fig. 1

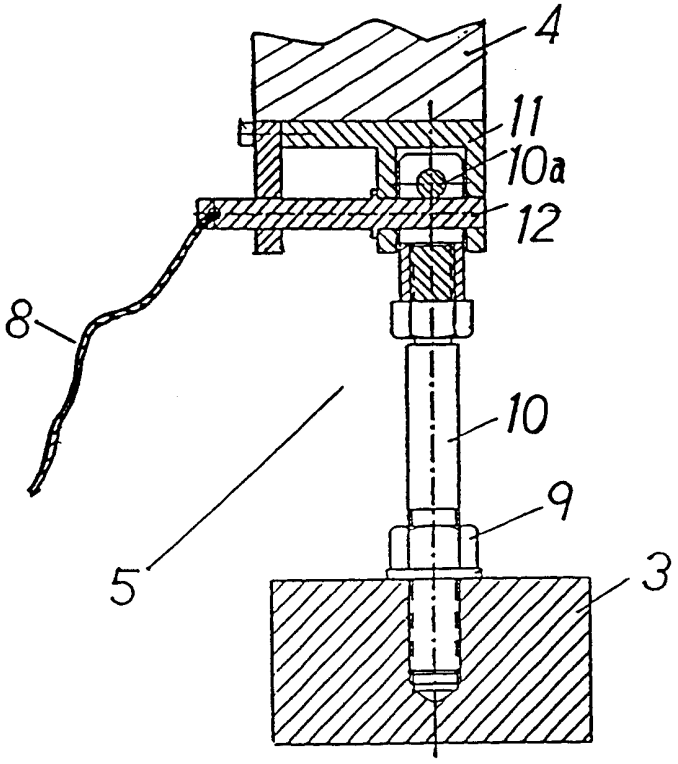


Fig. 2

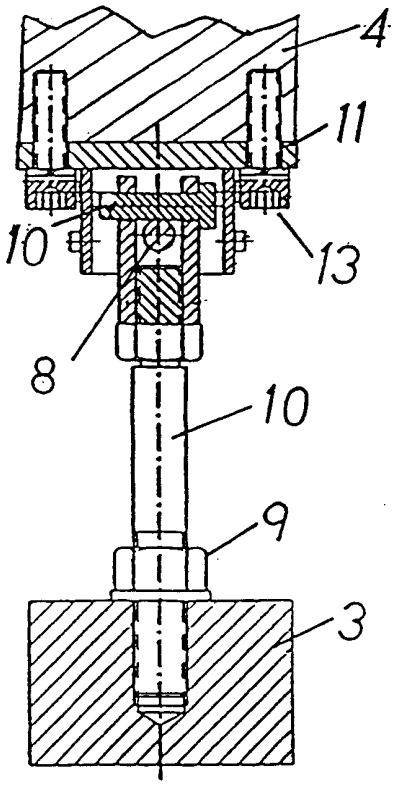


Fig. 3

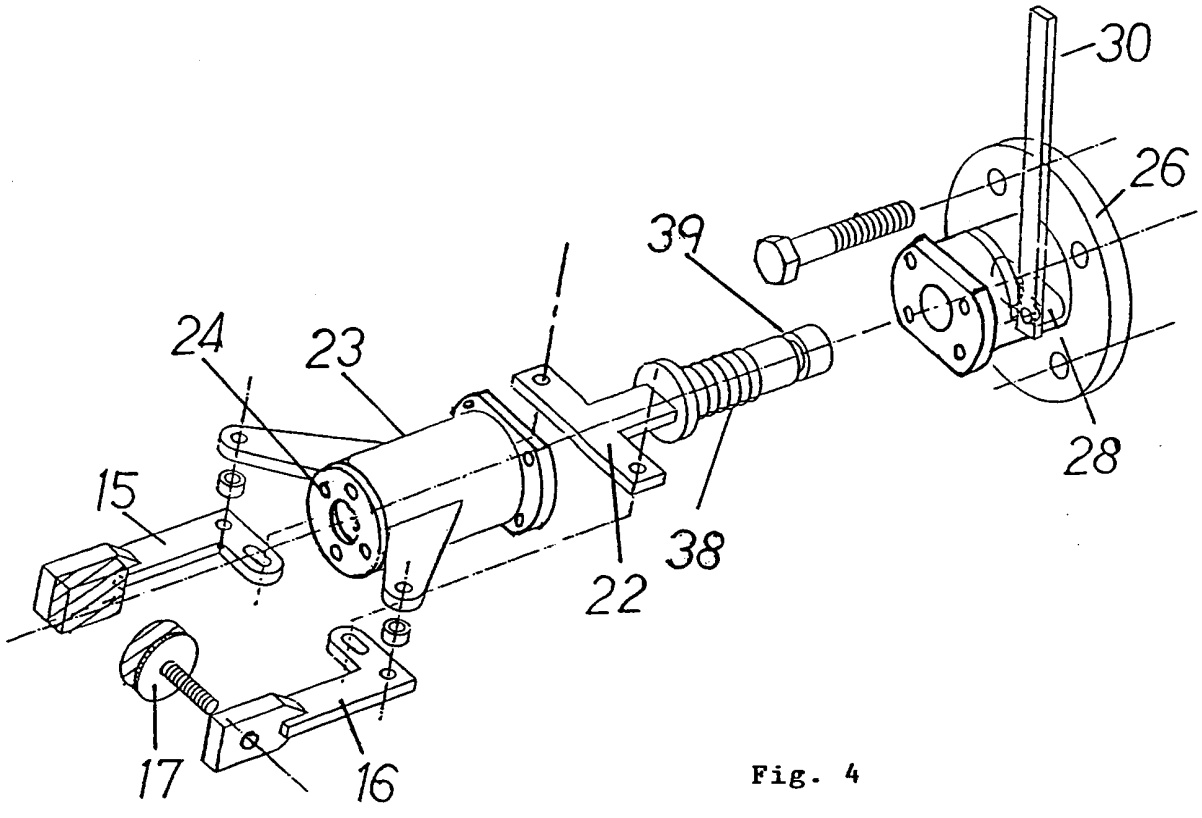


Fig. 4

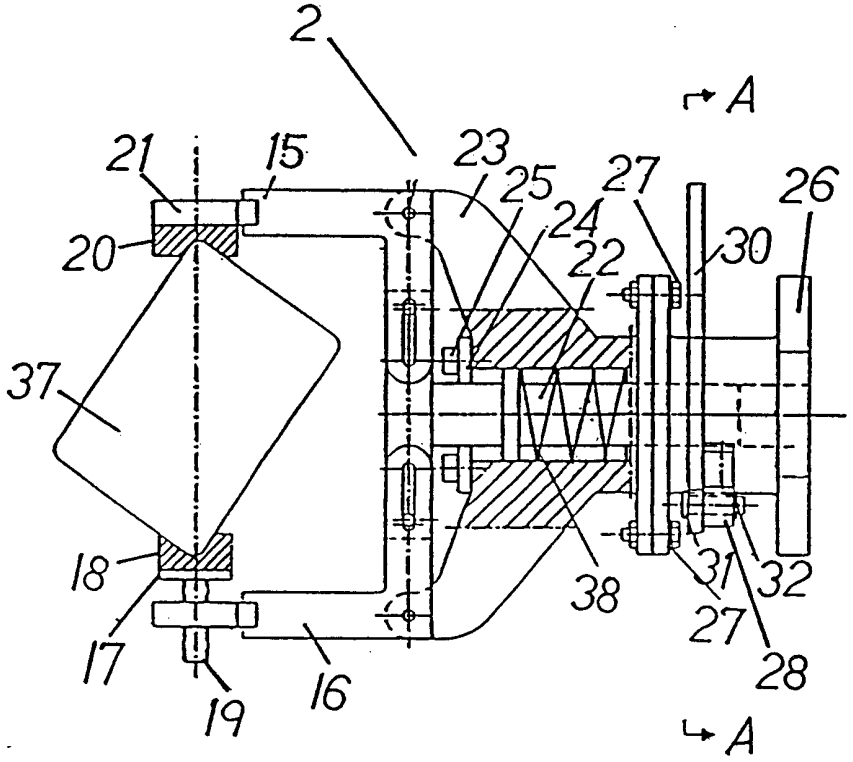


Fig. 5

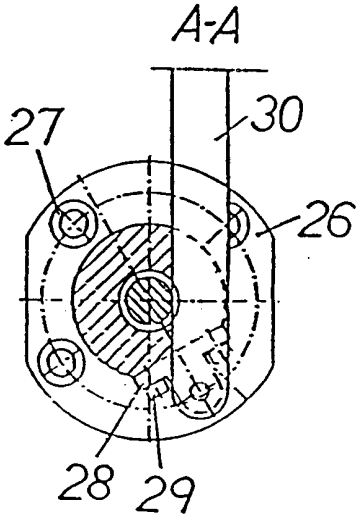


Fig. 6

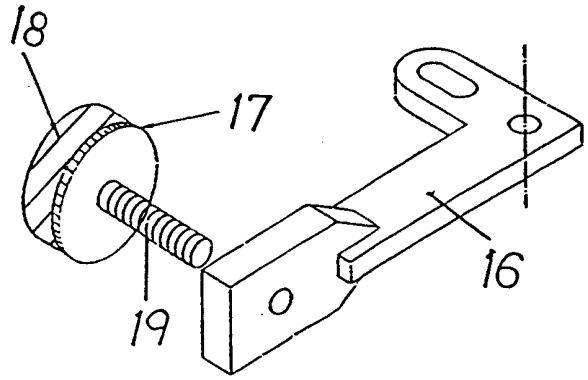


Fig. 7

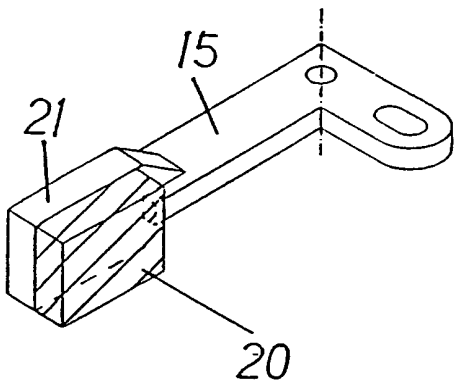


Fig. 8

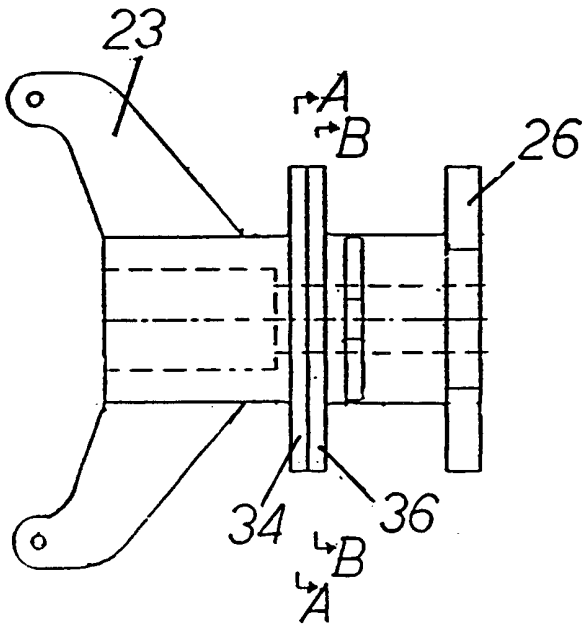


Fig. 9

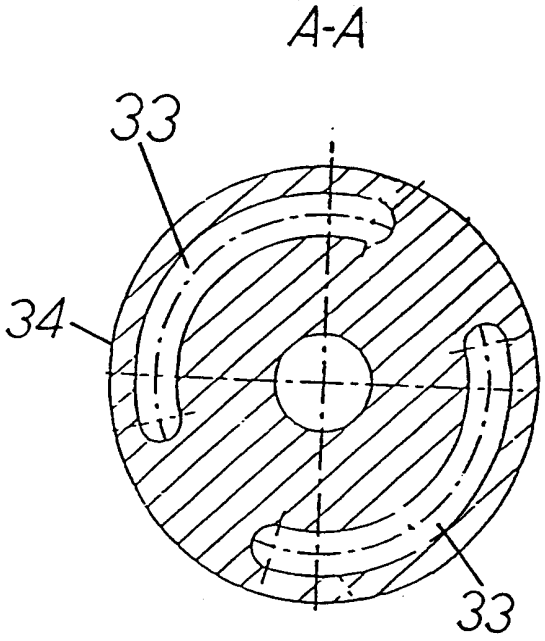


Fig. 10

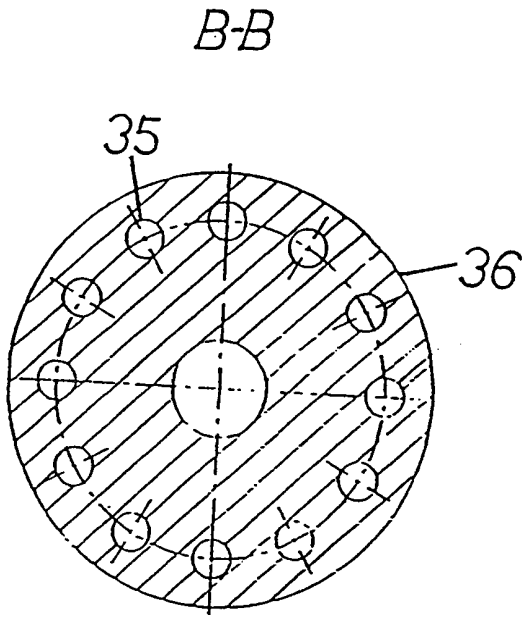


Fig. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG 00/00081

CLASSIFICATION OF SUBJECT MATTER

IPC[7]: G01N 3/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[7]: G01N 3/30, 3/34

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4910995 A (NISHIO) 27 March 1990 (27.03.90) abstract, claims 1, fig.3.	1
A	US 3426578 A (A. BERGS) 11 February 1969 (11.02.69) totality.	1,2,5,11,12
A	US 3412598 A (J.E. NEBB) 26 November 1968 (26.11.68) totality.	1
A	DD 50355 A (H. ROTHER) 20 September 1966 (20.09.66) claims, fig.	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
„A" document defining the general state of the art which is not considered to be of particular relevance
„E" earlier application or patent but published on or after the international filing date
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„X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
„Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
„&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 August 2000 (21.08.2000)	9 October 2000 (09.10.2000)
Name and mailing adress of the ISA/AT Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna Facsimile No. 1/53424/535	Authorized officer Erber Telephone No. 1/53424/382

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/SG 00/00081

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
DD	A	50355A				none	
US	A	3412598	26-11-1968			none	
US	A	3426578	11-02-1969			none	
US	A	4910995	27-03-1990	GB	A0	8907138	10-05-1989
				GB	A1	2217024	18-10-1989
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