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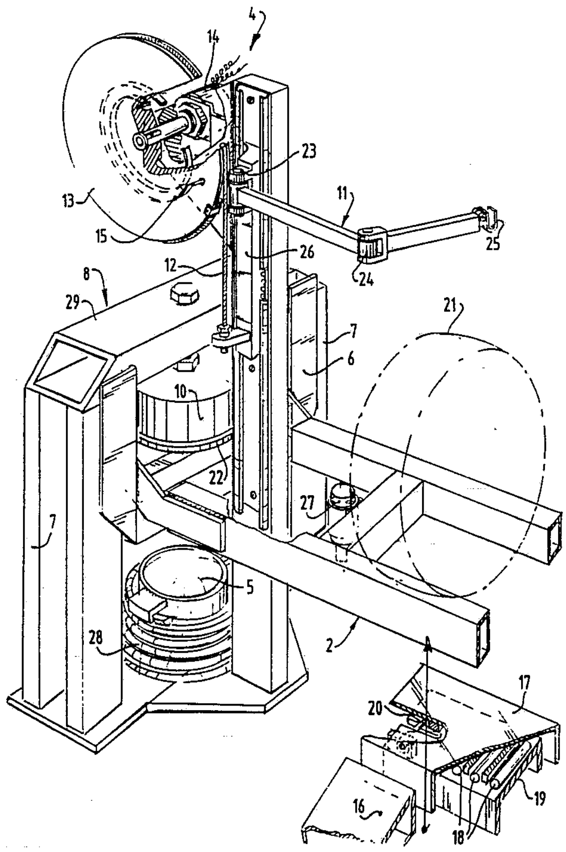
(57) Abstract

Method for testing a shock absorber of a vehicle by lifting to a determined height above the ground at least one vehicle wheel (21) to which the shock absorber is connected for damping, relinquishing the wheel (21) to a free fall and recording a resulting resilient movement of the vehicle, wherein an indicator of the damping is determined from the recorded resilient movement. A device for performing this method is provided with lifting means (2) for at least one vehicle wheel (21), control means (3) connected to the lifting means (2) and means (4) for recording a movement of the vehicle.



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METHOD AND DEVICE FOR TESTING A SHOCK ABSORBER

The present invention relates to a method for testing a shock absorber of a vehicle.

Good operation of vehicle shock absorbers is of great importance for traffic safety. Up to the present time however there has been no really practicable testing method for shock absorbers.

A shock absorber test is in fact known wherein the wheels of a vehicle are set into vibration on a test bench and the force with which they press on the test bench is measured, but this testing method is not very reliable and rather susceptible to fraud since the measured force also depends for instance on the load situation of the vehicle and its tyre pressure and tyre type. The test bench required for this testing method is moreover very expensive. The operation of the shock absorbers is therefore still tested by most garages by pressing a corner of the vehicle downward and observing the resulting spring movement after release.

The invention therefore has for its object to provide a method for testing a vehicle shock absorber with which reliable test results can be obtained in simple manner. This is achieved according to the invention by lifting to a determined height above the ground at least one vehicle wheel to which the shock absorber is connected for damping, relinquishing the wheel to a free fall and recording a resulting resilient movement of the vehicle, wherein an indicator of the damping is determined from the resilient movement and a value for an inspection criterion is thus obtained that is simple to apply.

In order to test the shock absorbers in realistic manner and to minimalize the time required for the tests, a plurality of wheels having a common axis are preferably lifted together from the ground and released substantially simultaneously.

The invention further relates to a device for testing a shock absorber of a vehicle. The object of the invention is herein to provide a device with which the above described testing method can be performed simply and at little cost. This is achieved according to the invention by a device provided with means for lifting to a determined height above the ground at least one vehicle wheel to which the shock absorber is connected for damping, control means connected to the lifting means and means for recording a movement of the vehicle.

In preference the device according to the invention further comprises means connected to the control means for holding fast the lifting means in a position raised from the ground, wherein the holding means may take the form of an electromagnet actuable by the control means. By switching off the electromagnet the lifting means can be abruptly released, whereby the vehicle wheel is relinquished to a free fall.

When the lifting means take the form of a lift, the main dimension of which is slightly greater than the width of the vehicle, and an electromagnet is arranged on either side of the lift, the shock absorbers of the front or rear train of the vehicle can be simultaneously tested.

The switch-off speed of the electromagnet can be increased by a spacer member arranged between the magnet and the lifting means which maintains an air gap between the magnet and the lifting means.

The switch-off speed of the magnet is still further increased when the control means comprise a capacitor connectable in series to the electromagnet.

The exciter coil of the magnet is preferably incorporated in a first electric circuit with a first power source and in a second electric circuit with a diode and a capacitor supplied by a second power source, and the control means comprise a switch for closing at choice the first or second electric circuit, this such that at switch-over the capacitor is discharged over the exciter coil.

Mentioned and other features and advantages of the invention are elucidated hereinafter on the basis of an embodiment, wherein reference is made to the drawing, wherein:

fig. 1 shows a partly cut away perspective view of a testing device according to the invention;

fig. 2 is a partly sectional side view of the lifting means in the rest position;

fig. 3 is a view corresponding with fig. 2 with the lifting means in the position raised above the ground;

fig. 4 is a view corresponding with fig. 2 and 3 in which the lifting means are held fast by the holding means;

fig. 5 is a partly cut away perspective view of a detail of the device, wherein the lifting means are raised from the ground;

fig. 6 shows a circuit diagram of the control means; and

fig. 7 shows a typical movement of the body of a tested vehicle.

A device 1 (fig. 1) for testing a shock absorber of a vehicle (not shown here) comprises lifting means 2, control means 3 (not shown) and movement recording means 4. The lifting means 2 have the form of a lift to be raised from the ground by air bellows 5. The movement of the lift is guided by U-shaped guidings 6 arranged on both its outer ends and gripping round posts 7 of a portal 8. Guide rollers 9 are mounted in the posts 7 to ensure a smooth movement of the lift. Each portal 8 further has a girder 29 to which are fixed holding means 10 in the form of electromagnets.

The recording means 4 comprise in each case an arm 11 which is connected over a cable 12 to a rotatably mounted cable pulley 13. The pulley 13 is connected to a potentiometer 14 and a biasing spring 15.

Drive-on plates 16 enable driving onto the lift 2 of front or rear wheels of a vehicle of which the dampers must be tested. Receiving plates 17 arranged slidably on the ground receive the vehicle after it has been relinquished to free fall and enable a movement of the wheels of the vehicle in transverse direction during in- and outward spring movement. The receiving plates 17 are mounted slidably on a ground block 19 by interposing pins 18 and are biased to their starting position by springs 20.

After the vehicle has been driven with its wheels 21 onto the lift 2, the latter is carried upward by the air bellows 5 (fig. 3). The electromagnet 10 is subsequently engaged by the control means 3 (not shown here) and attracts a plate 22 welded to the lift 2. Situated between the magnet 10 and plate 22 is a spacer member which ensures that between magnet 10 and plate 22 an air gap of several tenths of a millimetre is maintained which enables abrupt release of the lift 2. The control means 3 then switch off a pump (not shown) connected to the air bellows 5, whereafter the air bellows 5 are each retracted by a draw spring 28 (fig. 4).

Both arms 11, which are each arranged on a carriage 26 by means of a swivel connection 23, are then moved downward counter to the spring tensioning of their associated cable pulley 13 and swivelled about their swivel connections 23, 24 such that a hook 25 on the free extremity of each arm 11 engages round the edge of the wheel casing belonging to the wheel 21 (fig. 5).

When the electromagnets 10 are now switched off substantially simultaneously by the control means 3, the lift 2 is released and the wheels 21 relinquished to free fall. The fall of the lift 2 is eventually arrested by a damper 27 attached thereto. Because in the rest position the lift 2 is located lower than the receiving plates 17 the free fall movement of wheels 21 is not affected by the descent of the lift 2. The wheels 21 are received after free fall by the receiving plates 17 which, as indicated, enable a sideways movement of the wheels 21. When the wheels 21 come down onto the receiving plates 17, the body of the vehicle, which is resiliently connected to wheels 21, will for a time perform a resilient movement which is damped by the shock absorbers. The arms 11 of the recording means 4 follow the resilient movement very precisely and convert this into a rotation movement of the pulley 13 and the potentiometer 14 connected thereto. As a result of the repeatedly changing angle of rotation the potentiometer generates a variable signal which is received, stored and processed.

In order to ensure that both electromagnets 10 are switched off simultaneously and the vehicle assumes a substantially horizontal position during the free fall movement, the exciter coils 30 of both magnets 10 are not only each incorporated in a first electric circuit with a first power source 31 but also in a second electric circuit with a diode 32 and a capacitor 34 fed by a second power source 33.

When now the lifting means 2 have reached their position raised from the ground a first relay 36 is actuated by closing a control switch 35, which relay throws switches 37 connected thereto from their rest position to the operating position shown with dash-dot lines. The first electric circuit is hereby closed and the electromagnets 10 energized. A contact 38 of the first relay 36 is also closed whereby a second relay 39 is actuated and its contacts 40 closed. The capacitors 34 charged by the second power source 33 via a resistor 43 limiting the charging current are thus each connected to a contact 37.

If the control switch 35 is now opened in order to switch off the electromagnets 10, the switches 37 are then returned to the rest position shown in full lines. The first electric circuit is thus opened and the contacts 37, 38 of the first relay return to their rest position. A capacitor 41 ensures that the second relay 39 remains actuated for a time so that its contacts 40 remain closed.

Due to the inherent inertia of the exciter coils 30 current also continues to run in the original direction during switching of the switches 37. This current is guided by the diodes 32 to the capacitors 34. The current also runs through the exciter coils 30 after the switches 37 have returned to their rest position and the electromagnets 10 remain switched on. However, due to the much higher voltage over the capacitors 34 the current diminishes very rapidly. At a determined moment the current then reverses and the capacitors 34 are discharged over the exciter coils 30 in a short time. The magnet action 10 is thereby abruptly switched off. Capacitors 42 connected in parallel to the contacts 37 prevent the charging current in the capacitors 34 increasing too quickly when the contacts 37 are switched over.

The output signal of the potentiometer 14, which will normally have a sine-shaped path (fig. 7), is recorded and processed as described above. A measure ß for the spring movement of the body of the vehicle is determined according to the relation:

$$\beta = \frac{C + D + E}{a}$$

wherein ß is the normalized spring-back, C, D and E show the amplitude of respectively the second, third and fourth spring movement of the vehicle body and a is the height of fall. The amplitude of the first spring movement is not included in the evaluation of the damping since it is possible in the case of badly sprung and damped vehicles that in this first movement the limits of the spring path are reached, whereby no reliable picture results. A damping indicator γ is finally determined from the normalized spring-back ß. This indicator γ provides an easily applicable criterion for evaluating the action of the tested shock absorber. A value for this indicator that is too low will then result in the damper not being approved.

The spring movement of the vehicle could also be recorded optically instead of with the electromechanical movement recording shown. it is further possible to record the force of the wheels on the receiving plates in addition to or instead of the spring movement.

CLAIMS

1. Method for testing a shock absorber of a vehicle by lifting to a determined height above the ground at least one vehicle wheel (21) to which the shock absorber is connected for damping, relinquishing the wheel (21) to a free fall and recording a resulting resilient movement of the vehicle, wherein an indicator (ζ) of the damping is determined from the recorded resilient movement.

2. Method as claimed in claim 1, **characterized in that** several wheels (21) having a common axis are together lifted from the ground and released substantially simultaneously.

3. Method as claimed in either of the foregoing claims, **characterized in that** the resilient movement of a portion of the body of the vehicle close to the damper is recorded.

4. Method as claimed in claim 3, **characterized in that** the body portion is the wheel casing of the wheel (21) associated with the damper.

5. Device for testing a shock absorber of a vehicle provided with means (2) for lifting to a determined height above the ground at least one vehicle wheel (21) to which the shock absorber is connected for damping, control means (3) connected to the lifting means (2), recording means (4) for recording a movement of the vehicle and means connected to the recording means (4) for processing an output signal thereof.

6. Device as claimed in claim 5, **characterized by** means (10) connected to the control means (3) for holding fast the lifting means (2) in a position raised from the ground.

7. Device as claimed in claim 5 or 6, **characterized in that** the lifting means comprise air bellows (5) bringing about the lifting movement.

8. Device as claimed in claim 7, **characterized in that** each air bellows (5) is mounted in a helical draw

spring (28) which in its non-tensioned state holds the air bellows (5) in retracted position.

9. Device as claimed in any of the claims 5-8, **characterized in that** the holding means (10) comprise an electromagnet actuable by the control means (3).

10. Device as claimed in claim 9, **characterized in that** the lifting means (2) have the form of a lift, the main dimension of which is slightly greater than the width of the vehicle, and wherein an electromagnet (10) is arranged on either side of the lift (2).

11. Device as claimed in claim 9 or 10, **characterized by** a spacer member arranged between the magnet (10) and the lifting means (2)

12. Device as claimed in any of the claims 9-11, **characterized in that** the control means (3) comprise a capacitor (34) connectable in series to the electromagnet (10).

13. Device as claimed in claim 12, **characterized in that** the exciter coil (30) of the magnet (10) is incorporated in a first electric circuit with a first power source (31) and in a second electric circuit with a diode (32) and a capacitor (34) supplied by a second power source (33), and the control means (3) comprise a switch (37) for closing at choice the first or second electric circuit, this such that at switch-over the capacitor (34) is discharged over the exciter coil (30).

14. Device as claimed in any of the claims 5-13, **characterized in that** the recording means (4) comprise at least one arm 11 connected to a vertical guiding (26) by a connection (23) pivotable about a vertical axis, wherein the arm (11) is connected to a flexible member such as a cable (12) which is wound onto a rotatably mounted cable pulley (13) and is held in tensioned state by a biasing spring (15) engaging on the pulley.

15. Device as claimed in claim 14, **characterized in that** the pulley (13) is coupled to a coaxially arranged potentiometer (14) which generates an output signal

corresponding with the angle of rotation of the pulley and therefore the vertical position of the arm (11).

16. Device as claimed in claim 14 or 15, **characterized in that** the arm (11) comprises two parts mutually connected for swivelling (24) on a vertical swivel axis and a hook-like member (25) open to the top on its end.

17. Device as claimed in any of the claims 5-16, **characterized in that** this comprises receiving support members for each vehicle wheel, which receiving support members are arranged for free movement in a direction substantially parallel to the axis of rotation of the wheel.

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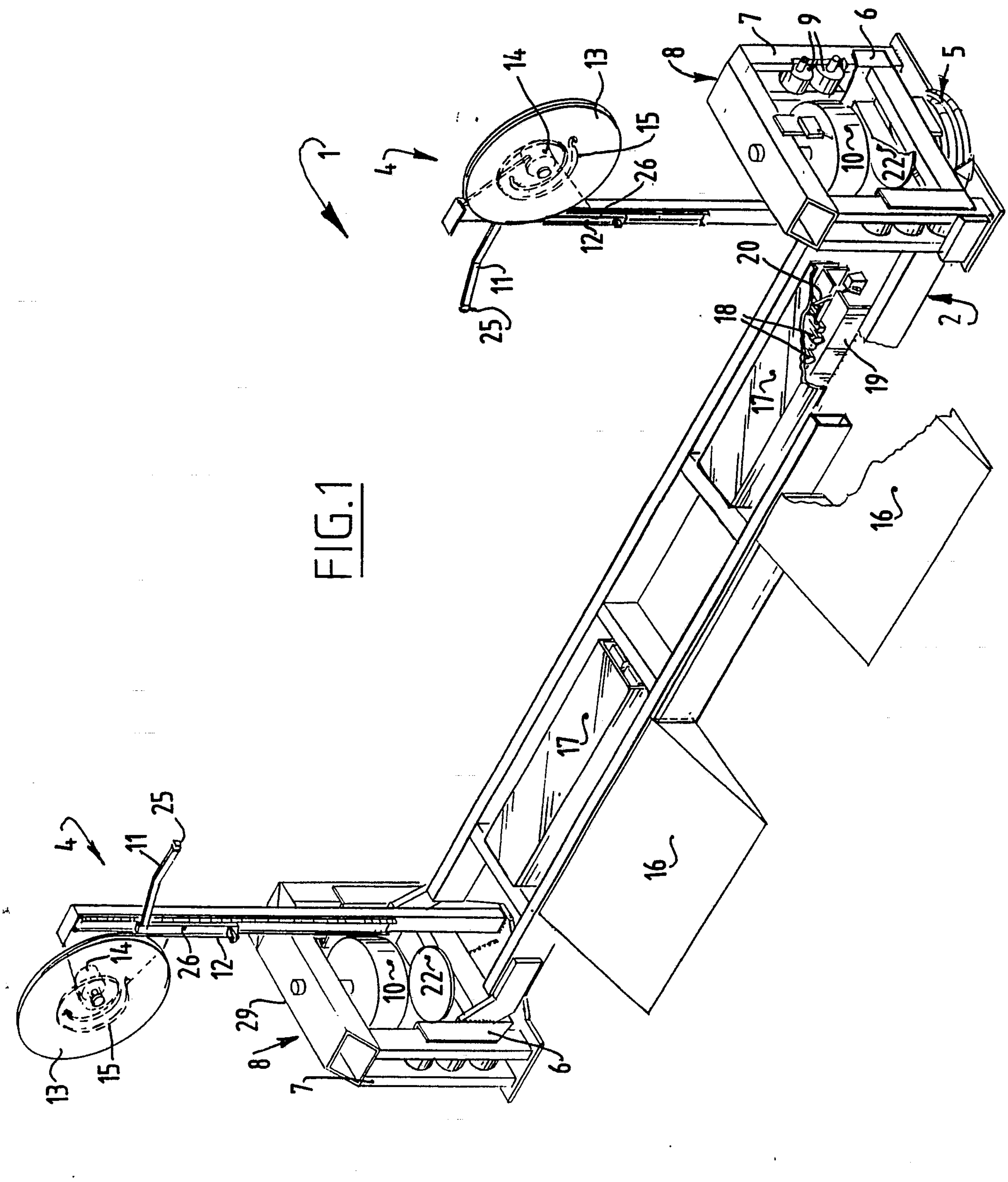

FIG.1

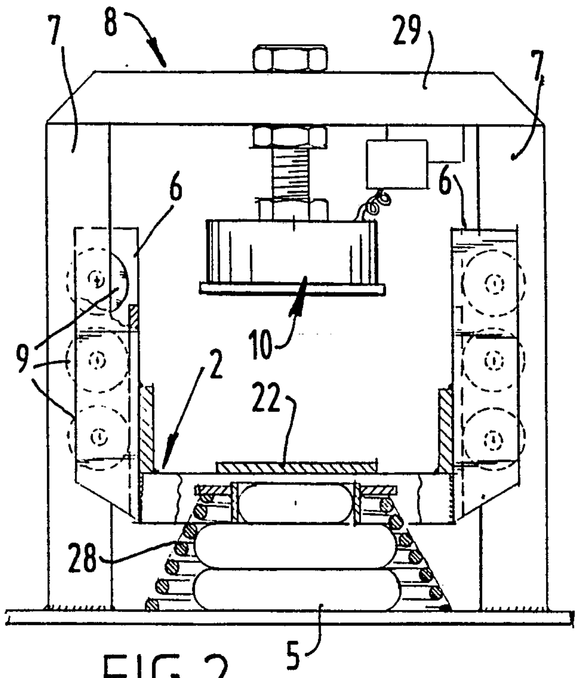

FIG.2

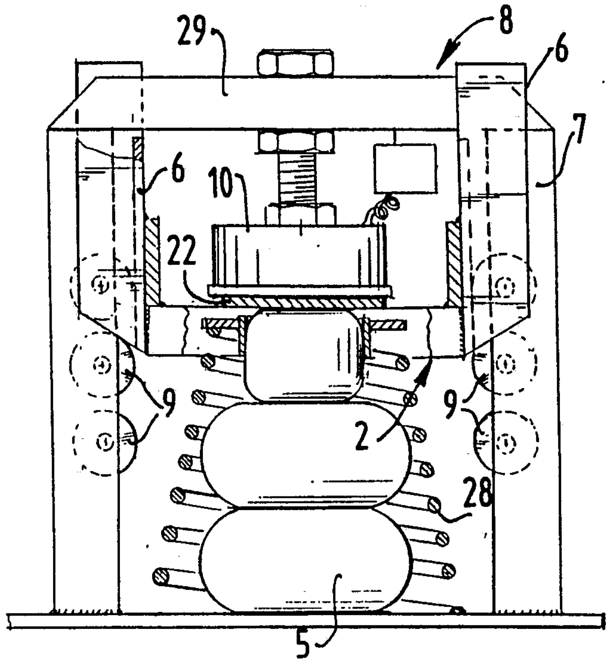

FIG.3

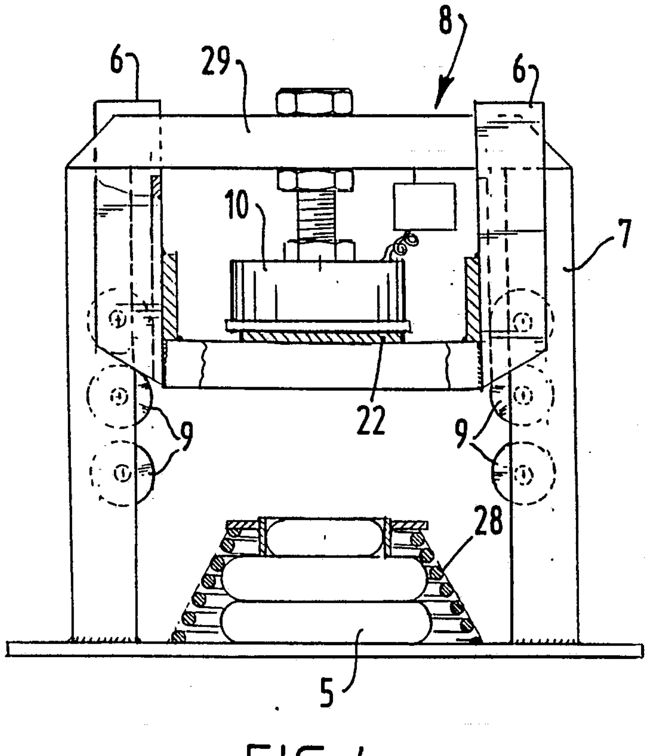

FIG.4

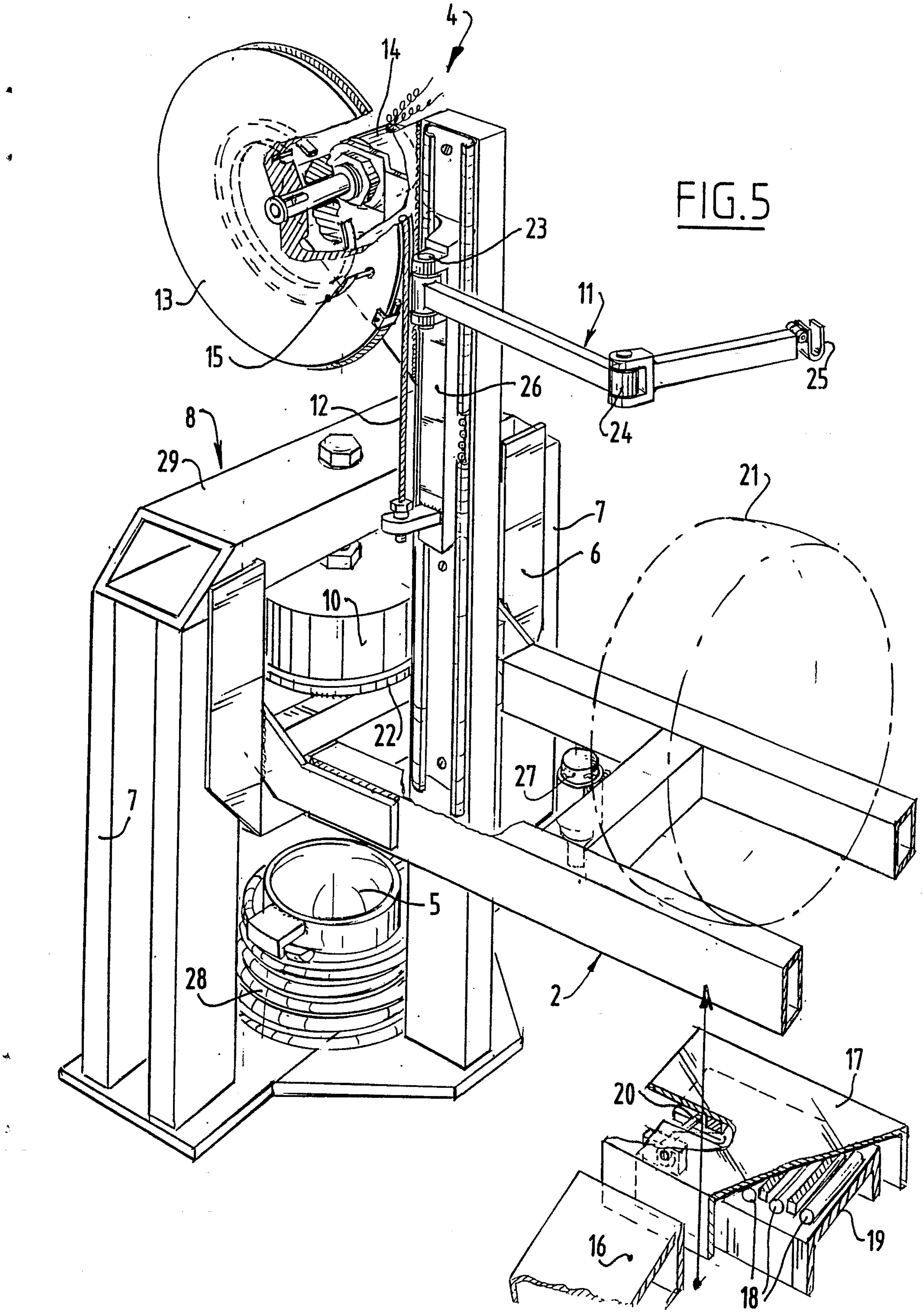

FIG.5

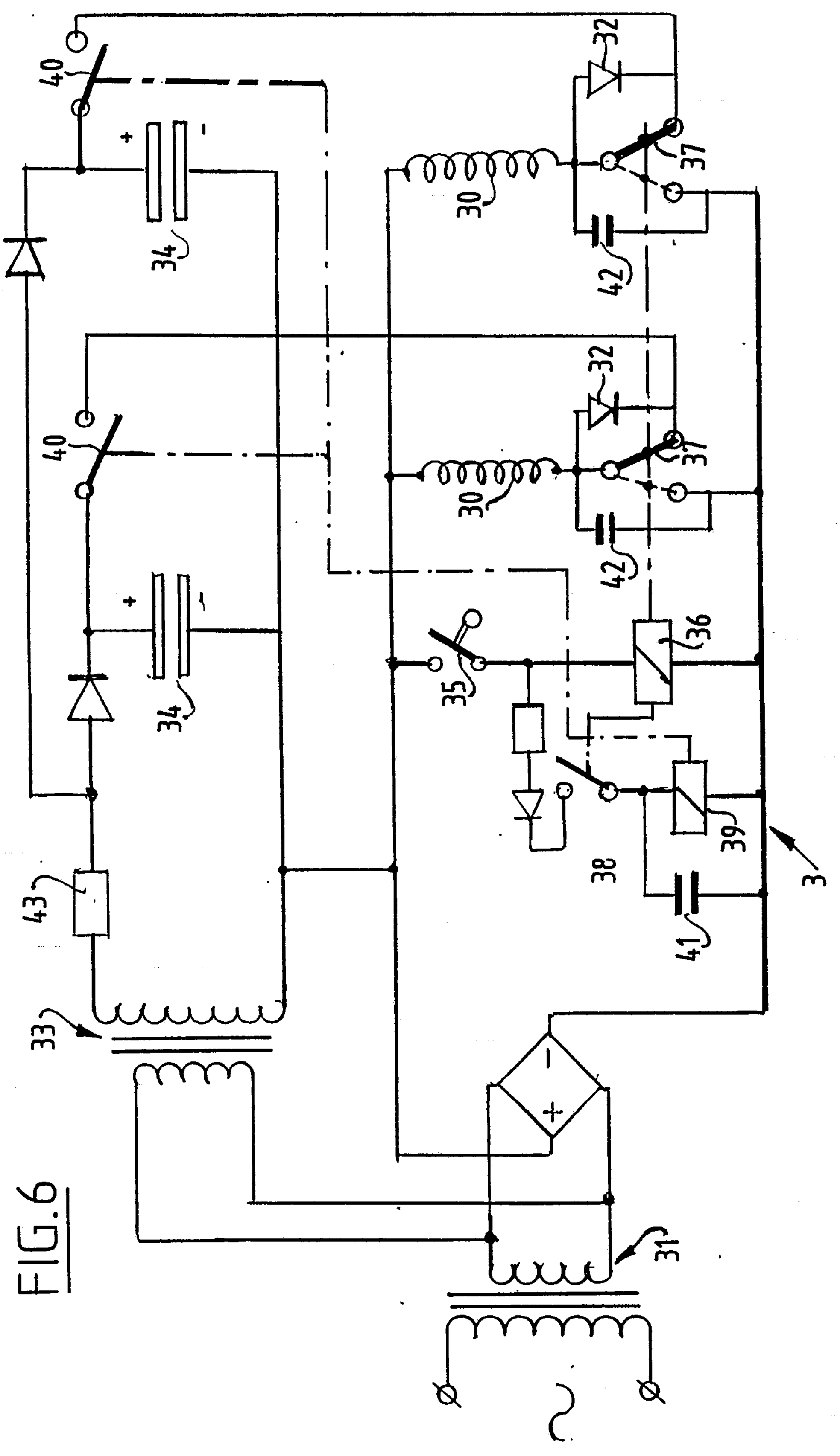

FIG.6

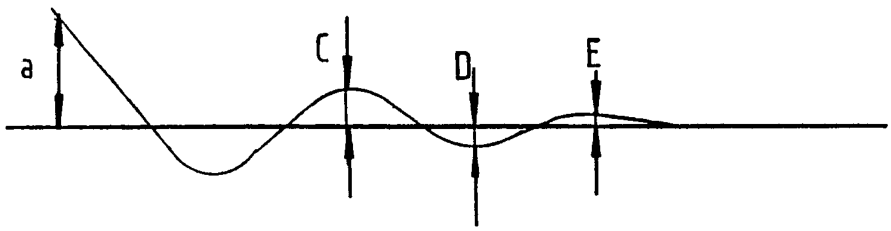

FIG.7

INTERNATIONAL SEARCH REPORT

International Application No PCT/NL 92/00122

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

Int.Cl. 5 G01M17/04

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	G01M

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

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]
X Y	DE,A,2 135 127 (LESLIE HARTRIDGE LTD.) 13 January 1972 see page 5, line 8 - page 6, line 27; claims 1-3; figures 1,4,5	1-4 6,10
X Y	US,A,3 906 779 (ROBERT PETER SAMUEL GRAHAM ET AL) 23 September 1975 see column 5, line 41 - line 61; claims 1,5-7; figures 8,9	1,2 6,10
A	FR,A,2 304 072 (DARLEY MAURICE) 8 October 1976 see page 3, line 25 - page 4, line 19; claims 1,7-9; figure 1	3-5, 14-16

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IV. CERTIFICATION

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Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
06 OCTOBER 1992	27. 10. 92
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FR-A-2304072	08-10-76	None	

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