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(71) Applicant: AB Samefa
Box 7 Granlidsvägen 4
S-736 00 Kungsör(SE)

(72) Inventor: Bergström, Hans Roar
Blomstervägen 2
S-736 00 Kungsör(SE)

(74) Representative: Nydell, Peder
Nydells Patentbyra Storgatan 57
S-392 31 Kalmar(SE)

(54) A method and apparatus for straightening deformed vehicle bodies.

(57) A method and apparatus for straightening a deformed vehicle body (1), in which a straightening force is applied to a deformed part (1a) of the body. In accordance with the invention the straightening force is given pulsations by means of a pulsatile force generator, e.g. a vibrator (12; 18) which is in force transfer connection with a straightening force transfer mechanism (10, 7, 9).

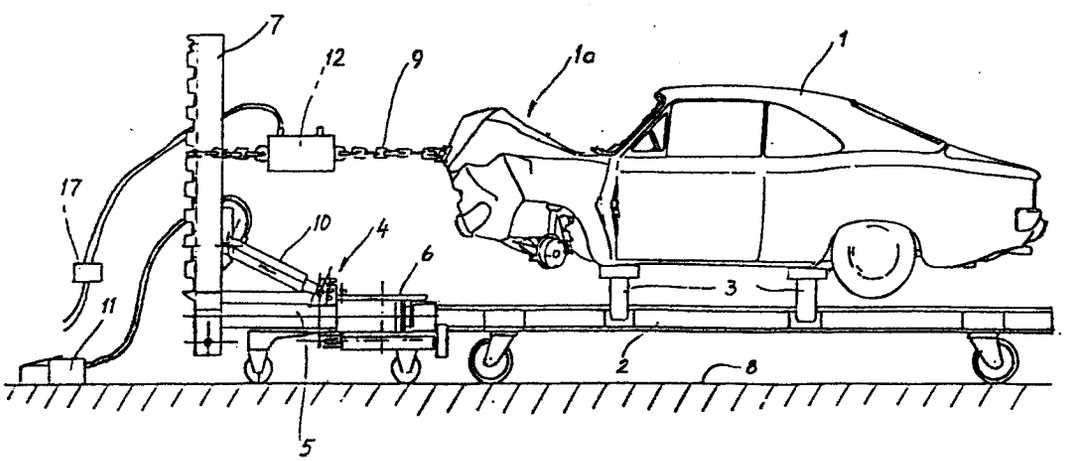

FIG. 1

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A method and apparatus for straightening deformed vehicle bodies

TECHNICAL FIELD

The present invention relates to a method for straightening av deformed vehicle body, in accordance with which a straightening force is applied to a deformed part of the vehicle body. The invention also relates to apparatus for straightening a deformed vehicle body in accordance with the method, this apparatus comprising vehicle-body attachment means for securing the vehicle body to a supporting surface, and a draw-straightening device capable of being secured to the supporting surface, the draw-straightening device including a plurality of straightening force transmission device, of which a first device is operative in generating a straightening force and the remaining transmission devices are adapted to transmit the straightening force from the first straightening force generating device to the deformed part of the vehicle body.

BACKGROUND PRIOR ART

All so-called draw-straightening devices used to straighten and repair impact-damaged vehicle bodies operate with a straightening force in the form of a mechanically, hydraulically or pneumatically generated traction force, which is applied to the damaged part of the vehicle body with the aid of a traction line, chain or rod, and co-operating clamps suitable for holding the damaged vehicle part steady when drawing-out metal body-work which has been buckled, dented, squashed etc. on impact.

The appplied straightening force changes in magnitude but very slowly and can be said rather to have a "static"

value. Normally, work is commenced by applying a relatively low traction force, for example a force of one ton, which is perhaps increased when necessary to 10 tons. Because the body plate-work of an impact-damaged vehicle has entrapped therein material stresses which are induced partly in the presses of the manufacturing workshops and partly as a result of the impact, the traction required to straighten the deformed plate is normally so high as to result in the fracture and dismembering of metal components during the work of straightening the vehicle. In an attempt to release these stresses in the material and to restore the elasticity of the metal plate, it is normal hitherto to subject the damage part of the vehicle body to tension releasing impact blows, e.g. by means of so-called spring hammering, while simultaneously placing the damaged vehicle part under pressure or stretch.

When straightening plates it is also known from for instance the U.S. patent specification No. 1,732,098, to transmit shaking movements to a clamping means for the plate, the direction of the shaking movements being perpendicular to the static stretching force. This means that the direction of the static stretching force will vary in response to the present location of the oscillating clamping means. The stretching force has, however always a constant value during the oscillation of the clamping means.

Hammering or shaking of the damaged part has not always been found to provide a satisfactory result, however.

DISCLOSURE OF THE INVENTION

The object of the invention is accordingly to provide a method and apparatus of the aforesaid kind which afford automatic release of the stresses in the material much

more effectively that is achieved with hammering methods.

This object is achieved by a method and apparatus according to the invention having the characterizing features set forth in the characterizing clauses of respective claims 1 and 5.

Further developments of the invention are set forth in the dependent claims.

In accordance with the invention the straightening force is given pulsations in the direction of the straightening force, whereby vibrations are produced in the material of the vehicle bodywork such as to obtain automatic release of the stresses acting therein. These vibrations also propagate to metal parts hidden within the conventional lattice work of vehicle bodies, thereby producing a more total tension-release effect than has hitherto been possible with conventional methods. The present invention enables deformed vehicle structures to be straightened more readily than was previously the case with smaller auxiliary tractional loads, when seen in total. It will be understood by the skilled person in this art that mutually different, desirable effects can be achieved, simply by controlling the frequency and shape of the pulses generated.

Because the tensions trapped in the metalwork are released more readily when practicing the invention, it is possible to maintain the requisite "static" tractional force over a longer period of time, thereby enabling the vehicle-body straightening equipment to be dimensioned in a more suitable and less expensive manner. Accordingly, the method and device of this invention makes it possible to decrease the force that must be applied for straightening and hence decreasing equipment size, and stress relieving the damaged area of the body so that it can be

straightened without exceeding its yield strength and/or fracturing the metal components of the body.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail with reference to the accompanying drawings, which illustrate three mutually different embodiments of the invention.

Figures 1-3 illustrates schematically and in side view the manner in which vehicle-body straightening operations are carried out on an impact-damaged vehicle where a pulsatile amplitude of the straightening force employed is applied in accordance with three embodiments of the invention. Figures 4 and 5 are enlarged sectional views illustrating more clearly a vibrator incorporated in the illustrations of Figure 1 and Figure 2. Figure 6 is a diagram illustrating different pulse forms of the straightening force.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figures 1-3 illustrate an impact-damaged vehicle body 1 which is secured firmly to a supporting structure in the form of a wheeled straightening bench 2 in definable positions thereon by means of four conventional work-holding attachments 3 which can be displaced along the bench 2 to selected lockable positions thereon and which are brought to bear on the vehicle body 1 through a respective sill-box not shown. A conventional wheel-carried draw-straightening device 4 comprises a substructure 5 which incorporates an anchoring section 6 rigidly connected to the straightening bench 2. A draw-straightening arm 7 is pivotally connected at one end thereof to the substructure 5.

The straightening bench 2 and the draw-straightening

device 4 can thus be moved as a unit along the workshop floor 8 or like foundation surface. It is conceivable in accordance with the invention to dispense with the bench 2 and instead to secure the vehicle body 1 and the draw-straightening device 4 to the workshop floor 8 for example, which can be provided to this end with appropriate attachment rails or like devices.

A draw chain 9 is connected in a conventional manner between the arm 7 and a damaged part 1a of the vehicle body to be straightened. A piston-cylinder device, for example a hydraulic or pneumatic pushing piston-cylinder device 10 is connected in a known manner between the substructure 5 and the arm 7. There is created in the piston-cylinder device 10 with the aid of a foot-operated hydraulic or pneumatic pump 11 a straightening force in the form of a pushing force which strives to move the arm 7 to the left in Figures 1-3, so as to exert a tractional force on the damaged vehicle part 1a. The piston-cylinder device 10, the draw-straightening arm 7 and the chain 9 thus form a series of straightening-force transmission means for transferring a straightening force to the damaged vehicle part 1a.

Since the described components 2-11 are of a kind generally known per se, it is not considered necessary to describe the nature of these components or their operational modes in more detail.

In the preferred embodiment illustrated in Figure 1, a pulsatile force generator, for example a vibrator 12, is incorporated in the chain 9 at a broken location along the length thereof between the arm 7 and the vehicle part 1a, such as to be in force-transmitting connection with said chain, the vibrator 12 being connected to the open chain-ends 9a and 9b as illustrated in the enlarged view of the vibrator 12 shown in Figure 4.

The vibrator 12 comprises a housing 13 having an inlet part 14 and an outlet part 15 for pressurized air. A weight or mass 16 in the form of a cylindrical steel body or the like widened at one end thereof is arranged for movement backwards and forwards in the housing 13 in response to the influence of pressurized air introduced thereto through the agency of air-flow switching valves not shown, said weight producing an impact force each time it moves to the right in the figure. Such vibrators, which are normally controlled by a control unit, illustrated schematically at 17 in Figure 1, are known to the art and need not therefore be described in detail here. It should suffice to mention that control unit 17 has an ON-OFF switch and a knob for the setting of the frequency.

The impact created by the weight 16 transmits a pulsatile force to the straightening force applied by the piston-cylinder device 10, imparting to the straightening force pulsations which are transmitted to the damaged vehicle part 1a through the chain 9.

An alternative embodiment is illustrated in Figure 2, in which a vibrator 18 is rigidly connected to the free end of the straightening arm 7. As illustrated in Figure 5, the vibrator may alternatively be rigidly connected to the arm 7 at a distance from the free and thereof. The vibrator 18 may be of the kind promoted by Netter Vibrationstechnik, Federal Republic of Germany, under designation PKL.

The vibrator 18 comprises a percussion piston 19 which is urged towards a spring 20 under the influence of pressurized air which is introduced through an inlet port 21 from a control device 22, of the same kind as control unit 17 above, and schematically illustrated in Figure 2, and which by controlled switching of the direction of air

flow with the aid of air valves causes the percussion piston 19 to oscillate back and forwards against a percussion plate 23, which thus transmits a pulsatile auxiliary force to the straightening arm 7, acting to the left in Figure 5.

According to a further embodiment of the invention illustrated in Figure 3, pulsation of the straightening force is effected with the aid of a schematically illustrated piston 24 which, by means of an auxiliary device 25, not described in detail, is caused to oscillate within the working medium of the piston-cylinder device 10 to produce pulsations in said medium.

The pulsations generated by the components 10, 18 and 24 are given a frequency, which is suitably variable. A preferred frequency range has been found to lie within the acoustic frequency range. Tests have shown that oscillation frequencies beneath 1000 oscillations per second, preferably beneath 100 oscillations per second provide extremely good results in releasing the tension in the vehicle body. Other frequencies, however, are also conceivable within the scope of the invention. The phrase "releasing the tension" here means relieving the stresses induced in the metal of the damaged area due to work hardening both during impact causing the damage and the pulling and straightening of the damaged area.

Figure 6 illustrates a number of differenct curve forms of the straightening force P as a function of time t capable of being achieved by means of the invention. The reference 26 identifies the "static" straightening force generated by the piston-cylinder device 10. The pulses emanating from the apparatus components 10, 12, 24 can be dimensioned to provide a pulsatile force which can either be superimposed on "static" straightening force as an addition thereto (auxiliary force), as illustrated by

curve form 27, or can lie alternately above and beneath the value of the "static" straightening force, i.e. in some form of modulation of the straightening force, as illustrated by curve form 28. The pulsations 27 and 28 are shown here as rapid fluctuation of the nature of noise fluctuations.

The pulsations can be given a steep, pointed wave form, as illustrated by curve forms 29 and 30. The pulse form 29 may therewith have a constant frequency and the pulse form 30 a changeable frequency.

By varying, for example the form of the pulse flanks, it is possible to produce pulses of mutually differenct duration. This can be effected in the embodiments illustrated in Figures 4 or 5, by varying the damping of the return movement of the oscillating weight. An example of a pulse form in which the pulses have been given an extended duration is shown at 31.

The reference 32 identifies a conglomeration of pulses of differing frequencies, obtained by the mutual co-action of a plurality of pulsatile force generators, or in some other way known to those skilled in this art.

The pulse form can also be dimensioned with a view to achieve resonance frequencies characteristic of the material under treatment.

Although the illustrated and described embodiments of the pulsating and vibrating forces have been shown to be obtained by mechanical, pneumatic and hydraulic means, they can, of course, also be produced electrically. It will also be understood that the pulse form and frequency can be controlled electrically, for example by data monitoring techniques.

Claims

1. A method for straightening a deformed vehicle body (1), in which a straightening force is applied to a deformed part (1a) of the body, characterized by applying pulsations to the straightening force, such that the value thereof alternately increases and decreases.

2. A method according to Claim 1, characterized by giving the pulsations a frequency within the acoustic frequency range.

3. A method according to any one of the preceding claims, characterized by giving the pulsations a variable frequency.

4. A method according to any one of the preceding claims, characterized by giving the pulsations a variable curve form.

5. Apparatus for carrying out the method according to Claim 1 when straightening a deformed vehicle body, comprising holding attachments (3) for securing the vehicle (1) to a vehicle-body supporting surface (2), a draw-straightening device (4) capable of being secured to the supporing surface (2), the draw-straightening device (4) comprising a plurality of straightening force transmission means (10, 7, 9) of which a first (10) is able to generate a straightening force and of which the remaining straightening force transmission means (7, 9) are arranged to transfer the straightening force generated by said first device (10) to the deformed part (1a) of the vehicle body, characterized by a pulsatile force generator (12; 18; 24) in force transfer connection (9; 7; 10) such as to impart pulsations to the straightening force, such that the value thereof alternately increases and decreases.

6. Apparatus according to Claim 5, characterized in that said first straightening force generator is capable of generating said straightening force with the aid of a working medium under pressure, and in that the pulsatile force generator (24) is arranged to pulsate the pressure exerted by the pressurized medium, to thereby obtain said pulsations of the straightening force.

7. Apparatus according to Claim 5, characterized in that the pulsatile force generator (12; 18) is in force transfer connection with one (9; 7) of said further straightening force generators in a manner to provide said pulsations of the straightening force.

8. Apparatus according to any one of Claims 5-7, characterized in that the pulsatile force generator (12; 18) is a vibrator.

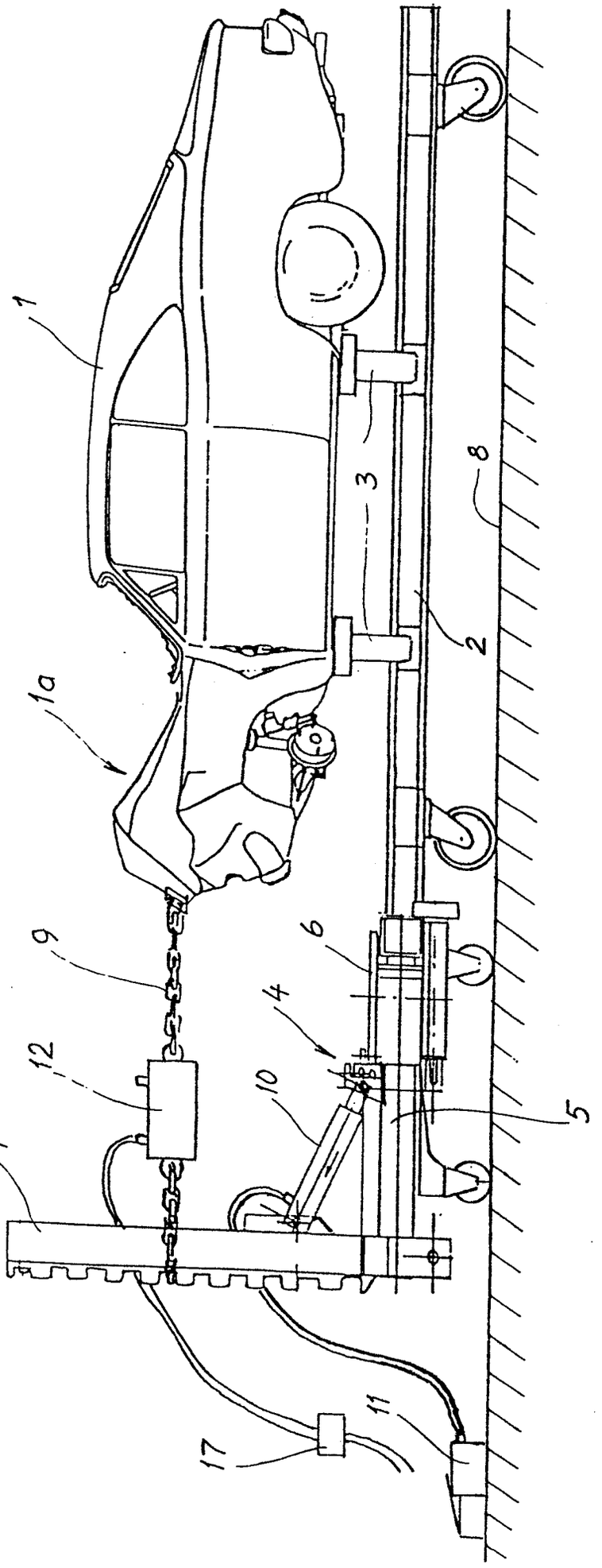

FIG. 1

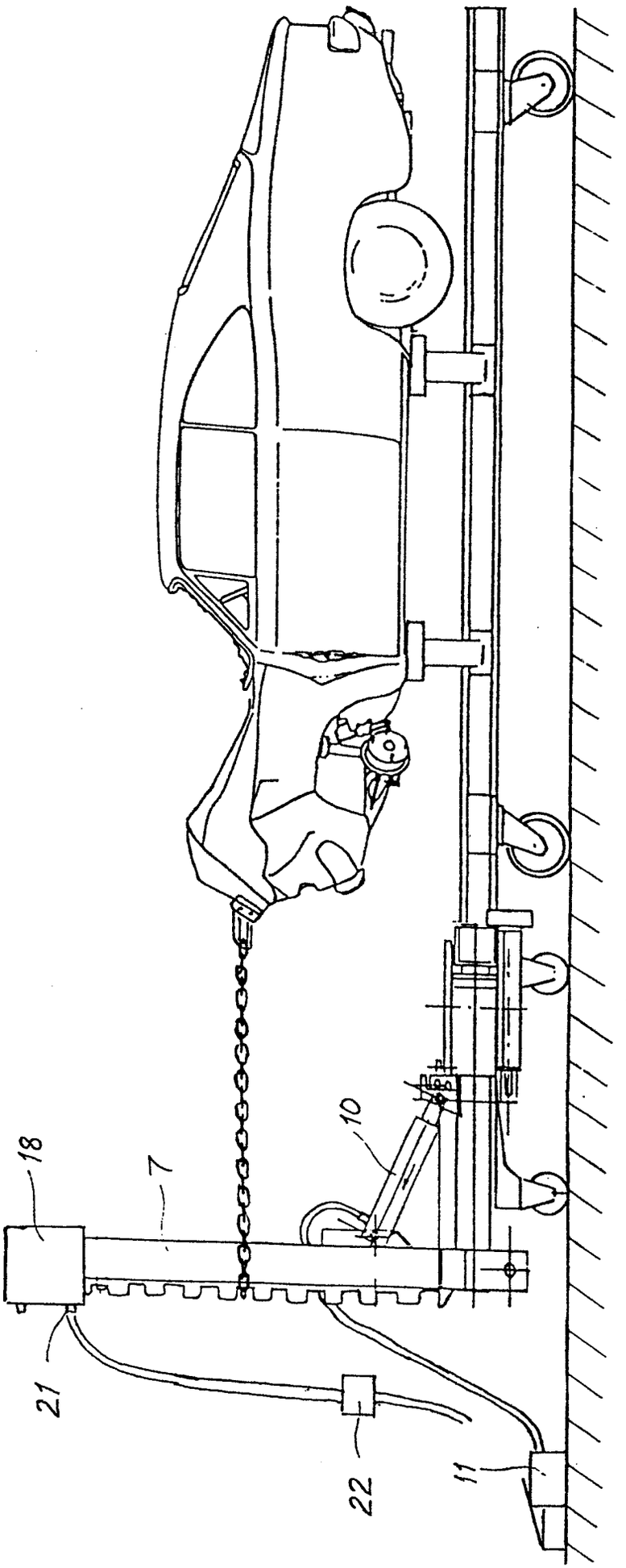

FIG. 2

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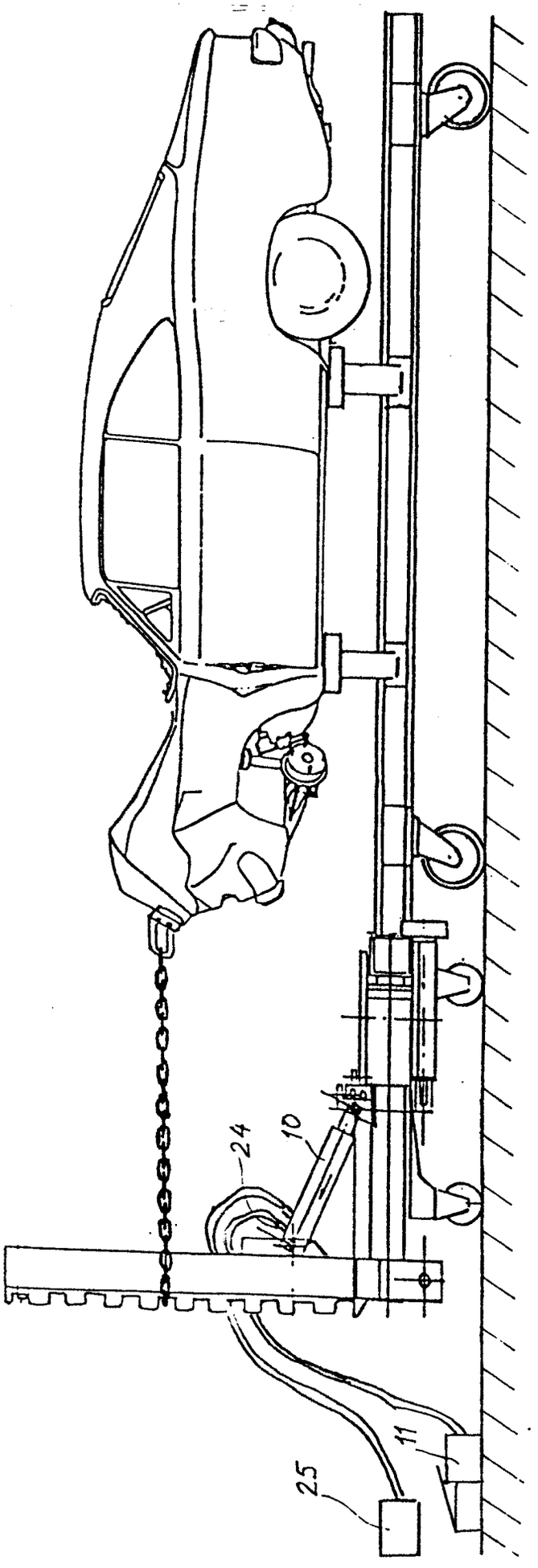

FIG. 3

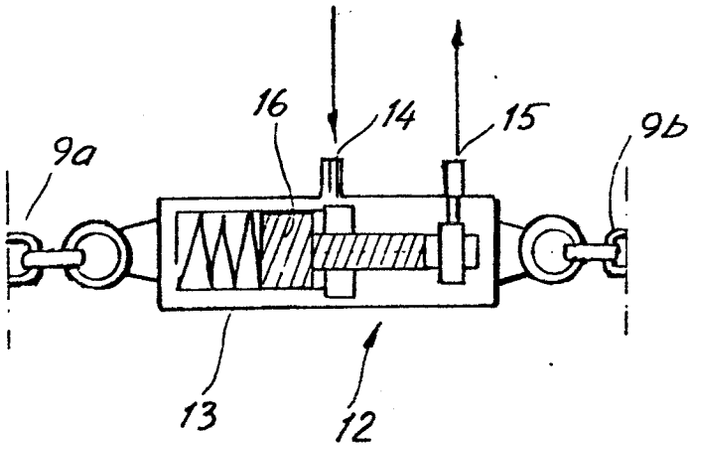

FIG. 4

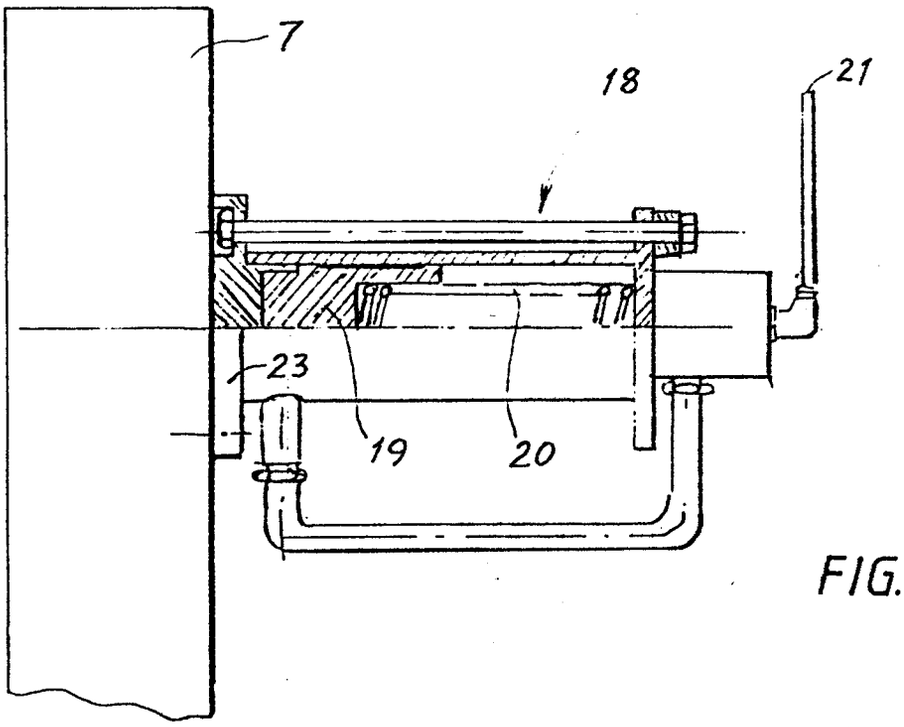

FIG. 5

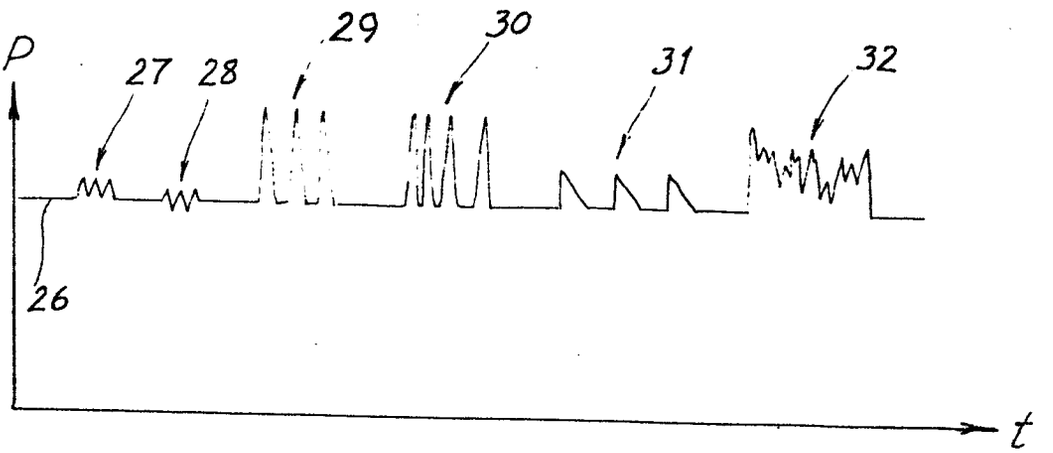

FIG. 6