Dec. 19, 1939. E. H. GODFREY 2,183,558

DECOMPRESSION DEVICE

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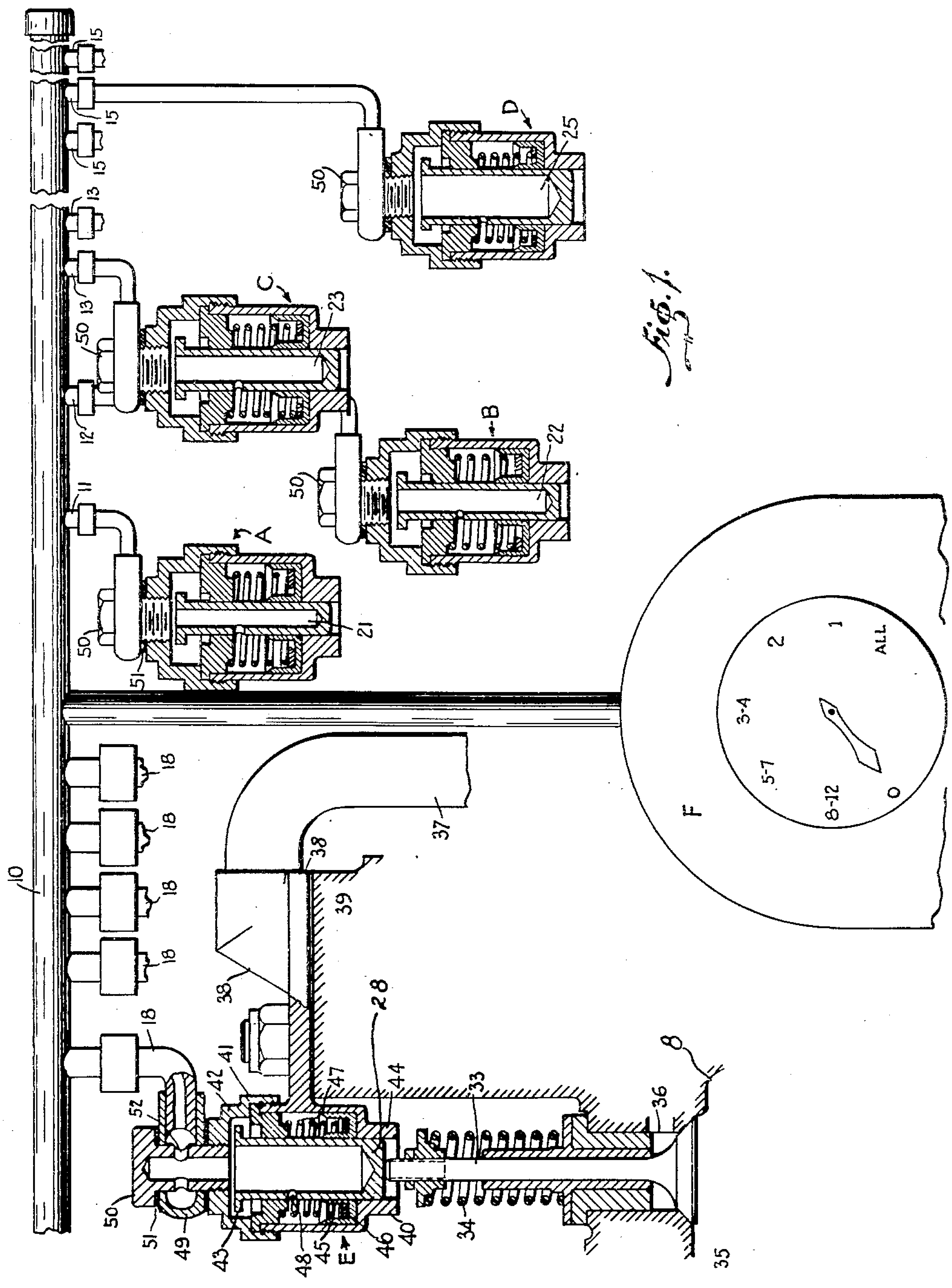

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DECOMPRESSION DEVICE

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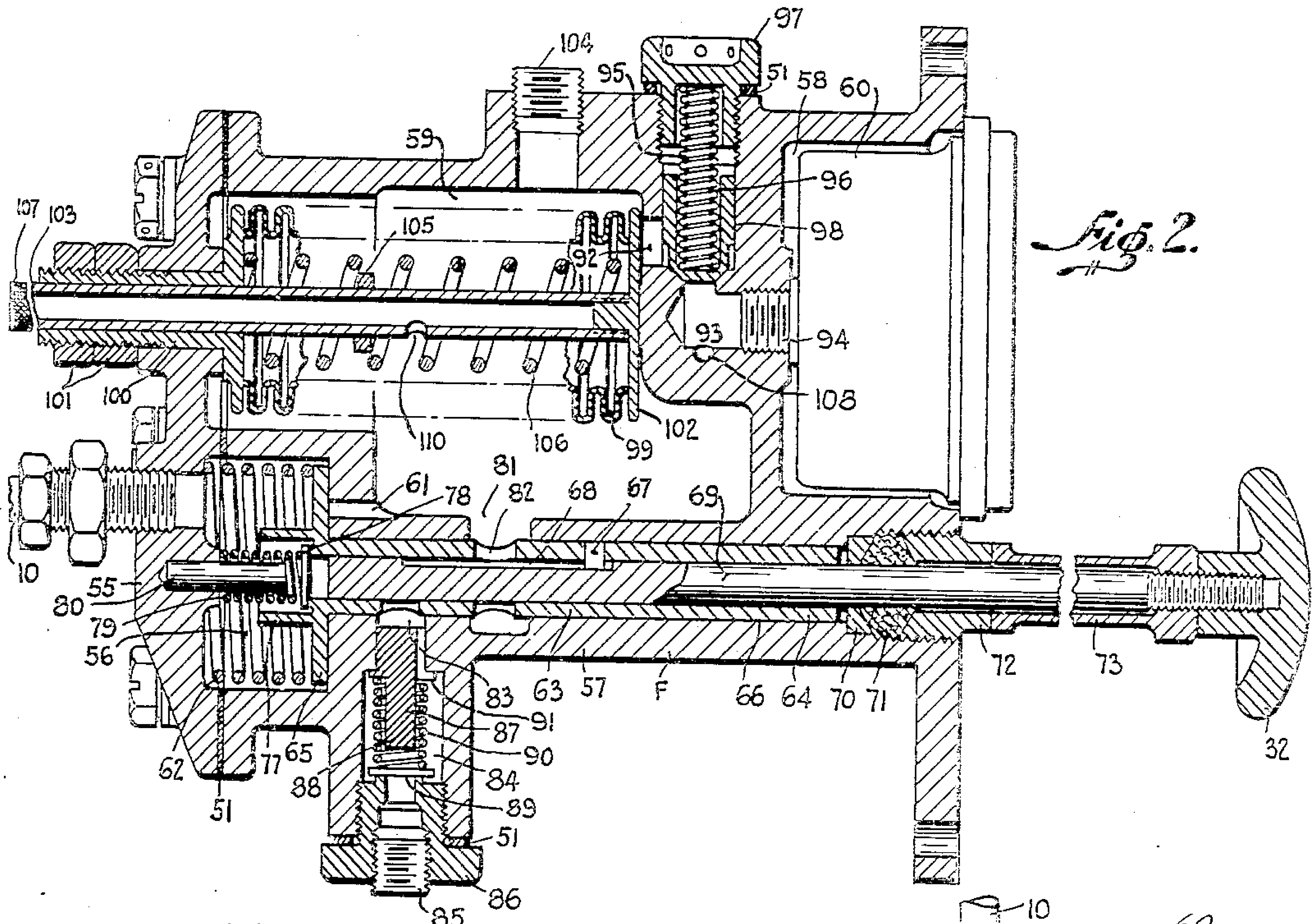

Fig. 2.

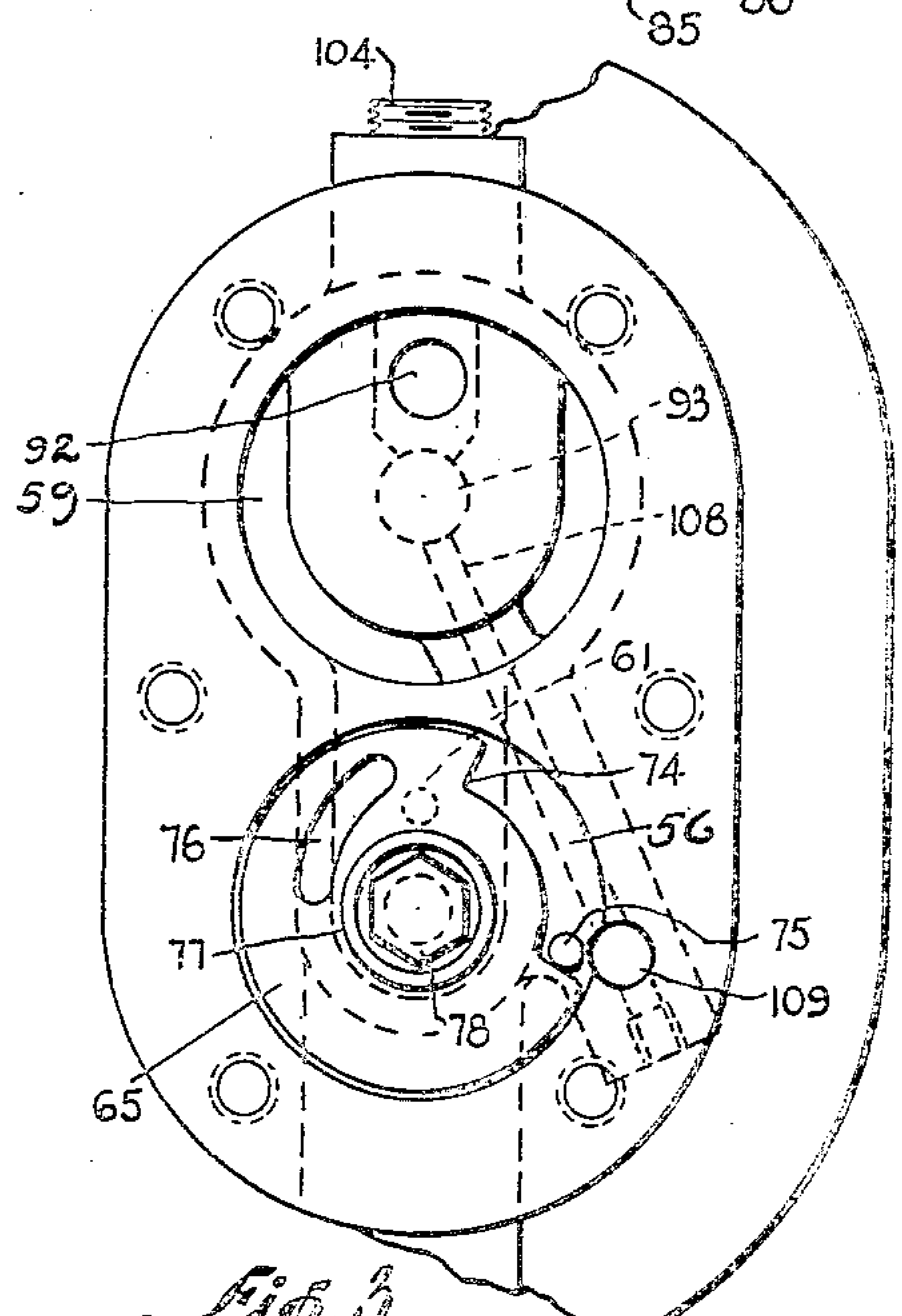

Fig. 3.

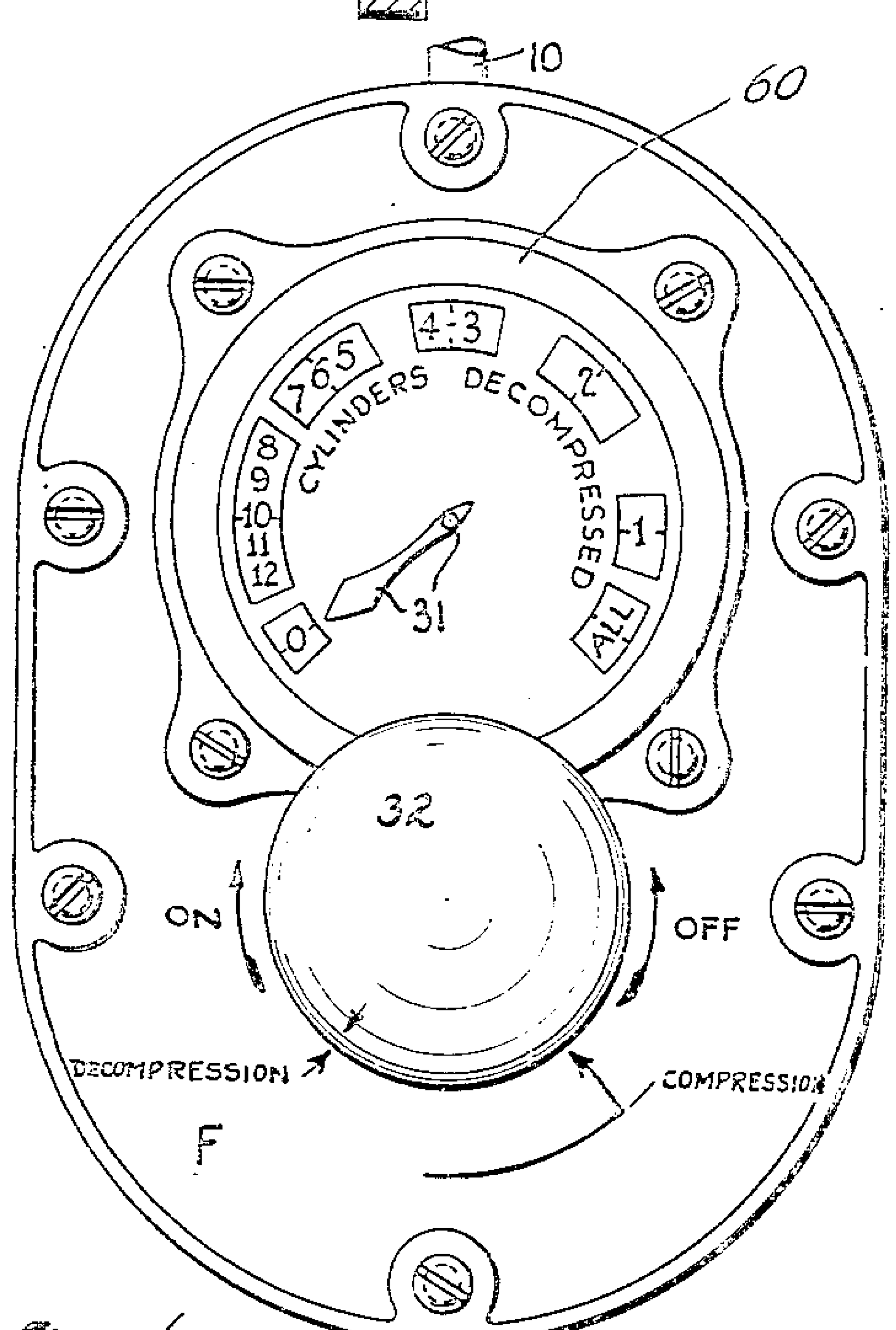

Fig. 4.

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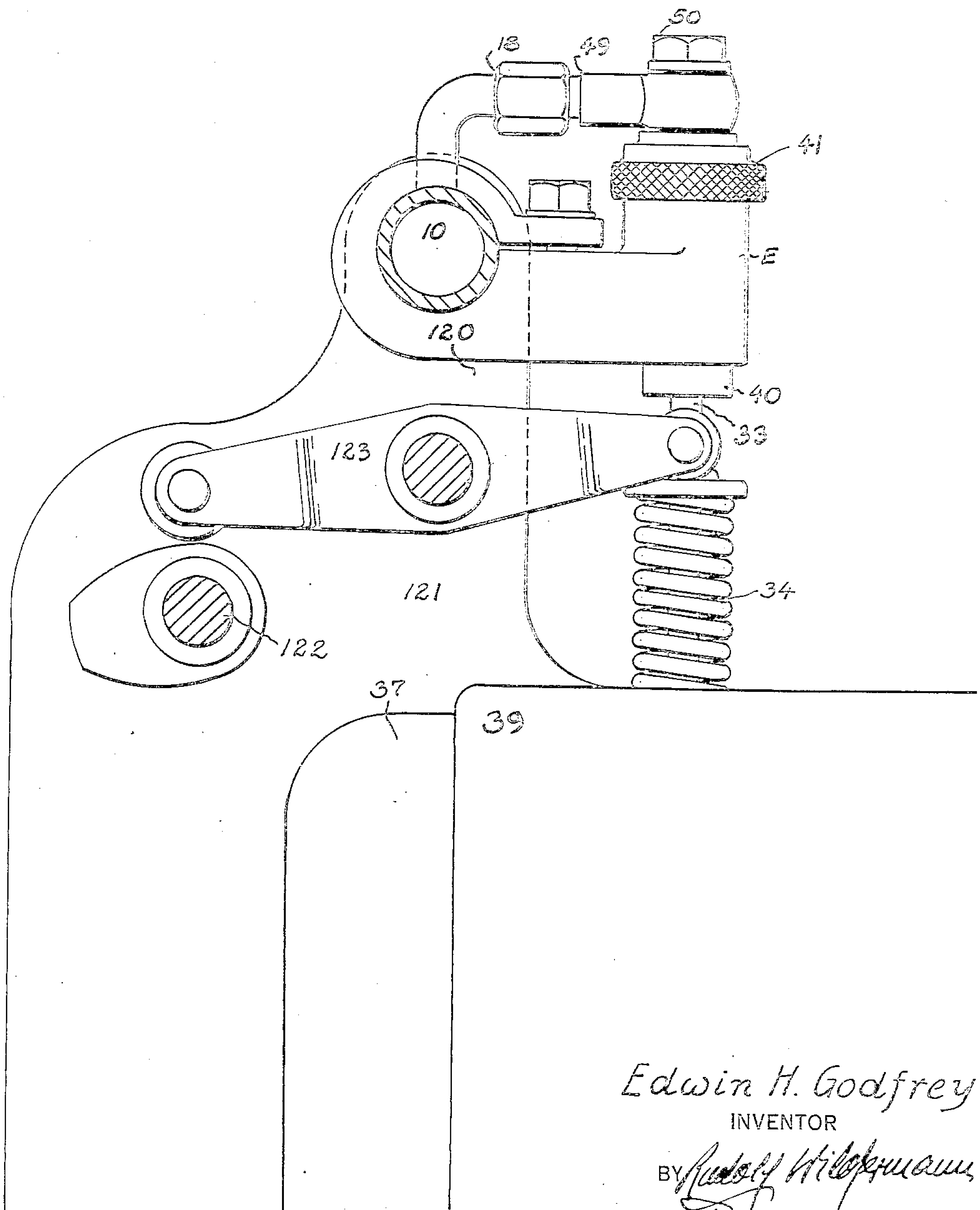
Fig. 5.



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UNITED STATES PATENT OFFICE

2,183,558

DECOMPRESSION DEVICE

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Application March 6, 1937, Serial No. 129,486

18 Claims. (Cl. 123—182)

This invention concerns a decompression device which may be of principal use in connection with engines, in order to eliminate in a cylinder various phases of pressure or the highest compression and suction occuring during each cycle of the operation of an engine.

The cylinder of an engine may be decompressed by opening the priming port thereof; the degree of decompression depends in that instance largely upon the dimensioning of the priming cup passage, the cylinder being the more effectively decompressed, the less obstruction the priming cup passage offers to circulation of gases.

In the past auxiliary arrangements in connection with the cam shaft have also been known, which made it possible to extend the period of opening of the exhaust valves, or even lock the exhaust valve in an open position, thus permitting free circulation of gas and air in both directions through the exhaust valve so that the cylinders were substantially decompressed.

These examples of decompression in the prior art have been cited in order to define the subject matter of the instant invention, and also in order to indicate the desirability of decompression devices.

Decompression of a cylinder is useful for the purpose of tuning it in, for checking the performance of various machine elements, for cleaning and for the purpose of starting. With the growing popularity and power of engines involving high compression, such as Diesel engines, compression becomes an important factor of load, setting up torque in opposite directions and rendering it difficult to turn the engine over without the help of its own power. A starting mechanism may well be able to turn an engine over, after the starting mechanism as well as the engine have gathered momentum, but it may not be able to overcome initially the added load of compression. Under such circumstances it may be highly desirable to have the engine completely decompressed at the very start;—then to place one cylinder under compression and into full operation, so that it may assist the starting mechanism in rotating the engine, and then to place, singly or in banks, other cylinders under compression, at random as to number and as to chronological order.

The instant invention provides for decompressing and for restoring compression in the cylinders of an engine in such deliberate starting order, at will, in a simple operation. But such an object is not attained by encumbering the mechanism of an engine, and by adding hazards in imposing additional duties and complexities upon the elements of an engine, which are known to perform best when restricted to their prime function. This applies in particular to conditions of operations, under which failure of engine elements may be fatal, e. g. in engines applied in warfare and aviation.

Thus it has been an important object of this invention to introduce a decompression device in engines supplementarily rather than complementarily, and still to provide positive flexibility.

An added object of this invention, which again applies particularly in aviation, but will also prove of good general use, is remote control. Here there is also entertained an added object, in accordance with which for purposes of flexibility, the control conduit connecting a control station with the engine, should be flexible, adapted for simple and rugged arrangement, and should preferably transmit by way of a single conduit and in a positive manner, so that the operator may simultaneously control the decompression in individual standards or groups of cylinders ad libitum.

In stationary as well as in mobile engines hydraulic control means are found most suitable for all requirements. Objects relating to such control in particular, and other objects of this invention become apparent and will be more understandable in connection with the details and description of an exemplary application of the principles of the invention illustrated in the accompanying drawings, in which:

Fig. 1 shows, in partly sectioned elevational views, various decompressors, part of the cylinder of an engine being shown in connection with one of these decompressors which are all schematically coordinated in a conduit system comprising a control device shown in a front view.

Fig. 2 illustrates the exemplary control device in a longitudinal cross-section.

Fig. 3 shows a rear view of the control device. The back cover, together with the parts attached thereto or retained thereby, are removed.

Fig. 4 is a full front view of the control device, which is merely indicated in Fig. 1.

Fig. 5 illustrates by way of one end view of a cylinder of an engine how a decompression device of this invention may interlock with the exhaust valve control of an engine.

Similar numerals refer to similar parts throughout the various views:

While the decompression device is not to encumber an engine and the environment thereof with a multiplicity of rigid connecting and transmitting parts and while it is desirable to provide such flexibility in the system that the control device may even be moved relatively to the engine, the system must be dependable, positive and must react accurately and spontaneously to the control exercised by an operator. In the exemplary showing of the drawings hydraulic control means serve such objects; they may however be replaced by other types of control, as long as they provide the same reliable action and flexibility.

The decompressor on each cylinder may bring about communication with the outside, i. e. the atmosphere, by way of a special port and valve, e. g. in the manner of a priming cup and valve of the old art. But as a measure of expediency there is shown the decompressors to be connected in the drawings to the exhaust valves. Fig. 1 shows exemplarily the decompressors A, B, C, D and E, of which A has the smallest hydraulic piston; the decompressors B, C, D and E have, respectively, larger pistons 22, 23, 25 and 28. While each piston reacts against the same uniform pressure, e. g. the spring of a standard exhaust valve, they are dimensioned so that they overcome that pressure at respectively preterminedly varying pressures in a common hydraulic conduit, i. e.: The decompressor E overcomes the reaction of the spring of the respective exhaust valve at a predetermined pressure above the atmosphere; successively the other decompressors D, C, B, and A,—in accordance with the respective piston diameters,—overcome such reaction at substantially fixed steps (say 20 pounds) of increasing pressure in a common hydraulic system. Such a common hydraulic system is indicated by the manifold 10 which connects to a remote hydraulic pressure control device F. The decompressors A, B, C, D and E are connected through this manifold by branch conduits 11, 12, 13, 15 and 18, respectively.

It should be noted that such an arrangement does not change the standard equipment of an engine and can therefore not affect its function, since normally, i. e. under full operation when the decompressors are out of action,—the exhaust valves perform in their usual relationship to the valve spring and other valve control elements. When decompression is removed the valve spring will push the decompressor piston into an inactive position in which it remains; thereafter the engine functions normally and is completely severed from and in every respect independent of the decompression device.

All decompressors may be constructed alike, a converse arrangement is resorted to, in which the reactions vary in order to allow removal of decompression at various pressures in the hydraulic system; thus, for intsance, the exhaust valve springs may vary in strength from each other. But under those circumstances factors are introduced which alter the functions of the engine, thus causing the loss of one of the objects.

A separate set of varying springs, superimposed upon the decompressors only, may by those acquainted with these arts be introduced in order to avoid varying piston diameters. The latter are however preferred by inventor in order to forestall the notorious disadvantages involved in the use of springs.

Five different sizes of decompressors have been exemplarily chosen in order to indicate the arrangement contemplated in connection with a 12-cylinder internal combustion engine.

Since the rotation of decompression is to be affected in accordance with varying pressures, the pressure gage of the control device F is calibrated for single cylinders or groups thereof which decompress as the hand 31 swings clockwise to the right in response to increasing pressures. By manipulation of a handle 32 arranged upon the control device F underneath the dial of the pressure gage, the operator may at random increase and decrease the pressures in the manifold 10, of the hydraulic system.

Let us number the cylinders from 1 to 12 in the rotation in which they are exemplarily to be decompressed. When hand 31 points to the extreme right, all twelve cylinders of the engine are decompressed; then the operator may for instance successively place two cylinders under compression, then two more together; then three, and finally the remaining five cylinders. At first there is a highest compression in the manifold 10, the hand 31 pointing to the legend "All" of the dial, indicating that all decompressors are actuated and all cylinders are decompressed. As the operator releases pressure from the hydraulic manifold or system, the hand 31 recedes to the position of the dial, referring to cylinder 1, at and below which position the small hydraulic pistons 21 of the decompressor A fails to withstand the reaction of the respective exhaust valve, allowing the valve to close.

At the next position 2 of the dial the second cylinder is placed in a state for operation (proceeding on the dial in counter-clockwise direction), because piston 22 of decompressor D fails to retain the exhaust valve of the second cylinder in an open position.

Two branches 13 issue from the manifold 10 and are connected to two decompressors of the type C, although only one such compressor C is shown in detail, as well as in connection with type D and E compressors hereinafter. The two decompressors C are arranged in connection with cylinders 3 and 4, so that these two cylinders are placed under compression, when the hand 31 sinks to the position 4—3 in counter-clockwise direction, as the operator effects a further drop of pressure. The next position 7—5 of the dial relates to cylinders 5, 6 and 7; the exhaust valve of each of these cylinders is under control of a decompressor D, as indicated by three branch conduits 15 issuing from the manifold 10. The decompressors D allow the exhaust valve of cylinders 5, 6 and 7 to close, when the hand 31 passes in counter-clockwise direction to the position 7—5.

The remaining cylinders 8, 9, 10, 11 and 12 are controlled by decompressors E, which are respectively connected by branches 18 to the hydraulic manifold 10. The decompressors of cylinders 8 to 12 release the exhaust valves of these cylinders from an inactive open position, when hand 31 swings through the position 12—8 of the dial in a counter-clockwise direction, and from that position to the zero position 0 of the dial the engine is in a fully operative position as far as compression is concerned, all decompressors being inactive.

In connection with the one compressor E shown,—such a decompressor being arranged on each one of the cylinders 8, 9, 10, 11 and 12,—the pertinent parts of the cylinder of an engine are also illustrated, and the decompressors will be generally described in connection with the particular showing:

By way of connections to the cam shaft known to those acquainted with this art (not shown) the exhaust valve 33 of a cylinder 8 is cyclically depressed, interconnecting the cylinder chamber 35 with the exhaust port 36, so that the exhaust gases escape by way of an exhaust conduit 37 which connects to the cylinder head 39 by way of a lug 38 fastened on the top thereof.

The decompressor housing 40 of the decompressor E is concentrically arranged above the valve 33, and is exemplarily made part of and supported by the lug 38. Into the top of the decompressor housing 40 fits a circular guide plate 41 which is retained upon the housing by the screw cap 42. The screw cap 42, the decompressor housing 40 and piston 28 enclose the hydraulic chamber of the decompressor. The decompressor piston 28 is vertically slidably guided by the guide plate 41 and faces the top end of the exhaust valve 33 after emerging from the hydraulic chamber by way of a bore in the neck 44 at the lower end of the decompressor housing 40.

A sliding seal is established for the lower end of the piston by a packing ring or gasket 45 pressed into position by a ring 46 fitting thereinto and depressed by a compression spring 47 reacting upon guide plate 41.

Suitable perforations, such as opening 48, may provide ready communication of the hydraulic fluid with all parts in the hydraulic chamber in the decompressor housing, and more particularly into the parts thereof located below the guide plate 41.

In the raised position shown the piston 28,—and likewise pistons 25, 23, 22, 21 of decompressor D, C, B, and A,—do not interfere with the normal play of an exhaust valve 33. But when they are actuated by pressure in the hydraulic system, they descend, and press the exhaust valves 33 into open positions as long as the required hydraulic pressure prevails. When the hydraulic pressure drops, the actuation of the spring 34 of each exhaust valve will automatically push the piston into the raised position, when the respective piston fails to withstand the spring reaction. Flanges 43 may be provided upon the pistons, in order to stop them in their lowest position, in which they hold valves 33 in fully open positions.

The decompressors A, B, C and D may be constructed similar to the decompressor E, except that the various sizes of the pistons 21, 22, 23 and 25 of these decompressors require obvious adjustment in respect to the inner diameters of the necks 44, of the packing 45, possibly the ring 46, and the guide plate 41.

The end of each one of the branches 11, 12, 13, 15 and 18 is provided with a connecting lug 49, which, using suitable gaskets 51, is sealedly attached to the top of the decompressor by a hollow screw 50. A clearance space upon the inside of the hollow lug 49 surrounds the screw 50 and transverse perforations 52 in the hollow screw 50 distribute the hydraulic liquid from the manifold 10 and the control device F to each decompressor.

The housing 57 of the control device F accommodates the gage 60 with the aforementioned hand or pointer 31 in one compartment; further it comprises a reservoir 59 and a hydraulic compartment 56, which chambers are backwardly closed by the backplate 55. The hydraulic manifold 10 is connected to the backplate and opens into the hydraulic compartment 56. Thus the same fluid pressure prevails at all times in said compartment 56, in the hydraulic chambers of all of the decompressors A, B, C, and D, and in the interconnecting conduits 10, 11, 12, 13, 15, and 18; and their space will hereafter be called the hydraulic system 56, 10 etc.

The hydraulic compartment 56 connects with the reservoir 59 by way of a passage 61, which is controlled by the disc 65 of a rotatable valve 64. A compression spring 62 reacts upon the backplate 55 and presses the disc 65 upon the bottom of the compartment 56.

The valve 64 also comprises a sleeve 63, which fits from the back of disc 65 into a bore 66 extending from the bottom of the hydraulic compartment 56 longitudinally through the housing 57. A pin 67 extends from the sleeve 63 into a feather keyway 68 on a plunger 69, so that the plunger 69 is longitudinally slidably, but nonrotatively accommodated in the sleeve 63. The bore 66 is enlargedly countersunk from the opposite end, at the front of the control device, up to a point near the free end of sleeve 63, in order to accommodate the bottom ring 70, the packing 71, and the packing nut 72, which provide a sealed passage for the plunger 69. The free end of plunger 69 protruding from the housing 57 carries a spacer sleeve 73, and the aforementioned handle 32, these two parts being permanently locked in an adjusted position upon a thread at the free end of plunger 69.

In the front view of the control device in Fig. 4, to the left of the knob or handle 32, a legend "On" is found together with an arrow pointing in a clockwise direction in which the handle 32 is to be turned as far as possible to a position, in which the hydraulic system may effect decompression. For the converse, i. e. the removal of decompression, we find upon the opposite side the legend "Off" together with an arrow in counterclockwise direction. The rotative play allowed for the knob or handle 32 is indicated by a peripheral cut-out 74 in the disc 65 of the valve 64. A pin 75 arises from the bottom of decompression compartment 56 into said cut-out and serves to limit rotation of the handle or knob 32 in clockwise or counter-clockwise direction.

When the knob, seen from the front, is turned into its extreme clockwise position, the stop 75 retains the disc 65 in the position shown in Fig. 3.

In this decompression position of the knob or handle 32 the passage 61 connecting the reservoir 59 with the hydraulic compartment 56 is closed by the disc 65 of valve 64. But when we move the valve 64 from this position in the "off" direction by turning the knob or handle 32, seen from the front, in counter clockwise direction, then the slot 76, which is spirally disposed in the disc 65, allows communication between the reservoir and the hydraulic compartment, first by way of a very small opening, which increases until finally full communication between the reservoir 59 and the hydraulic compartment 56 is established after passage 61 has been brought into alignment with the lower, left enlarged end of slot 76.

But when the disc 65 is in the position of Fig. 3 and closes the passage 61, then the hydraulic compartment 56 and the hydraulic conduit 10 and hydraulic system connected therewith are separated from the remaining parts of the control device.

From disc 65 arises a skirt 77; the skirt guides a valve disc 78 which normally, under the pressure of spring 79 retained by pin 80 mounted in plate 55, closes the hydraulic compartment 56 relatively to the inner bore or sleeve 63, in which the plunger 69 is travelable back and forth.

Pressure in the hydraulic system is built up for the purpose of effecting decompression, as follows:

A pocket 81 extends from the reservoir 59 around the sleeve 63 and the sleeve 63 is at that location provided with a plurality of openings 82 extending transversely therethrough. When the plunger 69 is partly withdrawn to the right from the sleeve 63, so that it clears the said opening 82, a hydraulic fluid contained in reservoir 59, e. g. oil, may enter through opening 82 into the left part of the bore of sleeve 63; oil, which has thus entered upon the bore of sleeve 63, will be pushed to the left (Fig. 2), lift disc 78 and flow past the disc into the hydraulic compartment 56, if the plunger 69 is moved as a piston to the left by manipulation of handle or knob 32. Thus the handle 32 may be pulled back and forth time and time again, the end of the plunger each time conveying and pressing a small amount of oil from the reservoir 51 into hydraulic system 56, 10, etc., the reciprocations of the plunger 69 being limited by the feather keyway 68, and in particular by the spacer sleeve 73 in a direction to the left. Thus there is gradually built up the pressure in the system 56, 10, etc., because the passage 61 is closed by the disc 65; and the various decompressors E, D, C, B and A in succession decompress the cylinders 12—8, 7—5, 4—3, 2 and 1, until finally the entire engine is decompressed. When all cylinders are thus decompressed, the engine may be turned over without laboring against the ordinary pressure and vacuum conditions. In other words it may be freely rotated anticipatory to a start.

The condition of decompression may then be removed, step-by-step, as follows: The operator slowly rotates the handle or knob 32 in counter-clockwise direction so that the passage 61 slowly establishes communication between the reservoir 59 and the hydraulic compartment 56, since the slot 76 is brought to register with passage 61, and the disc 65 does not separate the reservoir 59 from the hydraulic compartment 56 any more. As the compressed fluid slowly travels from the hydraulic compartment into the reservoir, the pressure in the hydraulic system 56, 10, etc. is slowly decreased and first the decompressors of cylinders 1 and 2 are released, one by one, thus reestablishing normal operating conditions in said cylinders; then the other cylinders follow as group 3 and 4, groups 5, 6 and 7 and group 8 to 12.

But this reestablishment of pressure conditions in the various cylinders may be controlled at will and interrupted at any stage and time by turning the handle or knob 32, and thereby the valve 64 and disc 65 in clockwise direction as far as possible. Thus the passage 61 is closed and the pressure in the hydraulic system 56, 10, etc. remains constant until knob 32 is again turned in counter-clockwise direction ad libitum.

The sleeve 63 is also provided with a perforation 83, where it faces the intake 84. The said intake 84 is normally closed outwardly by a plug 85 inserted in a bushing 86 at its outer end.

After the plug 85 has been removed a source of oil supply may be connected at that point to the control device and oil may then be sucked from the oil supply by way of lift valve 87, the plunger 69 being reciprocated by manipulation of handle or knob 32 in order to provide the suction, and the sucked in oil filling the system on the return stroke of the plunger, flowing past disc 78 through passage 61 into the reservoir.

The lift valve 87 comprises a disc 89 resting on top of bushing 86, a compression spring 90 decompressing said disc 89 and a plug 88 which serves to retain the compression spring in its central position and is flanged in order to seat at the bottom of the intake 84. The upper end of plug 88 is flattened as indicated at 91 to allow the oil to pass by. As the oil is slowly pumped into the reservoir 59, air is compressed therein, providing a reaction cushion, it being presumed that the whole device is normally in the upright position shown.

By way of a nipple 94, the gage 60 connects to passage 93, which in turn connects to the hydraulic system 56, 10 etc., as follows:

In the body of the housing of the control device F extends angularly down from passage 93 a drill hole 108 which is plugged up at its outer end. A hole 109 breaking through the side wall of the hydraulic compartment 56 extends from the back of the housing of the control device to the level of and merges with said hole 108, so that the gage 60 is in communication with and registers the pressure in the hydraulic system.

Between the passage 93 and a hole 92 at the front of the reservoir 59 there is provided a relief valve 95 which is normally closed, but allows the passage of the hydraulic fluid from passage 93 to the reservoir 59, when the pressure in the former and in the hydraulic system 56, 10 etc. is unnecessarily raised above the working range of the device as it would for instance be caused by excessive pumping of handle or knob 32. This pressure relief valve is set at a predetermined pressure just a little greater than that necessary to lift the smallest decompression piston 21. This is effected as follows:—Spring 96 determines the pressure at which the valve is set; because it reacts between the hollow plug 97 outwardly closing the valve and the valve shell 98, which is conically seated on top of passage 93, said shell 98 being circumferentially in communication with the reservoir 59 by way of hole 92.

It is preferred to eliminate all air from the hydraulic system as well as from the reservoir; because the decompressors react much quicker upon pumping, as brought about by reciprocating the plunger 69, and all actions become positive when a unitary liquid fluid, e. g. a light oil, is used. In order to compensate under these circumstances for the volumetric variations in the reservoir 59 there is provided in the reservoir 59 a Sylphon chamber 99, which is endwise sealed by way of a hollow shank 100, and locknuts 101 to the back plate 55 of the control device F. Underneath the cover plate 102 of the Sylphon, there is attached a hollow stem 103, which extends through the Sylphon and through the shank 100 thereof to the outside, and is there provided with a knurled end or suitable other gripping means 107.

In case it is not desired to fill by way of suction intake 84, as explained before, but want to pour a light oil in through a hole on the top of the reservoir, which is normally closed by plug 104, then the Sylphon is retracted in the reservoir by manipulating the gripping means 107 and pulling the top plate 102 back. A compression spring 104 may be provided upon the inside of the Sylphon in order to take up additional reaction pressure if the natural resilience of the bellows of the Sylphon is not sufficient. The interior of the Sylphon is shown to communicate with the atmosphere through a perforation 110 in the hollow stem 103. But it is understood that the interior of the Sylphon may also be sealed relatively to the atmosphere, so that the gaseous contents of the Sylphon supplement or replace the cushioning effect of the Sylphon or spring 106. A collar 105 may be provided upon the hollow stem 103 in order to protect the Sylphon so that it cannot be excessively compressed. Any piston or bladder type enclosure serving for volumetric compensation may replace the Sylphon.

While in accordance with Fig. 1 the valve 33 may be arranged at any point of the cylinder head as a relief valve, it is indicated in Fig. 5 as the exhaust valve on a cylinder head 39. The decompressor is here clamped onto the hydraulic manifold 10. The hydraulic manifold 10 is mounted upon an extension 120 of a bracket 121, which conventionally supports the cam shaft 122 as well as the rocking levers 123 which operatively interconnect the cam shaft 122 and the exhaust valves 33.

It should here be noted, that the whole arrangement of the control device is chosen as a self-contained unit, manually operated and controlled, in particular consideration of aviation requirements. Where the conditions presently peculiar to aircraft do not prevail,—in connection with a stationary Diesel engine for instance, where pressure is available in connection with storage means, or where there is no objection to an elaboration of the conduit system and by way of a power driven pump,—the experienced engineer may replace or supplement the control mechanism by such a pump and a by-pass merely controlled by a two-way valve; although he may adhere to the use of gage means for checking the state of decompression.

Where electric currents are available, they may replace the hydraulic control medium. In this connection, as well as in the case just mentioned a fully selective decompression control may be arranged for, but in routine operation a predetermined succession, as herein outlined, will be preferred.

Although there have been shown and described only a few exemplary forms of embodiment of this invention in detail, yet it is not to be limited thereby, except as the state of the art and the appended claims may require, for it is obvious that various modifications and changes may be made in the method and form of embodiment of this invention, without departing from the spirit and scope thereof.

What is claimed is:

1. In combination with an internal combustion engine, and with valves on two cylinders of said engine connecting the chambers of said cylinders with the atmosphere, a fluid pressure controlled decompressor on each of said valves, each decompressor opening or closing the respective valve when actuated or released, respectively, a control device for regulating the flow of a pressure fluid, fluid conduit means connecting said decompressors with said control device, and means on said device for releasing one of said decompressors at will after the other.

2. In combination with an internal combustion engine, and with valves on cylinders of said engine connecting the chambers of said cylinders with the atmosphere, a fluid controlled decompressor on each of said valves, each decompressor opening or closing the respective valve when actuated or released, respectively, a control device for regulating the flow of a pressure fluid, fluid conduit means connecting said decompressors with said control device, and means on said device for releasing some of said decompressors together and another decompressor separately.

3. In combination with an internal combustion engine, and with valves on cylinders of said engine connecting the chambers of said cylinders with the atmosphere, a fluid controlled decompressor on each of said valves, each decompressor opening or closing the respective valve when actuated or released, respectively, a control device for regulating the flow of a pressure fluid, fluid conduit means connecting said decompressors with said control device, and means on said device for releasing one of said decompressors separately from others, at will.

4. In combination with an internal combustion engine, and with valves on cylinders of said engine connecting the chambers of said cylinders with the atmosphere, a fluid controlled decompressor on each of said valves, each decompressor opening or closing the respective valve when actuated or released, respectively, a control device for regulating the flow of a pressure fluid, fluid conduit means connecting said decompressors with said control device, and means on said device for releasing said decompressors at will in a predetermined order of rotation.

5. In combination with an internal combustion engine, and with valves on cylinders of said engine connecting the chambers of said cylinders with the atmosphere, a decompressor on each of said valves, each decompressor opening or closing the respective valve when actuated or released, respectively, a control device, hydraulic means connecting said decompressors with said control device, and means on said device for releasing said decompressors at will in a predetermined order of rotation.

6. In combination with an internal combustion engine, and with valves on cylinders of said engine connecting the chambers of said cylinders with the atmosphere, a decompressor on each of said valves, each decompressor opening or closing the respective valve when actuated or released, respectively, a control device, a fluid conduit connecting said decompressors with said control device, and means on said device for releasing said decompressors at will in a predetermined order of rotation.

7. In combination with an internal combustion engine, and with valves on cylinders of said engine connecting the chambers of said cylinders with the atmosphere, a decompressor on each of said valves, each decompressor opening or closing the respective valve when actuated or released, respectively, a control device, a fluid conduit connecting said decompressors with said control device, and a hand controlled fluid pump and by-pass in said control device.

8. In combination with an internal combustion engine, and with valves on cylinders of said engine connecting the chambers of said cylinders with the atmosphere, a decompressor on each of said valves, each decompressor opening or closing the respective valve when actuated or released, respectively, a control device, a fluid conduit connecting said decompressors with said control device, and a hand operated fluid pump and by-pass in said control device.

9. In combination with an internal combustion engine, and with valves on cylinders of said engine connecting the chambers of said cylinders with the atmosphere, a decompressor on each of said valves, each decompressor opening or closing the respective valve when actuated or released, respectively, a control device, a fluid con-

duit connecting said decompressors with said control device, and a fluid pressure control means in said control device, one of said compressors responding to fluid pressure different from another.

10. In combination with an internal combustion engine, and with valves on cylinders of said engine connecting the chambers of said cylinders with the atmosphere, a decompressor on each of said valves, each decompressor opening or closing the respective valve when actuated or released, respectively, a control device, a fluid conduit connecting said decompressors with said control device, and a fluid pressure control means in said control device, one of said compressors together with the respective valve responding to fluid pressure different from another.

11. In combination with an internal combustion engine, and with valves on cylinders of said engine connecting the chambers of said cylinders with the atmosphere, a decompressor on each of said valves, each decompressor opening or closing the respective valve when actuated or released, respectively, a control device, a fluid conduit connecting said decompressors with said control device, a fluid pressure control means in said control device, one of said compressors responding to fluid pressure different from another, and a gage reacting upon fluid pressures in said conduit and calibrated to indicate the response of compressors to pressure.

12. In combination with cylinders of an engine, with exhaust valves on said cylinders, and with a stem outwardly extending from one of said valves, a fluid-actuated decompressor operatively aligned with said stem, and a fluid control system connected with said decompressor.

13. In combination with cylinders of an engine, with exhaust valves on said cylinders, and with a cam shaft cyclically actuating said valves, hydraulic decompressors for disengaging part only of said valves from said cam shaft at will.

14. In combination with cylinders of an internal combustion engine, with exhaust valves on said cylinders, and with a stem outwardly extending from one of said valves, a decompressor with a fluid actuated piston operatively aligned with said stem, and a remote fluid pressure control for said compressor.

15. In a hydraulic device for controlling decompression of the cylinders of an engine, valves on the cylinders, a hydraulic system comprising pistons operatively connected with said valves, a pump on said system, a handle on said pump, and a by-pass valve on said pump controlled by said handle.

16. In a hydraulic device for controlling decompression of the cylinders of an engine, valves on the cylinders, a hydraulic system comprising pistons operatively connected with said valves, a pump on said system, and an expansible reservoir feeding said pump.

17. In a hydraulic device for controlling decompression of the cylinders of an engine, valves on the cylinders, a hydraulic system comprising pistons operatively connected with said valves, a reservoir, a pump interposed between said system and said reservoir, said system, reservoir and said pump being outwardly sealed, and a relief valve provided on said hydraulic system and adapted to open into said reservoir.

18. In combination with cylinders of an internal combustion engine and with valves opening from said cylinders to the outside, a pressure control system, and pressure actuated decompressors interposed between said system and said valves, different ones of said decompressors reacting upon different pressures in said system.

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