Aug. 2, 1938. W. E. HAUPT 2,125,277

TESTING DEVICE FOR MULTIPLE CYLINDER INTERNAL COMBUSTION ENGINES

Filed May 2, 1935 2 Sheets-Sheet 1

Fig. 1.

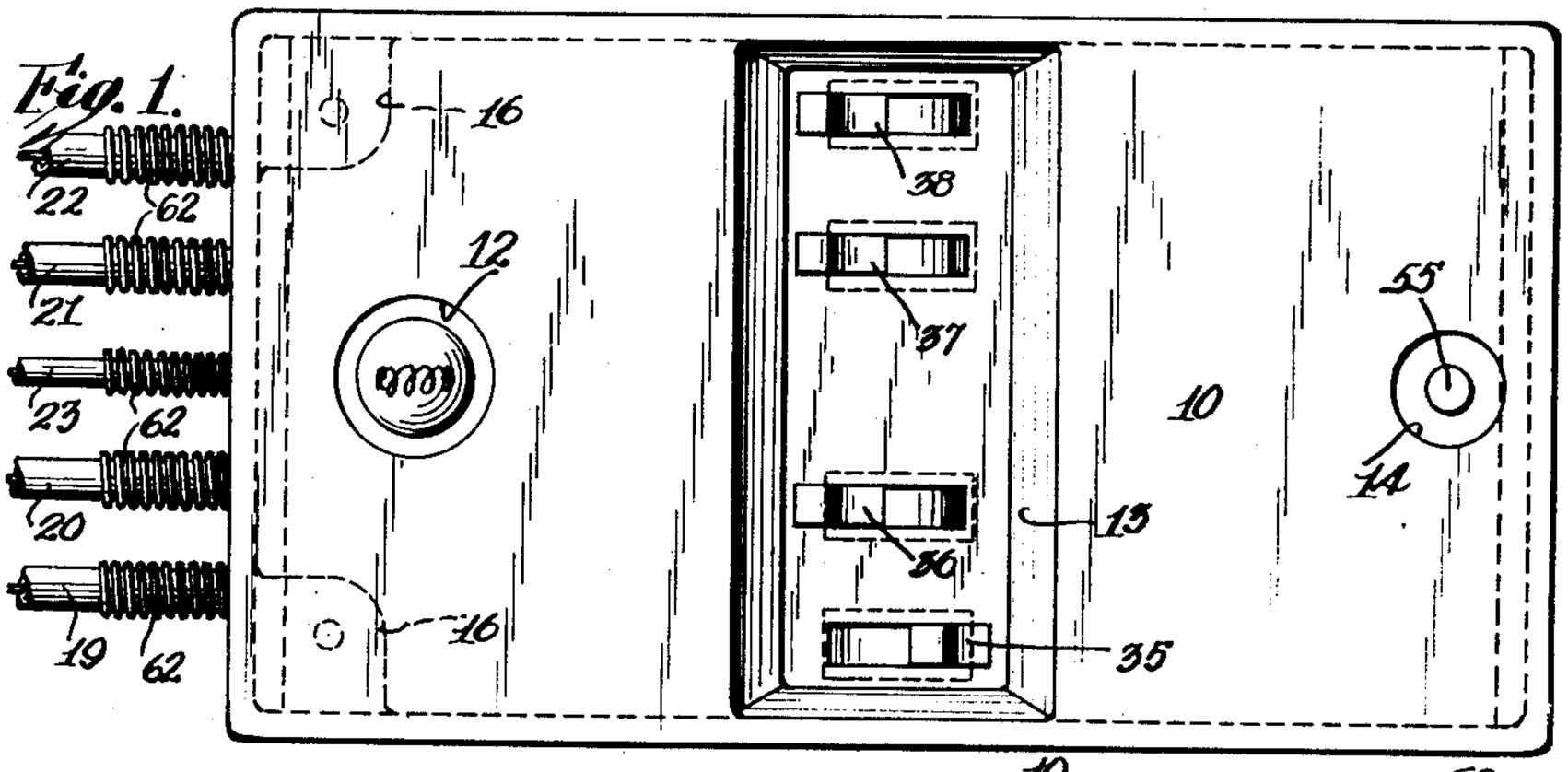

Fig. 2.

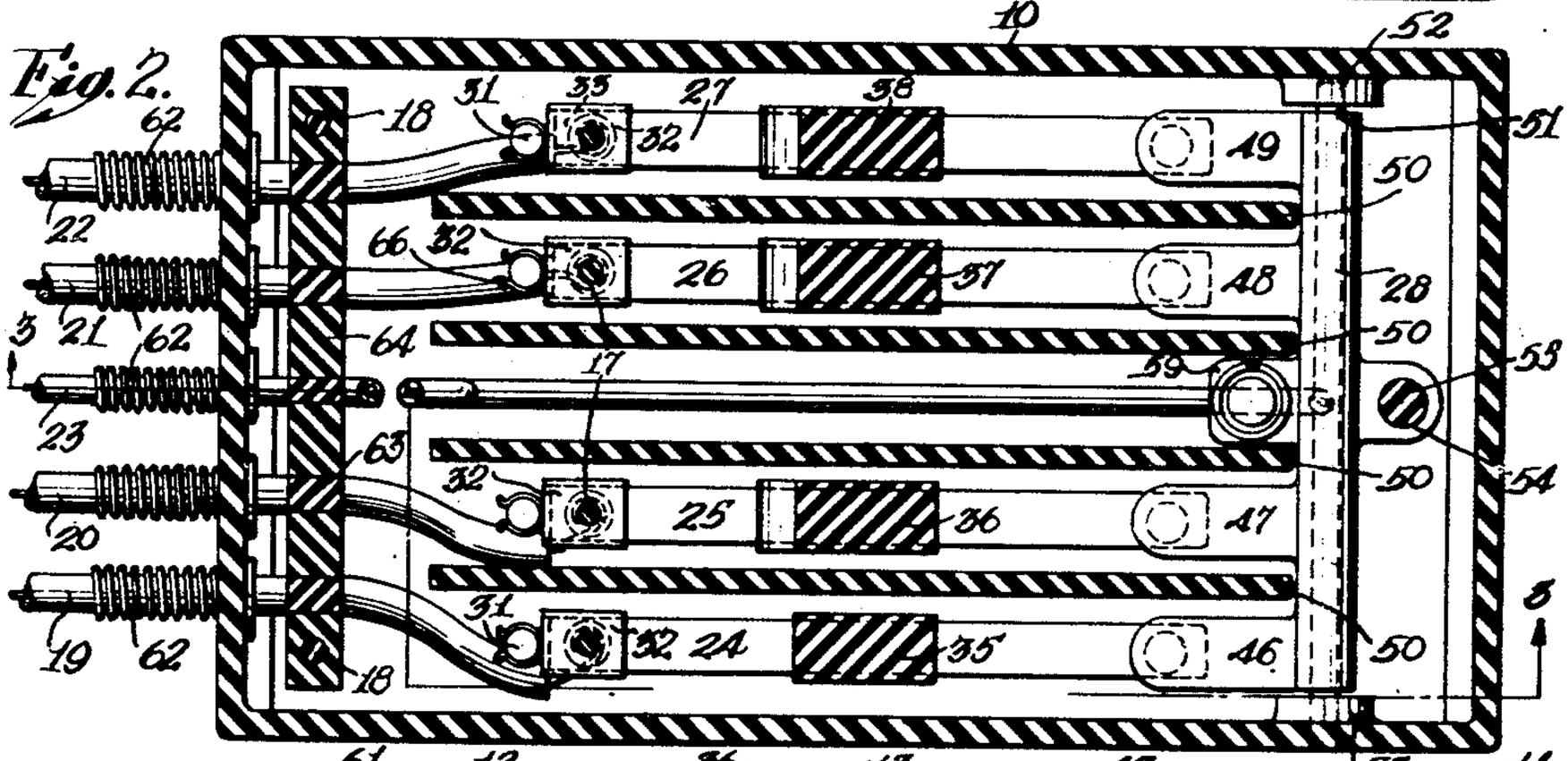

Fig. 3.

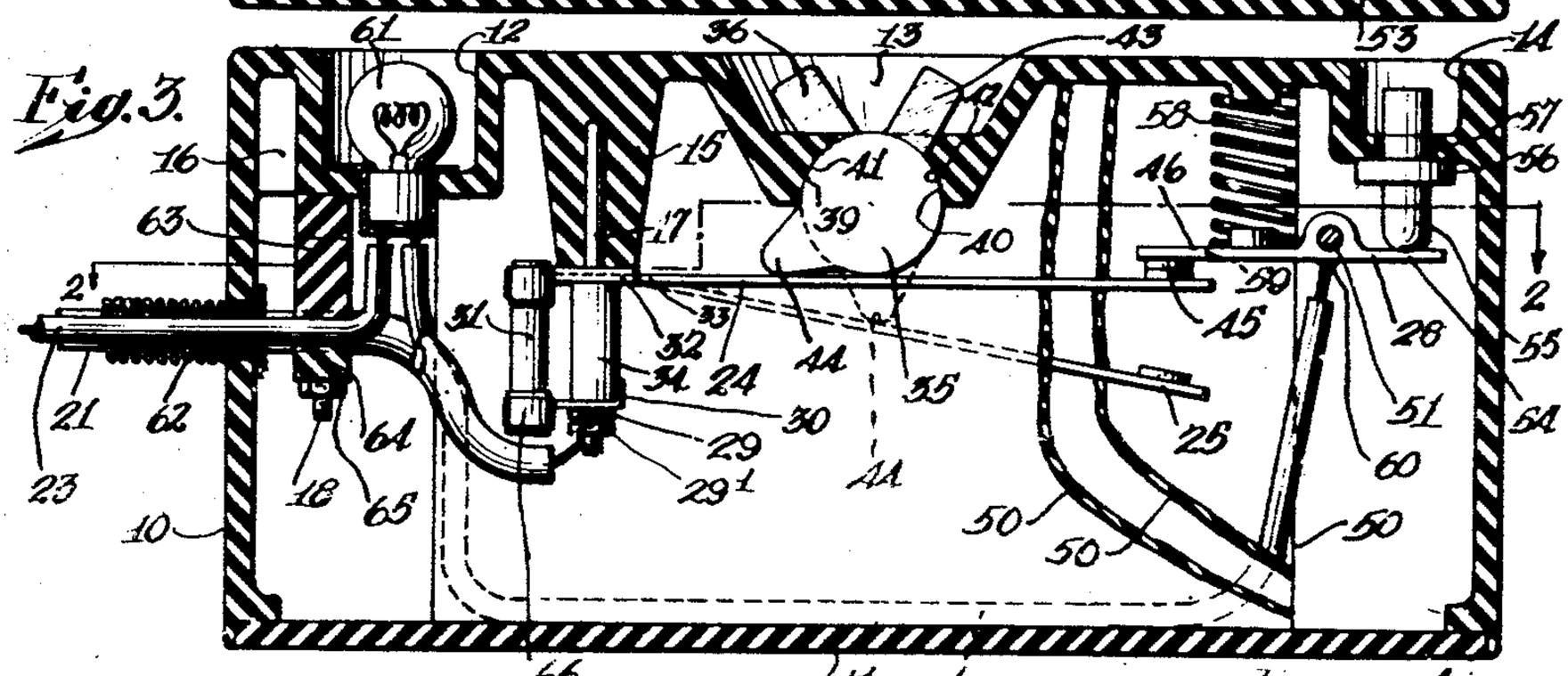

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Fig. 4.

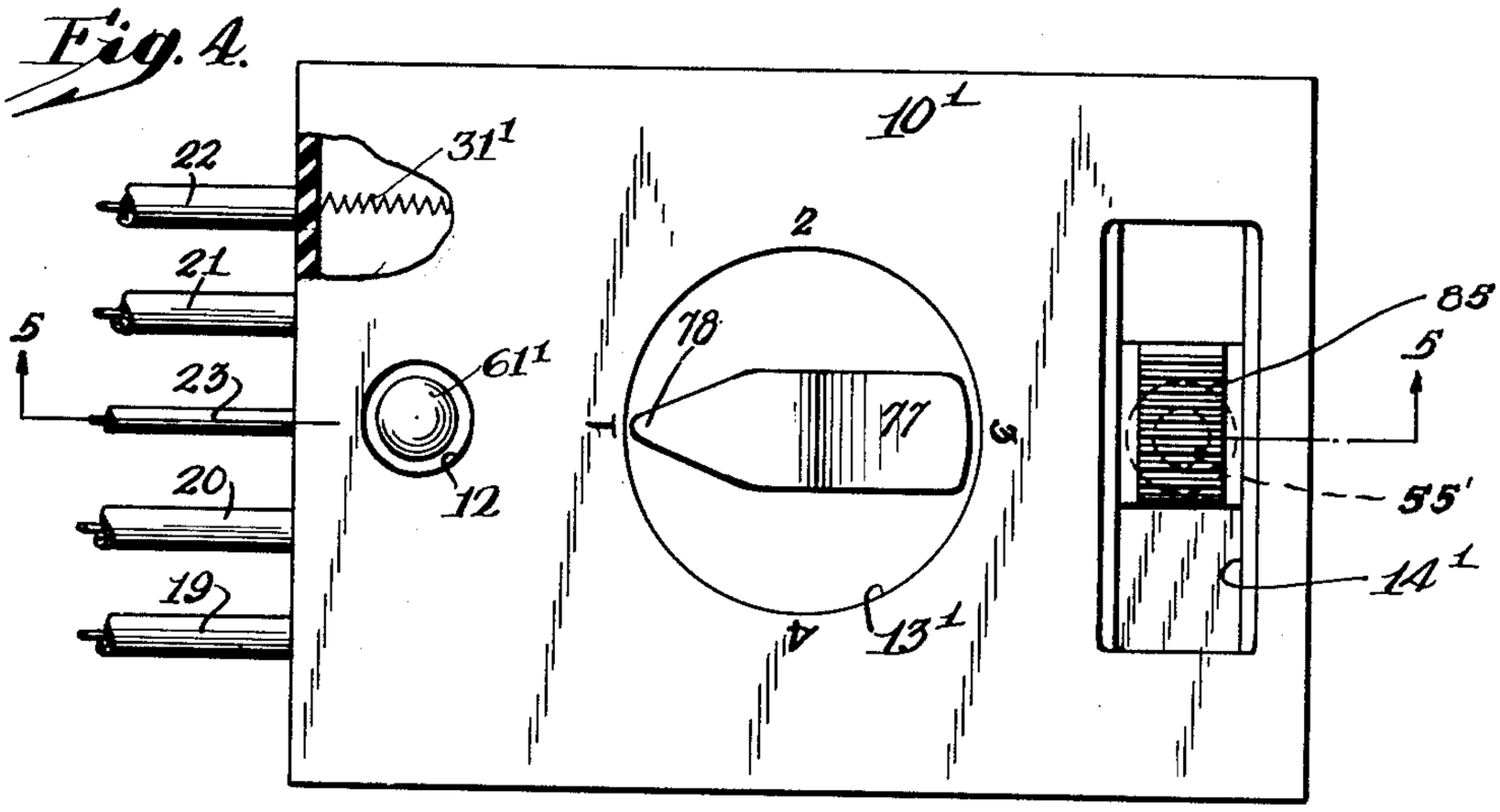


Fig. 5.

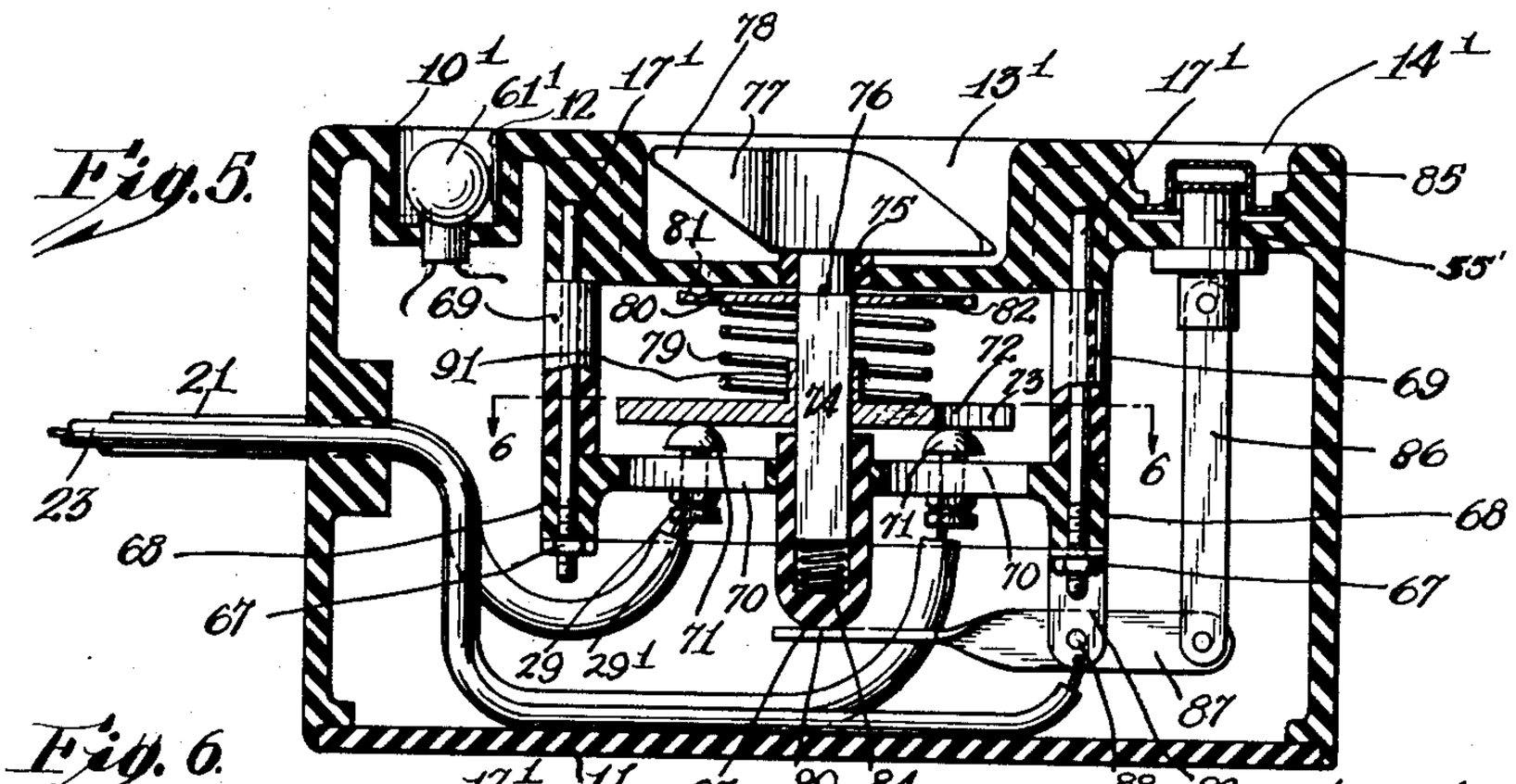


Fig. 6.

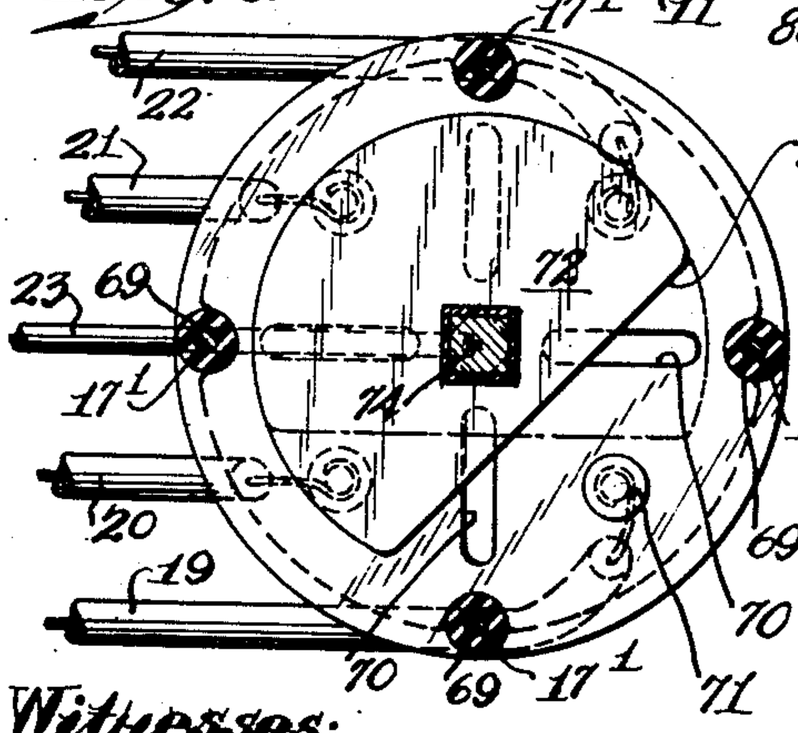
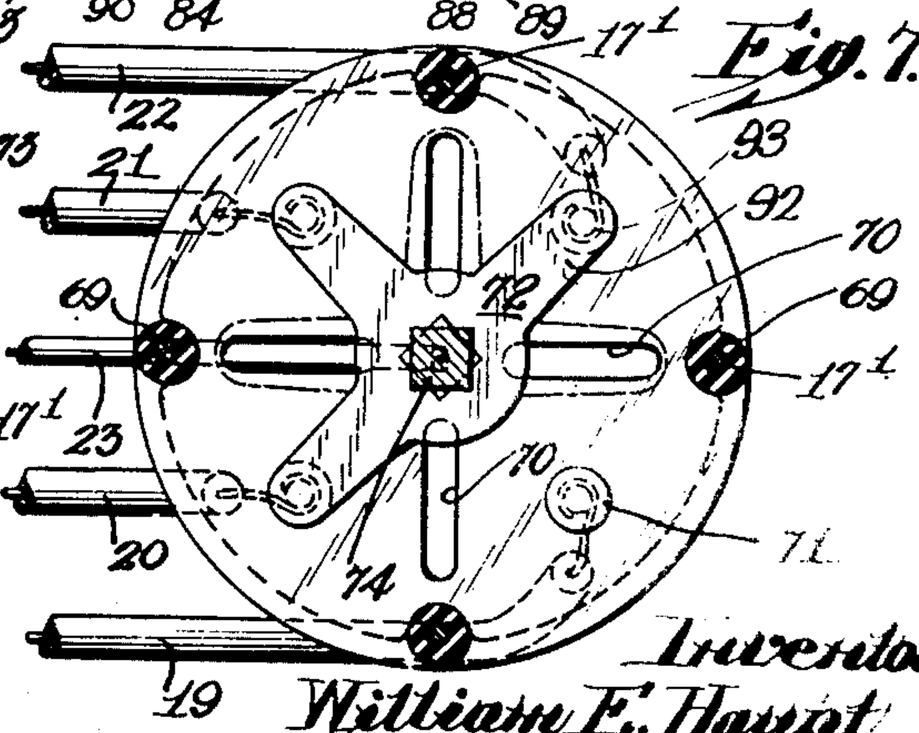


Fig. 7.



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TESTING DEVICE FOR MULTIPLE CYLINDER INTERNAL COMBUSTION ENGINES

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Application May 2, 1935, Serial No. 19,422

10 Claims. (Cl. 175—183)

My invention relates to the art of testing ignition and explosion conditions within or in connection with electrically ignited internal combustion engines, conducting the tests with the spark plugs in place.

The main purpose of the invention is to test each cylinder of an electrically ignited internal combustion engine individually under full load conditions as to throttle opening, maximum compression and temperature, by grounding or shorting all of the individual spark plug wires but one.

A further purpose is to supply a common grounding device for all of the spark plug wires and provide for instant release from or re-connection to the ground.

A further purpose is to provide ground control mechanism that will allow ready selection of the spark plug contacts which are to be grounded or free.

A further purpose is to make a test construction foolproof against connecting in the wrong circuit where relatively heavy currents would otherwise injure the contacts.

A further purpose is to provide means for making a simple test of the test system.

A further purpose of the invention is to provide for coincident grounding of any number and selection of the spark plugs of the engine, with controlled freedom from grounding and testing of the conditions within the cylinders in which the remaining spark plugs are located.

A further purpose is to maintain a common grounding device for the spark plug circuits selected for grounding and to provide a single manual control to shift this device so as to release at the same time all of the spark plug circuits grounded.

Further purposes will appear in the specification and in the claims.

I have preferred to illustrate my invention in a few forms only, selecting forms which are simple, effective and inexpensive and which at the same time well illustrate the principles involved.

Figure 1 is a top plan view of the preferred form of my invention.

Figure 2 is a section of the structure seen in Figure 1 parallel to the paper therein, taken upon line 2—2 of Figure 3.

Figure 3 is a transverse, vertical section of Figure 2 taken upon line 3—3.

Figure 4 is a top plan view of a modified form of the invention.

Figure 5 is a vertical section of the form seen in Figure 4 taken upon line 5—5.

Figure 6 is a section of the structures of Figures 4 and 5, taken upon line 6—6 of Figure 5.

Figure 7 is a section corresponding to Figure 6 showing a further modified form.

In the drawings similar numerals indicate like parts.

The illustration has been confined to a tester for the performance of a four-cylinder explosion engine for simplicity merely, recognizing the fact that for six or eight or more cylinders there would merely be six or eight or more individual wires from the corresponding spark plugs with individual switch mechanisms, (one for each of the additional spark plugs), each making contact with a common ground in the same manner and to the same effect as is the case with the four individual switch contact mechanisms shown.

In the illustration shown the tester is mounted within a box 10 having separable bottom 11. Recesses are formed in the top at 12, 13 and 14 for signal lighting, individual switch mechanism and common grounding control switch mechanism.

Ribs 15 and lugs 16 are provided for attachment of the switches and wire-supporting-mechanism. Within the ribs are studs 17, molded in, by which the wire terminals and the switches are connected, and studs 18 are molded into the lugs 16 for the purpose of supporting the wires.

Individual wires 19, 20, 21 and 22 connected to the spark plugs, and a ground wire 23 pass through openings in the casing and are connected through the spring switch strips 24, 25, 26 and 27 for the individual wires and to a rocker ground plate, 28, respectively.

The individual wires are connected through by nuts 29, 29′ to spring holding clips 30 forming holding devices for one terminal each of individual resistances 31 whose opposite terminals are held within clips 32. The clips 32 are held in contact with the ends 33 of the spring switch strips 24–27. Insulating sleeve 34 spaces the clips 30 from the ends 33 of the switch strips. The parts are held together by the nuts at 29. Nuts 29′ hold the respective wires against nuts 29. The openings through the clips 32 and through the ends 33 of the switch strips, through which the studs pass, are large enough so that no short-circuiting takes place.

Individual switch rockers 35, 36, 37 and 38 carry cylindrical surfaces at 39 and 40 which have bearing against correspondingly shaped surfaces 41 and 42 in the under part of the casing and are held against these surfaces by the individual spring switch strips so that the rockers turn in these surfaces as bearings.

The switch rockers 35 to 38 are turned by means of fingers 43 so as to shift cam projections 44 from the position as shown in full lines in Figure 3, where the cam projection 44 is held at the left by the pressure of the spring, to positions such as are shown in dotted lines in this figure, where the cam projection has been shifted to the right sufficiently to pass the center and to be held in its new position by the pressure of the spring strip. During the shifting of the switch rockers

the spring switch is shifted from the grounded position shown in full lines in Figure 3 to the position shown in dotted lines therein, opening the switch connection at 45 between the individual spring switch strip and the ground plate 28.

The several ground plate contacts engaged by the individual switch strips are carried by separate rocker arms 46, 47, 48 and 49 upon the rocker plate, the separation of these arms permitting the contacts to straddle insulating partitions 50 by which the switches and their switch mechanisms are separated in the casing. These partitions are preferably molded in the body of the casing. Desirably they extend from the top of the casing substantially to the bottom and far enough longitudinally to pass the points of circuit interruption and to make spacing of the ground plate contacts necessary.

The rocker plate is pivoted upon a pintle 51 which is supported at its ends within the bosses 52 and 53 and which is insertable through the casing at one end.

Counterclockwise movement of the rocker plate beyond the position seen in Figure 3 is prevented by engagement of a rocker arm 54 with pin 55 carrying a stop collar 56. The pin fits through an opening 57 within the casing and is accessible through recess 14.

The ground rocker plate 28 is urged in a counterclockwise direction and resistance to clockwise movement is afforded by a spring 58 which extends between the cover of the casing and a rocker arm 59. The ground wire 23 is connected to the rocker plate in any suitable manner as at 60 and at an intermediate point within the casing is interrupted to pass its circuit through a test lamp 61.

The individual wires, as well as the ground wire, are supported within the casing upon spring guides 62 and are clamped to other insulation between gridlike caps 63 and co-operating gridlike bases 64, both the caps and bases being held in position by nuts 65 on the studs 18 cast into the lugs or bosses 16.

The resistances 31 are formed as clip inserts laterally insertable between spring fingers 66 in a manner very common for fuse insertion.

In operation, with all of the switch levers or fingers 43 in the position seen at the right in Figure 3, and normally held in this position by engagement of the spring switch strips with their cams 44, the spring fingers will each engage at 45 with its corresponding individual point of contact upon one of the rocker arms 46, 47, 48 or 49, the initial shape of the spring being such that its pressure against the switch-operating-mechanism does not prevent full spring contact engagement at 45.

The contacts at 45 ground all of the individual wires in this position of their switch levers. However, when the switch levers are thrown in counterclockwise direction to a position at the left in Figure 3, each switch lever so thrown disconnects its spring switch strip from its contact at 45, clearing the corresponding wire from ground and permitting the operation of the cylinder in which the corresponding spark plug is located.

It will thus be seen that any one, or any selected group or all of the spark plugs can thus be grounded or freed from ground for operation of their cylinders as desired. During the test of a cylinder to find out how the engine operates with this cylinder alone effective, or with more than one cylinder effective, if the engine operation be so weak as to endanger stalling, either of two courses can be followed to quicken and strengthen the engine operation. Either one or more other switch levers can be thrown to free their corresponding spark plugs from grounding, or the button or pin 55 can be pressed to shift the rocker plate in a clockwise direction and to release all of the contacts at 45 to render all of the cylinders effective.

Because the ground is common to all of the switch circuits shown, any of the individual switch circuits can be tested by disconnecting the other circuits from the ground and applying an electromotive force across it through the ground and through the test light 61, making the voltage sufficient to light this test lamp under normal conditions and noting faults in the connections by failure of the test lamp to light.

The resistances 31 function to make the tester foolproof in that they make it impossible for an unskilled operator inadvertently to short a battery or generator for example through the tester except through electrical resistance high enough to avoid the danger of injury to the battery or generator. It will be seen that without the resistances 31 such destructive shorting might occur if one of the wires 19–22 were to ground with any one of the others thereof contacting with the off-ground side of a generator or battery.

In Figures 4, 5, 6 and 7 the grounding mechanism is moved to shift a grounding plate circumferentially so as to engage all but one or all but two of the contacts corresponding with the wires connected to the spark plugs, with provision in Figures 4, 5 and 6 for release of all of the contacts from the ground plate by lifting the plate.

In Figures 4, 5 and 6 the structure accomplishes the general purpose of the structure of that of Figures 1–3 but in a somewhat different way. Instead of having independently operated switches connecting with the common ground as in Figures 1–3, a rotatable grounded contact disc having a gap in its contact surface is turned about and over contacts connected with the respective spark plugs and is spring-pressed into engagement with these contacts. The circumferential extent of the gap in contact surface determines whether one or two contacts be free from grounding engagement with the disc at a time.

The casing 10′ is shown here with the same removable base 11 but with a very different arrangement of the interior of the casing. Recesses 13′ and 14′ appear there for much the same purposes as recesses 13 and 14. Within the walls of the top of the casing are encased four studs 17′ by which, through nuts 67 an insulating supporting plate 68 is held. It is spaced from the top of the casing by insulating sleeves 69.

The plate 67 may be apertured at 70 to increase leakage resistance and carries contact pins 71 electrically connected to the wires. The pins are held in place within the plate by nuts 29 with which nuts 29′ cooperate for the purpose of gripping the inlet wires.

The contact disc 72 is shown as cut away at 73 so that a segmental portion of what would otherwise be its area does not make contact with one of the pins 71. This segment is large enough so that during part, at least, of the rotation of the disc there is one pin with which contact is not made, and for a shorter part of the turning movement two contact pins are free from grounding engagement with the disc.

The disc is mounted upon a squared shaft 74

which is circular near its upper end so as to rotate within a bearing sleeve 75. The shaft is kept from upward movement within the bearing sleeve by a pin 76 which engages the lower surface of the sleeve. The shaft is turned by a button or knob 77 whose end 78 is used as an indicator to show the cylinder and spark plug which are on test and free from circuit grounding.

The disc 72 is preferably thick enough axially of the squared shaft or otherwise guided to prevent it from harmful tilting on the shaft, thus avoiding gripping engagement with the shaft. The disc is pressed downwardly by a spring 79 which presses upwardly against a rotating disc 80.

Both the disc 72 and the rotating disc 80 are turned by the shaft, fitting the noncircular, here squared, section of the shaft.

The spring 79 reacts upwardly against the disc 80 so as to seat fixed pin 81 in successive depressions 82 as the button is turned, so that the entire rotating mechanism will be checked at successive positions corresponding with freedom of individual contacts from grounding and the mechanism is retarded against rotation from these checking positions by the engagement of the pin within the recesses.

The ground connection with the shaft is made through a sleeve 83 movable upwardly along the length of the shaft and pressed downwardly by a spring 84. The button or pin 55' is here free for finger pressure when the slide 85 is back but is capable of being controlled by moving the slide forward beyond the position shown so that the slide engages with the button to depress and hold the button depressed or which frees from engagement with return movement of the slide to release the button to the position shown.

Connected with the button or pin 55' is a thrust link 86 connected with a lever 87 pivoted at 88 in a clip 89 whose angular extension is held in place beneath one of the nuts 67. The lever 87 is extended past the pivot at 90 to operate against the disc 72 and to lift it so that movement of the disc frees all the contacts from grounding against the disc. The grounding disc is shown as carrying a sleeve guide 91 to prevent tilting. All the parts are returned to their former positions by the spring 79.

In the illustration the disc is connected with a guide 91 which lies above the disc or plate so that a thin disc or plate may be used and may be prevented from objectionable tilting and gripping. The sleeve or slide 83 is guided by the shaft and is pressed upwardly against the pressure of the spring 79 by the end 90 of lever 87.

In operation the disc is turned by means of the button or knob 77 until the pointer indicates a contact corresponding to the cylinder whose spark gap circuit is to be cleared, i. e., is to be freed from grounding and which, therefore, is to be tested. In this button-indicator position the grounding disc or plate and the contact freed therefrom are in some such positions as in Figures 5 and 6. If the engine operates so weakly as to endanger stalling the button or knob can be rotated to an intermediate position between two of its indicator markings at which intermediate portion two of the contacts will be cleared. If this clearing of two adjoining contacts be insufficient to afford the needed pick-up to the engine or if greater pick-up be desired than can be expected from adding a second cylinder, the button or pin 55' can be depressed by hand or the slide 85 can be shifted to act as a wedge and to depress the button and hold it down, by which depression the grounding plate or disc is lifted and all of the spark plug circuits are cleared.

In the form shown in Figure 7 the construction may be of the same character identically as in Figures 4, 5 and 6 except that a star or spider grounding mechanism is used instead of the grounding disc. At least one contact is always clear as the star has arms in number one fewer than the number of spark plugs.

At intermediate rotary positions all of the contacts are clear. Since rotation to star arm positions between contacts will clear all of the contacts from the grounding effect of the star, lifting of the grounding contact star is unnecessary and the rest of the construction of Figures 4, 5 and 6 can be used or, for this reason need not be followed but may be much simplified when the star is to be used as in Figure 7 instead of the disc of these figures. It is still desirable to have the contact star resiliently pressed against the contacts and to have the rotatable mechanism spring-held in its positions of contact engagement. The resilient engagement can be effected by forming the star with spring arms 92 and cupping the under faces of these arms as at 93 to conform with the upper surfaces of the contacts. By this construction the button or pin 55', thrust link 86, lever 87 and other lifting mechanism of Figure 5 may be omitted wholly and it is not necessary to have the grounding device movable along the shaft nor to have it spring-pressed downwardly by any such spring as that shown at 79. The disc 80 with its pin engagement within disc depressions 82 also becomes unnecessary, cutting down the structure to a button-rotated shaft carrying the star or spider and any suitable supporting mechanism for the contacts to insulate them and to hold them in position for engagement with the slightly cupped spring arms of the star or spider.

It has not been considered necessary to illustrate a test lamp in the ground circuit, nor the permanent protective resistances in the different spark-plug circuits in all of Figures 4–7 to perform the function of the test lamp 61 and of the resistances 31 shown in Figure 3, it being the intention that these shall be used or omitted in these Figures 4–7 as may be desired, depending upon whether the user be after simplicity and cheapness and therefore omit these features, or desire completeness and safety rather than low price; I therefore have shown one of the resistances 31' diagrammatically and in Figure 4 only, and have shown a light 61' in Figures 4 and 5 only, the light 61' and resistances 31' being intended to function respectively in the manners already described.

The term "resistance" as here used in the specification and claims as applied to one or more of the members 31 or 31' I define as a resistance suited to the intended service, both low enough to prevent an ignition voltage at a spark plug that it by-passes to ground and high enough to prevent dangerously high current if subjected to the generator or battery voltage.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such in so far as they fall within the reasonable spirit and scope of my invention.

Having thus described my invention, what I

claim as new and desire to secure by Letters Patent is:—

1. In a system for testing the performance of electrically ignited internal combustion engines, a plurality of connections individually attachable to the spark plugs, a ground common to all of the connections, spring switches between the connections and the ground normally spring-connected with the ground, a plurality of cam disconnectors, one for each spring switch held in position by the spring of the switch against the disconnector, levers by which the cams are thrown and means for disconnecting all of the switches from the ground.

2. In a system for testing the performance within electrically ignited internal combustion engines, a plurality of connections individually attachable to the spark plugs, a ground common to all of the connections, a casing about the ends of the connections, spring switches within the casing, one for each connection, cam switch operating mechanisms, one for each switch, held in place by the spring of the switch and common means for disconnecting the switches from the common ground.

3. In a system for testing the performance of electrically ignited internal combustion engines, a plurality of connections individually attachable to the spark plugs, separate spring switches in the circuits of the individual connections, a ground common to all the spring switches with which they normally make contact, a casing about the switches and the ends of the connections, said casing having downwardly facing bearings, one for each spring switch, a plurality of cam disconnectors, one fitting each of the bearings and held in position by the spring of the switch, levers for operating the cams, adapted to throw the cams to position where they respectively hold the switches away from the ground and common means for disconnecting the ground from the spring switches.

4. In a system for testing the performance within electrically ignited internal combustion engines, a casing, a plurality of connections therefrom, one for each of the spark plugs of the engine and adapted to be connected with it, a stationary light, a ground connected to one side of the light and a movable conducting member common to a plurality of said connections and having spring engagement between the connections and the light, means for disconnecting individual connections from said member while maintaining contact of the other connections with the member, a current limiting resistance in series with each of the connections for rendering the test system foolproof against connecting in the wrong circuit where relatively heavy currents would otherwise injure the contacts, and means for moving the member to separate it from contact with the other connections.

5. In a system for testing the performance within electrically ignited internal combustion engines, a casing having a switch support presenting downwardly facing bearings, a plurality of connections one for each spark plug of the engine to be tested, a plurality of spring pressed switches in circuit, one with each connection, cam operating mechanism, one for each switch and held in position against the bearings by the individual switches, means for tilting the operating mechanisms to open the switches, common ground mechanism with which the switches normally make contact, spring pressed toward engagement with the switches and means for shifting the ground against the spring pressure to separate said ground from said switches.

6. In a system for testing performance within electrically ignited internal combustion engines, a casing having a switch support presenting downwardly facing bearings, a plurality of connections one for each spark plug of the engine to be tested, a plurality of spring pressed switches in circuit, one with each connection, operating mechanisms, one for each switch and held in position against the bearings by the individual switches, means for tilting the operating mechanisms to open the switches and common ground mechanism with which the switches normally make contact.

7. In a system for testing the performance within electrically ignited internal combustion engines, a plurality of connections individually attachable to the spark plugs, a resistance within the circuit of each connection, spring switches, one for each connection and by its closure to ground the connection through its resistance, cam means for opening the switches individually against their spring retractions, common means normally grounding the individual closed switches and rocker means for tilting the common grounding means to open the closed switches.

8. In a system for testing the operation of an electrically ignited internal combustion engine, a main case, individual external test leads, one for each spark plug and one for grounding, a test lamp grounding through the said grounding external circuit, internal test circuits for and one connecting with each external lead, the internal test circuits including current limiting resistances in series with each of the test leads for rendering the system foolproof against connecting in the wrong circuit where relatively heavy currents would otherwise cause injury, manually controlled contacts for each of the respective internal circuits, an internally located common conductor normally engaged by the contacts, and manually operated means for opening all of the common conductor contacts at one time.

9. In a tester for internal combustion engines, a plurality of leads adapted to connect to the spark plugs of the respective cylinders of the engine under test, a plurality of switch arms supported at one end and displaceable from their normal position, said switch arms being electrically connected to the respective leads, a grounding plate pivoted between its extremities and adapted in one position to make contact with one end of the grounding plate when the switch arms are not displaced, means for displacing the individual switch arms from the position in which they make contact with the grounding plate and means for pivotally moving the grounding plate out of the position in which it contacts the switch arms.

10. In a tester for a multiple cylinder combustion engine, a plurality of leads adapted to be connected to the spark plugs of the engine, a ground connection, switch means including contacts for connecting a selected group of the spark plug leads to the ground connection, instantaneously operable means for ungrounding all grounded spark plug leads simultaneously and a current limiting resistance in series with each spark plug lead for rendering the test construction foolproof against connecting in the wrong circuit where relatively heavy currents would otherwise injure the contacts.

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