July 27, 1954 E. W. PIERCE ET AL 2,685,060

SPARK PLUG TESTER

Filed July 13, 1949 3 Sheets-Sheet 1

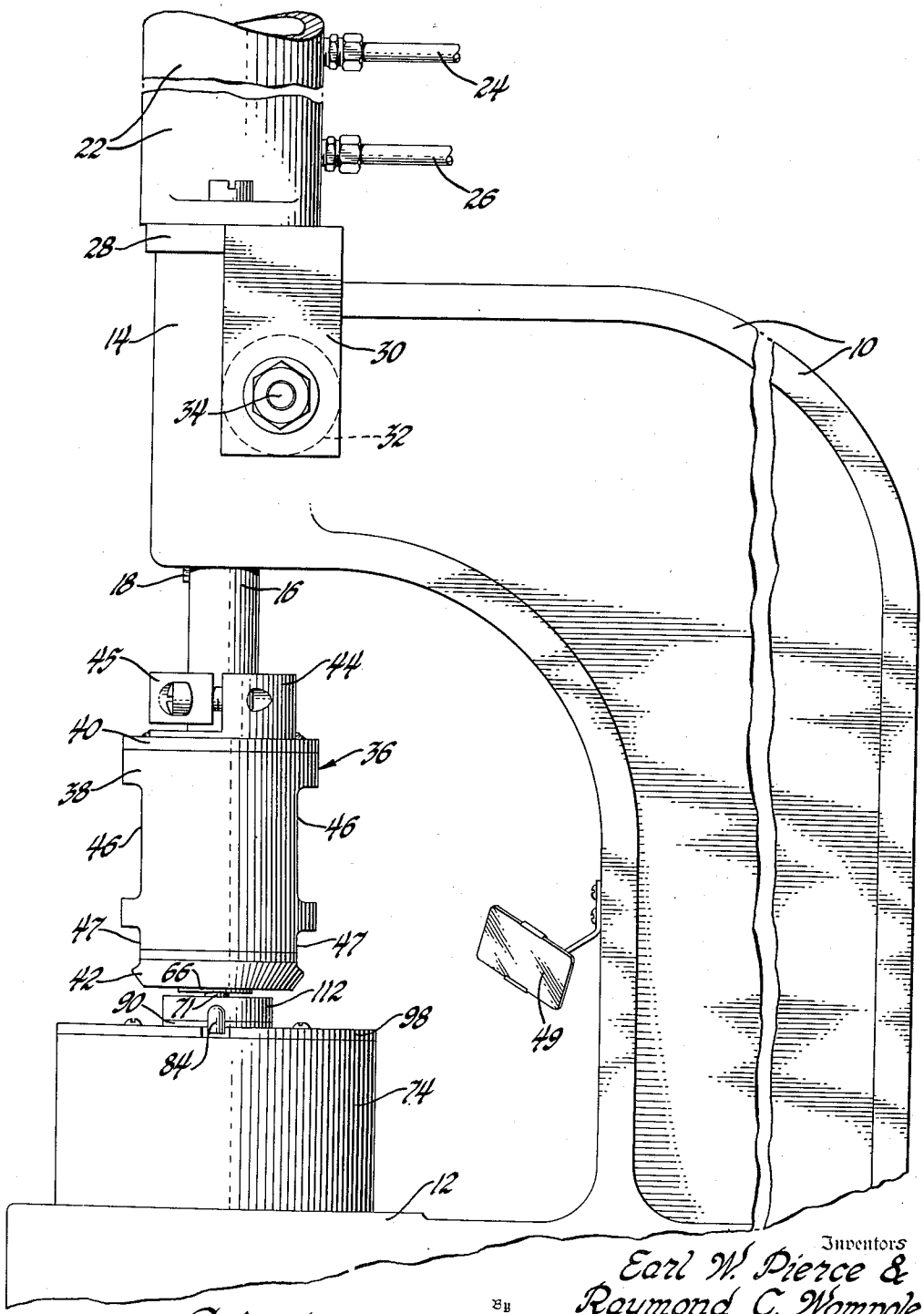


Fig. 1

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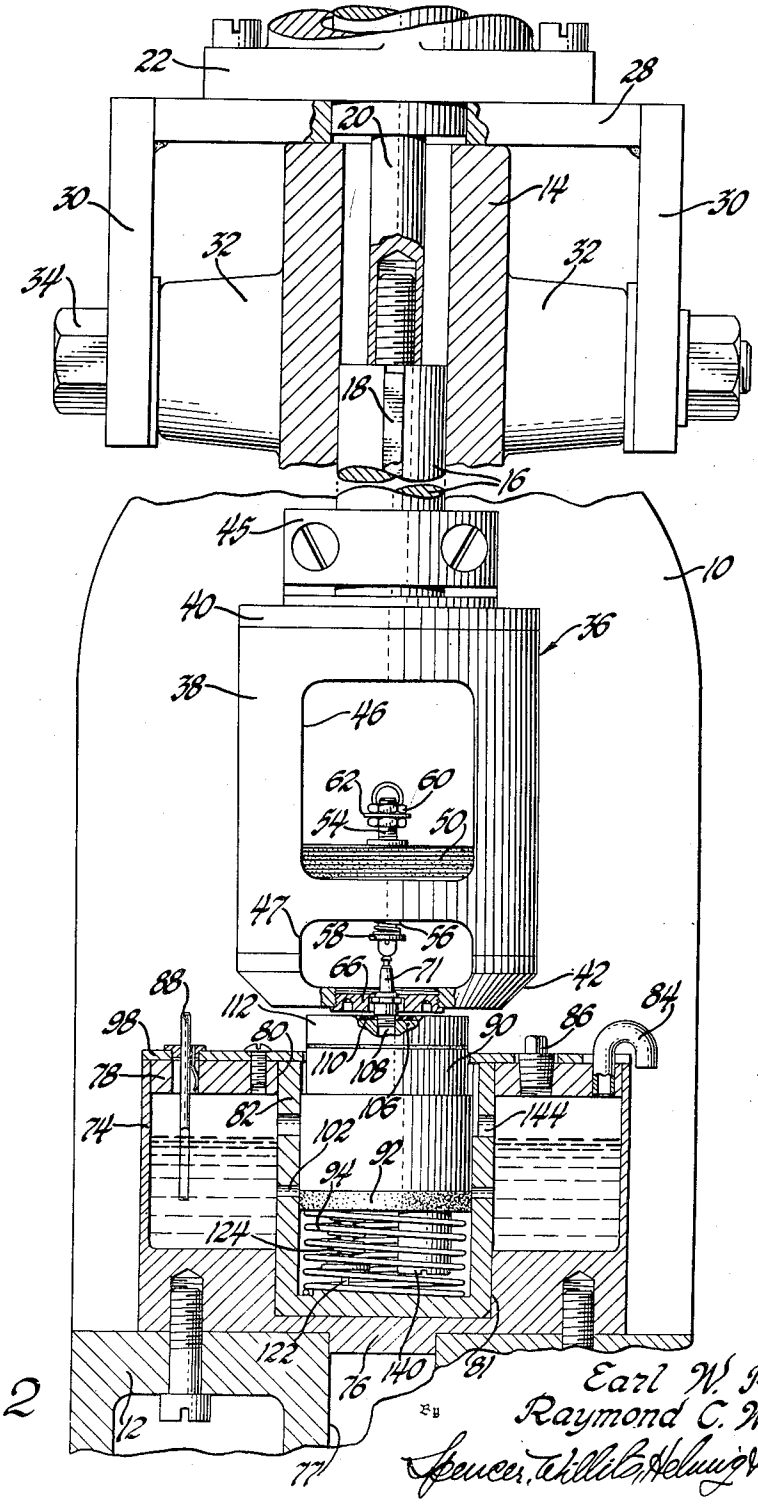


Fig. 2

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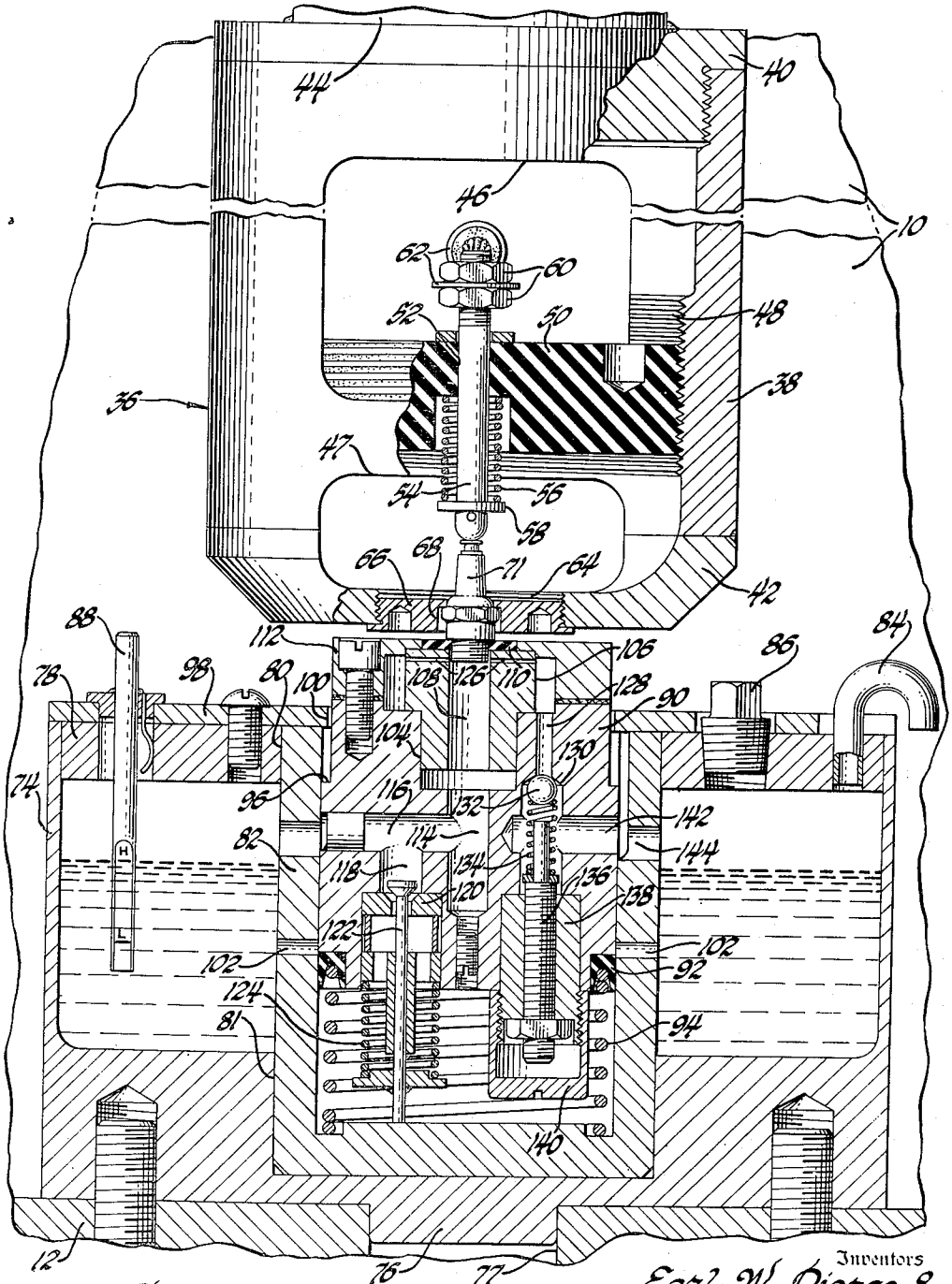


Fig. 3

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UNITED STATES PATENT OFFICE

2,685,060

SPARK PLUG TESTER

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Application July 13, 1949, Serial No. 104,566

18 Claims. (Cl. 324—15)

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This invention relates to a machine for testing electric insulation, and more particularly for testing the insulation of spark plugs.

This testing machine tests the insulation of a spark plug by quenching or insulating the spark gap with oil and applying a high voltage electric potential to the spark plug terminal. If the spark from the terminal to the shell of the spark plug is around the insulator and thus visible, the insulator is good, and if the spark is through the insulator and thus only partly visible or invisible, the insulator is defective.

The tester consists of a small press with a C frame and a vertically movable spindle or ram, such as an arbor press. The vertical ram engages the spark plug, and has an electrical contact held in contact with the spark plug terminal by a light spring. The spark plug is seated in the bore of a piston mounted in an oil cylinder. Inlet and outlet check valves in the piston maintain the oil level adjacent the top of the bore of the piston and relieve high pressure in this bore. The ram applies pressure to the spark plug to move the spark plug and piston downward in the oil cylinder to force oil around the spark plug gap. Since the inlet check valve in the piston maintains the oil level adjacent the spark plug in the bore, a minimum of piston movement is necessary to raise the oil to quench the gap. The outlet check valve controls the pressure so that the oil covers the smallest possible portion of the tip of the insulator, so that a maximum amount of the tip of the insulator may be tested.

The object of this invention is to provide a high speed spark plug testing machine whereby a minimum of movement of the spark plug and a valved piston will force the oil from a sump to quench or insulate the spark plug gap.

Another object of this invention is to provide in a spark plug testing machine in which the spark plug is mounted on a movable piston mounted in an oil cylinder to quench or insulate the spark gap, a plurality of valves to maintain the oil level adjacent the spark plug to reduce the necessary movement of the piston and a relief valve to control the pressure so that the oil covers just enough of the insulator to quench the gap.

In the drawings,

Figure 1 shows a partial elevation of the spark plug tester.

Figure 2 is an enlargement of a portion of the tester with parts in section showing the press head, the ram and oil tank.

Figure 3 is a further enlargement of the tester with parts in section showing the details of the ram and piston.

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The spark plug testing machine shown in the drawing employs a conventional C-shaped press frame 10, having a base or platen 12 and a head or guide portion 14 for the ram 16. A conventional arbor press may be used for this frame portion of the spark plug testing machine. A key 18 is fitted into suitable keyways in the internal surface of the bore in the head 14 and the ram 16 to prevent rotation of the ram. The ram 16 is connected to a piston rod 20 and a piston (not shown) within the fluid motor 22. The conduits 24 and 26 supply suitable fluid pressure to raise and lower the piston and ram assembly. The base of the fluid motor 22 is attached to plate 28 mounted on top of the head 14. Downwardly extending members 30 integral with or suitably attached as by welding to the plate 28 are anchored to the head 14 by bosses 32 and bolt 34, in order to secure the fluid motor 22 on the frame head.

The ram head 36 consists of a central cylindrical portion 38, an upper cap 40 and a lower cap 42. The ram head 36 is secured to the ram 16 by means of a two-part collar having one part 44 secured to the upper cap 40 and a second part 45 secured by screws or bolts to the first part to clamp about the end of the ram 16. The central cylindrical portion 38 of the ram head has a central internally threaded portion 48 of reduced diameter to receive a threaded plug 50 of insulating material. On opposite sides of the cylindrical portion windows 46 are located above the internally threaded portion 48 and plug 50 to provide access for the electrical conductor member 62. Below the plug 50 the cylindrical portion and lower cap 42 have suitable windows 47 on opposite sides to view the spark plug 71 being tested. With the aid of the mirror 49 both sides of the spark plug may be viewed at once.

The plug 50 has a central bore 52 to provide a guide for the reciprocally mounted contact rod 54. A spring 56 is positioned around the rod 54, and seats at one end against the plug 50 in a counterbore surrounding the rod and at the other end against a stop or abutment 58 fixed to the rod. The spring 56 exerts a light pressure on the rod 54 to hold it in contact with the electrical terminal of the spark plug with sufficient force to maintain electrical contact. At the upper end of the rod 54 suitable nuts 60 are provided to secure an electrical conductor 62 to the rod and to provide an abutment to retain the rod 54 and spring 56 in position when the ram is up. These

nuts also serve as an adjustment for the rod 54 for various length plugs. This conductor 62 is connected to one terminal of a suitable source of high voltage electricity while the machine is grounded to the other terminal.

The lower cap 42 which is secured to the cylindrical portion 38 of the ram head has a central threaded aperture 64 to interchangeably receive various pressure plates 66 having different sized central apertures 68 for each of the different sized spark plugs that are to be tested in the machine. Each of the pressure plates 66 has a central shouldered aperture 68 which engages the shell of the spark plug 71 to hold the spark plug downwardly in order to quench the gap in the oil. The plates 66 also have spanner wrench sockets to receive a spanner wrench to facilitate insertion and removal of the plate 66.

The oil tank 74 is mounted on and suitably secured to the platen 12. The tank may have the central boss 76 on the outside of the base to provide simplified locating means in connection with the bore 77 in the base. The tank has a cover 78 with a large central aperture 80 engaging and positioning the opened end of cylinder 82, while a bore 81 in the inside of the base of tank 74 receives and positions the closed end of cylinder 82. Suitably located in the cover are a vent elbow 84, a filler plug 86 and a stick-type oil level gage 88. A piston 90 is slidably mounted in the cylinder 82 and has a gasket 92 set in an annular peripheral recess at the lower edge of the piston. A coil spring 94 seated on the closed end or bottom of the cylinder 82 engages the gasket 92 and holds it in contact with the piston and resiliently urges the piston toward the top of the cylinder. The upper end of the piston has a reduced portion to provide a shoulder 96 which engages a covered stop plate 98 suitably secured to the cover 78 by screws. The cover stop plate 98 has a central aperture 100 having a slightly smaller diameter than the internal diameter of the cylinder, so that it will engage the shoulder 96 on the piston to limit the outward movement of the piston under the influence of the spring 94. When the shoulder 96 engages the stop plate 98 the ports 102 in the cylinder wall are uncovered to allow oil to flow into the lower portion of the cylinder below the piston. The upper portion of the piston 90 has a central bore 104 to receive an adapter 106 having a central bore 108 to receive the end of the spark plug 71. A gasket 110 is set on the top surface of the adapter 106 to provide a seal between the spark plug shell and the adapter. An annular clamp or securing member 112 having an inwardly extending flange which centrally locates the gasket 110 and the adapter 106 and clamps the adapter to the piston, is secured to the piston by suitable screws.

The bore 108 in the adapter connects with the bore 104 and axial passage 114 which is plugged at the end, and transverse passage 116 which is also plugged at the end to provide a continuous passage from the spark plug to the check valve passage 118 and through the check valve passage to the lower face of piston 90. This series of bores and passages provides a continuous passage from the upper face to the lower faces of the piston. The check valve 120 has a suitable body with a seat and valve stem guide for the stem 122, which has a head engaging the valve seat and a stop at the other end. A compression spring 124 engages the base of the cylinder 82 to open the valve and allow fluid to flow through valve passage 118 and passages 114 and 116 to bores 104 and 108 to quench the gap of the spark plug 71.

Near the top of the adapter 106 a plurality of radial relief passages 126 are formed. These relief passages connect with an annular space between the adapter 106 and the clamp 112. This annular space is connected to the bottom of the piston by a relief valve passage 128 having a valve seat 130. A ball valve 132 is resiliently urged in contact with the valve seat by a spring 134 supported by the adjustable abutment 136. This adjustable abutment 136 is threaded into a support 138 secured in a bore in the piston and locked by a suitable lock nut. A cap 140 threaded on the support provides protection for the adjustable abutment 136. Just below the relief valve 130 a transverse outlet passage 142 connecting passage 128 to the side of the piston provides an outlet from the relief valve to the outside of the piston. An outlet passage 144 in the cylinder allows the oil to flow to the tank.

Though this spark plug testing machine is particularly adapted for testing miniature spark plugs of less than one inch in length, the general principle may be used in testing spark plugs of any size. In testing spark plugs on this machine the ram head 36 is moved upward by the fluid motor 22. Then the spark plug 71 is seated on the gasket 110 of the piston 90 which is held in its uppermost position by the spring 94. Then the fluid motor moves the ram head down to engage the plug. The end of the electrical contact rod 54 first engages the terminal of the spark plug 71. As the ram head moves a short distance further the rod 54 moves and compresses the spring 56 and then the adapter 66 engages the shell of the plug 71 and seals it to the gasket 110.

Further movement of the ram moves the piston 90 downward. As the piston moves down the seal 92 closes the ports 102 in the cylinder and thus traps oil in the bottom of the cylinder. The pressure of the trapped oil in the bottom of the cylinder opens the valve 122 to allow oil to flow up the valve passage 118, the transverse passage 116 and axial passage 114 to the bore 108 into which the base of the spark plug 71 is seated. The oil under pressure is forced into the cavity at the base of the spark plug and surrounds the plug electrodes at the gap to prevent a spark at this point. The height to which the oil rises about the insulator, which should be the minimum necessary to quench the spark gap, is controlled by the relief valve pressure setting.

If the oil pressure is too high the pressure on the spark plug is relieved by ball valve 130. The bore 108 immediately adjacent the spark plug is connected by passages 126 and 128 to the valve 130. The pressure maintained on the electrodes at the gap is normally four pounds for miniature plugs. However, if more or less fluid pressure is needed to force the oil around the electrodes at the gap the adjusting screw abutment 136 may be moved to vary the spring pressure on the ball 132 and thus vary the pressure.

When the gap between the electrodes of the spark plug 71 is quenched by the oil the high potential electricity applied through the rod 54 will jump from the spark plug terminal through the air gap to the spark plug shell if the insulator is in good condition. However, if the insulator is defective the high potential electricity will pass from the center electrode through the insulation to the shell without producing the large

visible arc over the entire surface of the insulator. Thus the good insulators are indicated by the visible spark or arc over the insulator.

In order to remove the spark plug the ram and head are moved upward by the fluid motor 22. The piston 90 is moved up with the head by the spring 94. During the upward movement the valve 120 is held open due to the fact that the stem 122 remains in contact with the bottom of the cylinder 82. Thus the oil pressure on the bottom of spark plug 71 is relieved and the oil is allowed to recede slightly below the base of the spark plug in bore 108, after an upward movement sufficient to relieve this pressure and lower the oil level, the valve 120 closes to keep the fluid passages 114, 116 and 118 and the bores 104 and 108 substantially filled with oil. Since the oil is held in these passages the proper oil pressure can be applied at the base on the spark plug 71 with a very small movement of the piston.

Substantially at the same time or with a very slight further upward movement of the piston the ports 102 in the cylinder 82 open to enable the oil in the tank 74 to fill the space beneath the piston by gravity. At this point the upward movement of the piston 90 is stopped when the shoulder 96 engages the top stop plate 98. With further upward movement the ram head 36 releases the spark plug 71 and enables the operator to place another spark plug in the machine.

The above described embodiment is illustrative of the invention. It will be seen that various modifications of the invention may be made within the terms of the claimed invention.

We claim:

1. In a spark plug tester, a cylinder closed at the bottom end, a piston in said cylinder slidable between top and bottom stops, a bore in said piston extending from the top end to the bottom end, resilient means urging said piston against said top stop, means filling the bottom portion of said cylinder with fluid when the piston is moved against the top stop by said resilient means, a one-way valve in said bore preventing return of fluid to the bottom portion of said cylinder.

2. In a spark plug tester, a cylinder closed at the bottom end, a piston in said cylinder slidable between top and bottom stops, a bore in said piston extending from the top end to the bottom end, resilient means urging said piston against said top stop, means filling the bottom portion of said cylinder with fluid when the piston is moved against the top stop by said resilient means, a one-way valve in said bore preventing return of fluid to the bottom portion of said cylinder, and means to hold said one-way valve open when the piston is in the lower position.

3. In a spark plug tester, a cylinder closed at the bottom end, a piston in said cylinder slidable between top and bottom stops, a bore in said piston extending from the top end to the bottom end, resilient means urging said piston against said top stop, means filling the bottom portion of said cylinder below said piston with fluid when the piston is moved against the top stop by said resilient means, a one-way valve in said bore preventing return of fluid to the bottom portion of said cylinder, means to hold said one-way valve open when the piston is near the lower position and a relief valve connected to said bore.

4. In a spark plug tester, a press having a guide portion and a platen portion, a ram in said guide portion, a head on said ram, said head having an apertured plate adapted to fit over a spark plug having a terminal and a shell below the terminal and engage the shell, an electrical contact slidably mounted on said head, a spring resiliently holding said contact to engage the spark plug terminal, an oil tank on said platen, a cylinder closed at one end and having a top stop and being positioned in said oil tank, a piston in said cylinder slidable between the top stop and bottom, a port in said cylinder which is uncovered when the piston engages the top stop, a bore through said piston, a spark plug seat at the top end of said bore, a one-way valve in said bore to prevent return of fluid to said cylinder.

5. In a spark plug tester, a press having a guide portion and a platen portion, a ram in said guide portion, a head on said ram, said head having an apertured plate adapted to fit over a spark plug having a terminal and a shell below the terminal and engage the shell, an electrical contact slidably mounted on said head, a spring resiliently holding said contact to engage the spark plug terminal, an oil tank on said platen, a cylinder closed at one end and having a top stop and being positioned in said oil tank, a piston in said cylinder slidable between the top stop and bottom, a port in said cylinder which is uncovered when the piston engages the top stop, a bore through said piston, a spark plug seat at the top end of said bore, a one-way valve in said bore to prevent return of fluid to said cylinder, and means holding said one-way valve open when the piston is below the port.

6. In a spark plug tester, a press having a guide portion and a platen portion, a ram in said guide portion, a head on said ram, said head having an apertured plate adapted to fit over a spark plug having a terminal and a shell below the terminal and engage the shell, an electrical contact slidably mounted on said head, a spring resiliently holding said contact to engage the spark plug terminal, an oil tank on said platen, a cylinder closed at one end and having a top stop and being positioned in said oil tank, a piston in said cylinder slidable in substantial alignment with said ram between the top stop and bottom, resilient means holding said pistons against the top stop, a port in said cylinder which is uncovered when the piston engages the top stop, a bore through said piston, a spark plug seat at the top end of said bore, said ram positioned to move the spark plug and said piston, a one-way valve in said bore to prevent return of fluid to said cylinder, and means holding said one-way valve open when the piston is below the port and means to relieve excess pressure in said bore.

7. In a tester, a tank providing a fluid reservoir having an opening at the top, a cylinder having an opening at the top end and a closed bottom end, said cylinder being positioned in said tank below said tank opening, a piston in said cylinder slidable between upper and lower positions, resilient means holding said piston at the upper limit, means communicating with said tank and said cylinder to maintain fluid in said cylinder below said piston, a bore through said piston, a one-way valve in said bore, a spark plug seat at the top end of said bore, and means to depress said piston.

8. In a tester, a tank providing a fluid reservoir having an opening at the top, a cylinder having an opening at the top and a closed bottom end, said cylinder being positioned in said tank and being accessible through the opening in said tank, a piston in said cylinder slidable between upper and lower positions, resilient means holding said

piston in the upper position, a passage in said cylinder wall at the lower edge of the piston connecting said tank and said cylinder, a bore completely through said piston having a spark plug seat at the top and a one-way valve therein, a relief passage in said piston connecting the bore to the wall of the cylinder, a pressure relief valve in said passage, a relief port in said cylinder connecting with said passage in all positions of said cylinder, and means to depress said piston.

9. In a spark plug tester, a press having a guide portion and a platen portion, a ram slidably mounted in said guide portion, a head on said ram, said head having an apertured plate adapted to fit over a spark plug and engage the shell, an electrical contact slidably mounted on said head, a spring resiliently holding said contact to engage the spark plug terminal, a fluid tank on said platen, a cylinder closed at one end mounted in said fluid tank, a piston in said cylinder, means to supply fluid to the space in said cylinder between the piston and the closed end of said cylinder, a bore through said piston, a spark plug seat at one end of said bore, and valve means in said bore to hold fluid in said bore.

10. In a spark plug tester, a press having a guide portion and a platen portion, a ram slidably mounted in said guide portion, a head on said ram, said head having an apertured plate adapted to fit over a spark plug and engage the shell, an electrical contact slidably mounted on said head, a spring resiliently holding said contact to engage the spark plug terminal, a fluid tank on said platen, a cylinder closed at one end mounted in said fluid tank, a piston in said cylinder, means to supply fluid to the space in said cylinder between the piston and the closed end of said cylinder, a bore through said piston extending from the closed end to the open end of the cylinder, a spark plug seat at one end of said bore, a one-way valve in said bore preventing return of fluid to said closed end of said cylinder.

11. In an apparatus of the character disclosed, a cylinder having an opened end, a piston movably mounted in said cylinder and having one face adjacent said opened end, a passage in said piston extending from said one face completely through said piston, said cylinder and piston including cooperating means actuated by relative movement of said cylinder and piston to supply fluid under pressure to said passage, and means operative in said passage to maintain the fluid level in said passage adjacent the said one face.

12. In an apparatus of the character disclosed, a cylinder having an opened end and a closed end, a piston movably mounted in said cylinder and having one face adjacent said opened end and another face adjacent said closed end, a passage in said piston extending from said one face to said another face to provide a fluid passage through said piston, said cylinder and piston including cooperating means actuated by movement of said piston to supply fluid under pressure to said passage, and a check valve in said passage to maintain the fluid level in said passage adjacent said one face.

13. In an apparatus of the character disclosed, a cylinder having an opened end, a piston movably mounted in said cylinder having one face adjacent said opened end of said cylinder, a fluid test port in said one face, a passage in said piston extending from said port completely through said cylinder, said cylinder and piston including cooperating means to supply fluid under pressure to said passage to said port, means operative in said passage to maintain the fluid level in said passage adjacent said port, and a relief valve operatively connected to said passage to limit the pressure of the fluid in said passage.

14. In an apparatus of the character disclosed, a cylinder having an opened end, a piston movably mounted in said cylinder having one face adjacent said opened end of said cylinder, a fluid test port in said one face, a passage in said piston extending from said port completely through said cylinder, said cylinder and piston including cooperating means actuated by movement of said piston to supply fluid under pressure through said passage to said port, means operative to control flow in said passage to maintain the fluid level in said passage adjacent said port, and a relief valve connected to said passage.

15. In an apparatus of the character disclosed, a cylinder having an opened end and a closed end, a piston in said cylinder movable between said ends and having one face adjacent said open end, resilient means engaging said piston and cylinder and urging said piston toward said open end, a passage extending completely through said piston having a one-way valve therein to maintain the fluid in said passage adjacent said one face, means on said piston to connect a member with said passage at said one face, means to move said piston against said resilient means and said cylinder and piston including cooperating means to supply fluid under pressure to said passage when the piston is moved against said resilient means.

16. In an apparatus of the character disclosed, a cylinder having an opened end and a closed end, a piston in said cylinder movable between said ends and having one face adjacent said opened end, resilient means engaging said piston and cylinder and urging said piston toward said open end, a main passage extending completely through said piston, a relief passage in said piston and cylinder connecting said main passage to the exterior of the piston and having a pressure relief valve therein, means on said piston to connect a member under test with said main passage, means to move said piston against said resilient means and said cylinder and piston including cooperating means to supply fluid under pressure to said main passage.

17. In a tester, a press having a guide portion and a platen portion, a ram slidably mounted in said guide portion, a hollow head having one end secured on said ram, an apertured plate member at the other end of said head adapted to fit over a spark plug terminal and engage the shell, a transverse support plate within said head located centrally between the ends of said hollow head, an electrical contact slidably mounted on and extending through said plate support into both ends of said hollow head, a first abutment on the end of said electrical contact extending toward the end of said hollow head secured on said ram, a second abutment on the end of said electrical contact extending toward said apertured plate member, a spring between said second abutment and said support resiliently holding said contact to engage the spark plug terminal, said first abutment retaining said electrical contact in said support, and a spark plug seat on said platen.

18. In a tester, a support, a member reciprocally mounted on said support and having a

top face, a passage in said member terminating in a port in said end face, fluid supply and control means including cooperating means on said member and said support to supply fluid under pressure to said passage in response to movement of said member, means on said member to maintain the fluid level in said passage adjacent said port in the top face, and a relief valve connected with said passage to limit the pressure in said passage.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,175,038	Soper	Oct. 3, 1939
2,369,920	Saunders	Feb. 20, 1945
2,370,945	Fields	Mar. 6, 1945
2,401,533	Wall	June 4, 1946
2,434,969	Snider	Jan. 27, 1948
2,490,821	Leonard	Dec. 13, 1949