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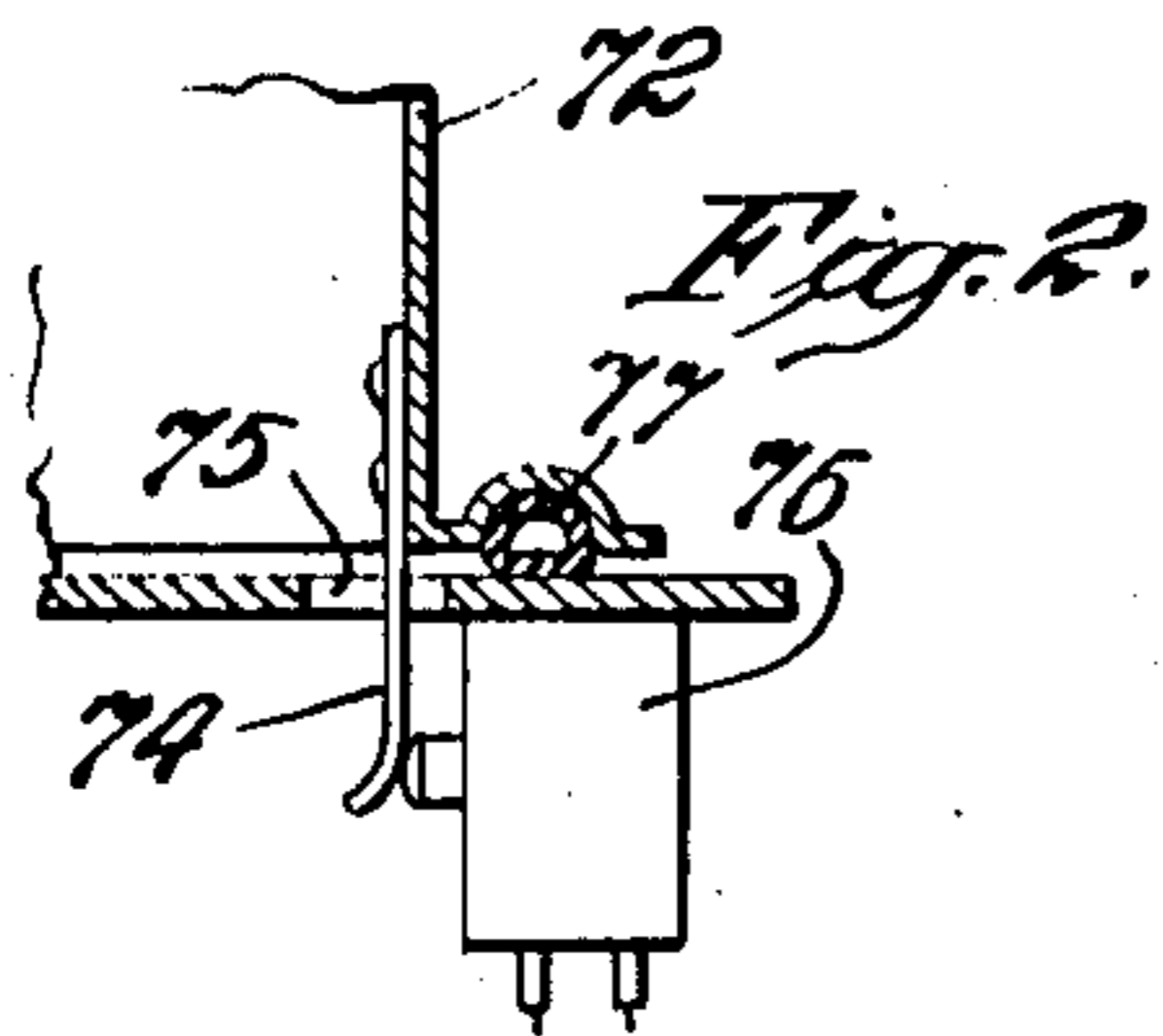
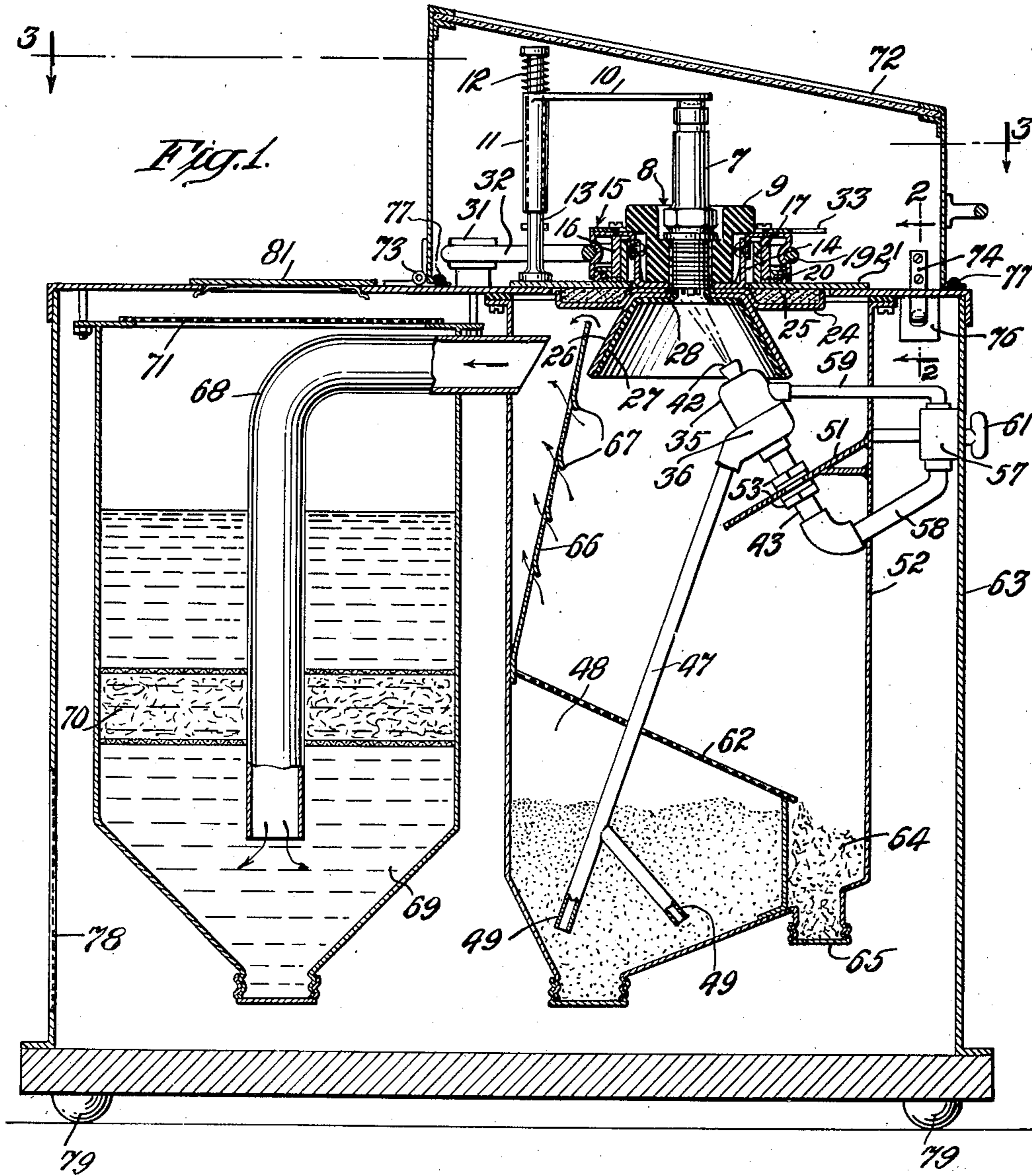
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2,332,063

SPARK PLUG CLEANER

Filed April 21, 1943

3 Sheets-Sheet 1



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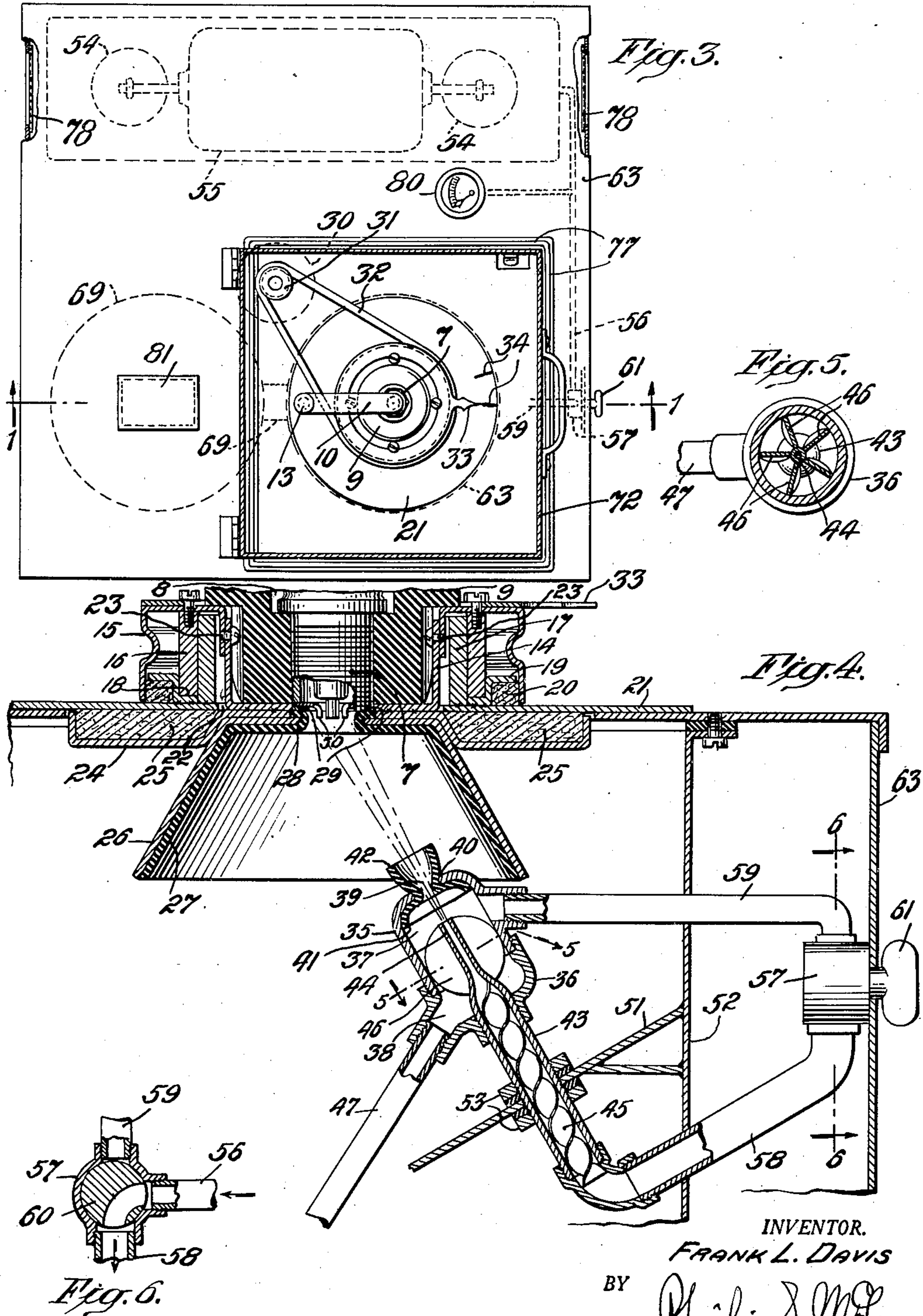


Fig. 3.

Fig. 5.

Fig. 4.

Fig. 6.

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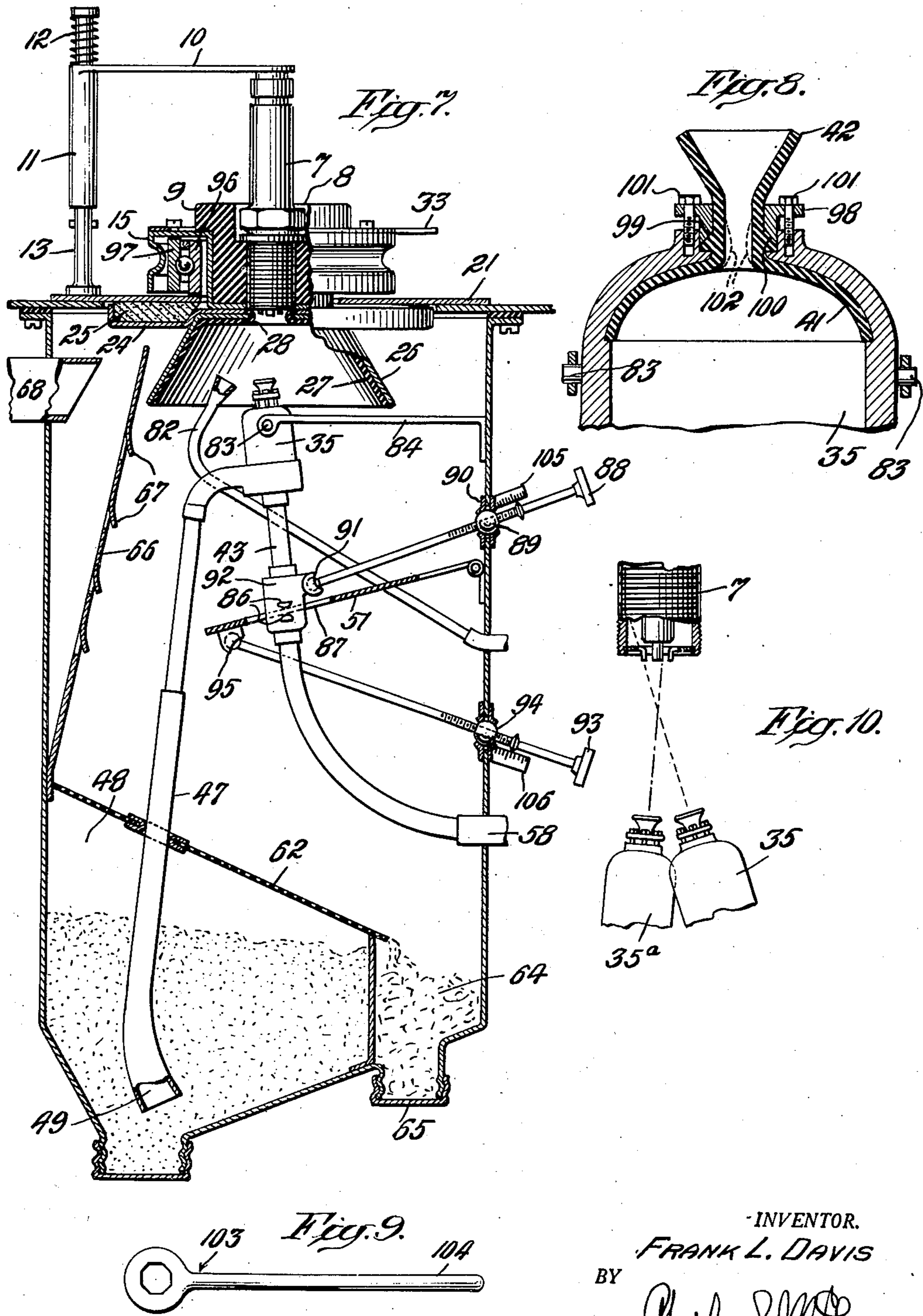
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3 Sheets-Sheet 3



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# UNITED STATES PATENT OFFICE

2,332,063

## SPARK PLUG CLEANER

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Application April 21, 1943, Serial No. 483,971

17 Claims. (Cl. 51—15)

The invention here disclosed relates to apparatus for cleaning spark plugs and particularly the plugs used in aircraft engines.

The cleaning of plugs used in aircraft engines involves special difficulties. These plugs customarily have a center electrode and a series of cooperating radial projections forming the second or outer electrode. These projections close in the end of the spark plug to a very material extent, making it difficult to reach in behind them for cleaning away accumulations of carbon and foreign matter between the outer shell and the insulating support for the center electrode.

The cleaning of these plugs is usually carried out as a part of the overhaul routine of aircraft engines. It has been impossible to use the ordinary mechanical spark plug cleaners around these overhaul jobs because of the dust and fine abrasive which these cleaners release into the surrounding air.

Special objects of the present invention are to provide a spark plug cleaner capable of reaching in behind the electrodes of the typical aircraft engine plug and of thoroughly and efficiently scouring and cleaning the same and which with all the necessary action required to secure these results, will be perfectly safe to use right in the immediate vicinity where the engines are being overhauled or other necessarily fine work is being done.

Another special object is to guard against any possibility of accidentally releasing a blast of the cleaning medium into the air, as through failure to properly cover a spark plug inserted in the machine.

Other objects of the invention are to create a more effective form of cleaning blast, to automatically screen the carbon out of the used abrasive and in general to provide a machine having all the foregoing attributes, which will be of practical, rugged design and so simple in structure and number of parts that it may be produced at reasonable cost.

Other desirable objects will appear in the course of the following specification, in which the novel features of the invention are described and broadly claimed.

The drawings accompanying and forming part of the specification illustrate certain of the present practical commercial embodiments of the invention. Structure however, may be modified and changed as regards the present disclosure, all within the true intent and broad scope of the invention as hereinafter defined and claimed.

Fig. 1 in the drawings is a broken vertical sec-

tional view of one of the machines as in actual use.

Fig. 2 is an enlarged broken sectional detail substantially on line 2—2 of Fig. 1, illustrating the automatic switch control.

Fig. 3 is a horizontal part sectional view of the machine as on line 3—3 of Fig. 1 but on a smaller scale.

Fig. 4 is an enlarged broken sectional view of the rotary plug holder and blast nozzle structure.

Fig. 5 is a cross-sectional view of the blast nozzle as on line 5—5 of Fig. 4.

Fig. 6 is a broken sectional detail of the nozzle control valve as on line 6—6 of Fig. 4.

Fig. 7 is a broken sectional view illustrating a modified form of the invention.

Fig. 8 is an enlarged broken sectional detail of an adjustable form of blast nozzle.

Fig. 9 is a face view of a special wrench and gage for accurately adjusting the blast nozzle.

Fig. 10 is a diagrammatic view illustrating the provision of a plurality of differently positioned or angled scouring nozzles.

In Fig. 1, an aircraft type plug is indicated at 7, held seated in the central opening 8, in an adapter 9, by an overstanding arm 10, projecting from a sleeve 11, tensioned downwardly on post 13, by a spring 12.

Adapters such as 9, may be provided for different sizes and styles of plugs, each arranged to support the plug or plugs for which it is intended with the open end of the plug exposed to the blast from the cleaning nozzle.

These adapters may be of rubber or like elastic material, to grip and hold the plug and to hold in place removably seated in an open socket 14, in the rotary support or pulley 15.

The latter is shown in detail in Fig. 4, as having an internal annulus 16, which may be an "oilless" bushing, journalled on an upstanding annular bearing flange 17, and riding on a step or thrust bearing 18. The latter may be the depressed inner annular flange of a collar 19, confining a ring of packing material 20, against the inner face of the pulley flange 15.

The bearing flange 17, and flange 18, of the packing collar may be welded or otherwise secured on the top plate 21, of the cabinet structure, about the central opening 22.

The annular member 14, forming the adapter socket is shown as removably secured to the surrounding pulley structure by screws 23, and this socket member is shown as having an annular outstanding cupped flange 24, welded or otherwise secured thereto and confining a gasket or



ring of packing material 25, against the under-side of the top plate 21.

Also dependent from the rotary socket portion of the pulley is a frusto-conical form of shield 26. A lining 27, of rubber or like material is shown extending up over the inner face of this shield and through the central opening 28, in such shield outwardly over the rim of such opening at 29, to form a gasket, sealing against the lower end of the shell of the plug.

The rotary plug holder described is driven in the present instance, by a small motor 30, and suitable reduction gearing, including small pulley 31, and belt 32, passing around the pulley flange 15, at slow speed, such as less than 1 R. P. M.

A pointer 33, is shown projecting out from the pulley flange to register with suitable index markings such as 34, Fig. 3, to enable one to easily make sure that the holder has completed at least one full revolution.

The blast nozzle is shown in Fig. 4, as made up of two companion shell members 35, 36, screwed together to form a mixing chamber 37, having an abrasive opening 38, in the base of the same and a central discharge nozzle in the opposite end.

The discharge nozzle is shown as made up of a rubber sleeve 39, constricted in its central portion to engage and be held in the opening 40, in the end of the chamber and flared out at the inner end at 41, to fit the inner surface of the chamber and flared to a less extent to its outer end to form a cupped discharge orifice 42.

Extending axially into the back end of the mixing chamber is an air pipe 43, constricted to a nozzle 44, spaced in back of and discharging through the orifice piece 42.

Within the air conduit there is shown a helically twisted deflector 45, for imparting rotation to the issuing air flow.

Similarly within the surrounding chamber 37, there is provided a vane or series of vanes 46, for imparting twist to the cloud of abrasive entering this chamber through conduit 47. The latter conduit as shown in Fig. 1, dips into the body of abrasive contained in the holder 48, and may have one or more branches, as indicated at 49, to reach all portions of this container.

The rotation imparted to the abrasive entering the chamber 37, creates a dispersion and forms more or less of a cloud of these grains which with their dispersion and rotative movement are picked up the more readily and forcibly carried forward by the rotating blast of air issuing from the air nozzle 44.

The abrasive nozzle is supported with its discharge end a short distance below the shell of the supported plug and inclined to direct the blast within the conical shield and upwardly at an angle against the inner wall of the plug shell.

The spacing of the nozzle a short distance below the end of the plug and the inclination of the jet from one side across to the far side of the plug shell "fans" out the jet sufficiently to project the scouring blast fully around all sides of the radial projections 50, of the outer electrode.

The nozzle is shown supported in the inclined relation described by extending the air pipe 43, through an inclined shelf or bracket 51, projecting inwardly from the wall of the enclosure 52, and by engagement of the nuts 53, on the threaded exterior of said pipe at opposite sides of said bracket or shelf.

Compressed air is supplied in the present dis-

closure by a pump 54, operated by motor 55, and connected by piping 56, with a valve body 57, Fig. 6, ported to carry air through piping 58, to the nozzle pipe 43, or to carry air through piping 59, into the upper end of the chamber 37, beyond and above the central injector nozzle 44. A ported valve plug 60, rotatable in said valve body by external handle 61, provides a control for directing either a scouring blast or an abrasive-free cleaning blast from the nozzle.

To effect a separation of the carbon and dirt removed from the plugs, from the abrasive, there is provided in the illustration, an inclined screen 62, over the abrasive compartment 48, of a mesh to generally exclude the flaky carbon particles and to pass the grains of abrasive. The greasy character of the carbon is an assisting factor, enabling the carbon to slide more freely over the inclined screen while the abrasive drops through.

The screening action described is aided and promoted in the present disclosure by mounting the motor and pump within and supported by the cabinet structure 63, and by employing a reciprocating type of pump, such as a diaphragm pump which at the high speed it is normally run, will create a definite vibration, imparting to the screen a desirable continuous shaking movement. Thus this separator has the full efficiency of a shaking screen, without taking off any useful energy for vibrating the screen.

The carbon and accompanying dirt is delivered off the lower end of the inclined shaking screen into a pocket or well 64, from which it may be removed at 65.

The nozzle supporting shelf 51, is shown as placed directly above the dirt trap 64, and as inclined inwardly and downwardly toward the upper end of the screen, thus to act as a baffle, which will deflect material away from such trap and force it to traverse the separating screen.

At the opposite side of the cleaning chamber 52, from the baffle 51, there is shown an inwardly inclined baffle 66, extending upwardly from the upper end of the screen, in back of the conical shield and louvered at 67, for passage of air into an air escape conduit 68, which extends downwardly below a body of kerosene or other dust trapping and sealing liquid in the bottom of an air exhaust chamber 69. This chamber may contain a layer or layers of glass wool or other dust packing 70, and may have one or more vents or openings 71, in the upper portion for release of the purified air.

To avoid any possibility of escape of abrasive or dust laden air at the top about the rotating spark plug holder, there is provided in the illustration a transparent hood 72, hingedly mounted on the cabinet at 73, to cover the rotary holder, the plug holddown 10 and the belt drive connections to the holder.

Use is also made of this hood to insure that the power will not be thrown on to set the machine in operation until the parts are properly protected. In the illustration, the hood carries a downwardly extending cam projection 74, at one side which will project through a narrow slot 75, in the cabinet top to throw on the control switch 76, when the hood is fully closed and conversely to let this switch open as soon as the hood is released or starts to open. This switch may control both the pump motor and the plug holder rotating motor. If desired, the plug holder may be driven through reduction gearing directly from the pump motor.

The concealment of the switch within the cabi-



net and the operation of the same from a cam carried by the hood and projecting through a small opening in the cabinet provides a desirable simple safety interlock for preventing operation until the machine is fully closed but other or additional safety features may be provided.

The rubber adapters are desirable because they yieldingly hold themselves seated in the rotary carrier and yieldingly hold the spark plugs in properly sealed relation in such carrier. The spring holddown assures the plug remaining sealed in its seated position during the entire cleaning operation. The rubber lining to the conical shield, engaged by the shell of the plug assists in this complete sealing of the plug in the operative position. The spring holddown is easily lifted and swung out of the way in the removing and placing of plugs in the machine.

Usually only one complete rotation of the plug is necessary for a thorough scouring action. The pointer 33 provides an easy guide for this operation. In practice, the holder may be slipped around one way or the other, using the pointer as a handle and the machine started with the pointer at the near index mark, that is, the mark 34, to the left in Fig. 3 and the machine continued in operation until the pointer passes this mark and goes beyond that to the next mark, thus making sure of a full complete rotation.

After making one turn with the abrasive on, that is, with the control valve as in Fig. 6, the valve handle 61, may be turned to bypass the air through the upper line 59, to flush out any loose particles in the scoured plug with clean air.

The rotation of both the air from the injection nozzle and the abrasive entering the nozzle chamber assures a concentrated uniform jet of abrasive and the direction of this concentrated blast on an incline inwardly across the transverse axis of the plug assures a thorough scouring of the plug interior behind the radially projecting portions of the outer electrode.

In the machine illustrated, the motor driven pump imparts vibration to the rotating spark plug holder as well as to the carbon separating screen. This is advantageous in actually shaking free carbon particles loosened in the plug in the scouring action of the blast from the nozzle.

The protective hood may be sealed by a gasket such as indicated at 77, and this may be sufficiently elastic to allow enough movement of the hood to actuate the control switch while the hood remains closed. Thus in the illustration, the hood is sealed by this gasket as soon as it is lowered, but slight additional pressure is required to close the switch. This is a further safety feature, for if at any time this closing pressure is released, this resilient gasket will raise the hood without actually opening it, enough to throw the switch off.

The air filter is shown supported in spaced relation below the top of the cabinet, so as to provide ample space for release of the air through the screen 71, in the top of this filter. The sides of the cabinet may be screened as indicated at 73, for free flow of air into and out of the same.

To promote desired vibration, the cabinet may be mounted on resilient supports, such as indicated at 79.

A gage 80, is shown in Fig. 3, hooked in on the pressure line from the pump so that the operator may check the action when the machine is closed and in operation.

A small door 81, is shown in the top of the cabinet directly above the air filter, providing

convenient access for supplying this filter with the sealing and purifying liquid.

In the modified form of the invention illustrated in Fig. 7, an air blast cleaning nozzle is indicated at 82, separate and apart from the abrasive nozzle 35, and the latter is shown supported so that it may be adjusted both as to angle of inclination and spacing from the plug in the holder.

For purposes of such adjustments, the nozzle is shown pivotally supported at 83, substantially on the longitudinal axis of the plug by a spring arm 84, and the inclined shelf or baffle 51, as shown as pivotally mounted at 85, and as having an adjustable connection with the nozzle.

In the illustration, the nozzle pipe 43, has a sliding mounting at 86, in a slotted portion 87, of said shelf. A hand screw 88, projecting through a spherical nut 89, sealed in a universal clamp mounting 90, in the side of the casing, has a universal ball joint connection 91, with the pipe fitting 92, so that turning of this screw will rock the nozzle on pivotal axis 83, thus to adjust the angle of inclination of the scouring blast.

A similar hand screw 93, projecting through a sealed ball bearing nut 94, and having a universal connection 95, with the shelf, provides means for raising and lowering said shelf and hence raising and lowering the nozzle, the spring pivot arm 84, yielding sufficiently for such adjustments.

By adjusting either or both screws 88, 93, the nozzle may be set to best advantage to clean different kinds and sizes of spark plugs.

Fig. 7 also illustrates how the rotary plug holder made be made up from an annular ball bearing unit, preferably of the sealed type, by securing the inner race-ring 96, fast to the supporting structure and securing the pulley flange 15, and the socket 14, fast to the outer race ring 97.

To compensate for wear, the nozzle may be constructed as shown particularly in Fig. 8, by providing a gland 98, about the neck of the orifice lining, having a beveled inner end 99, bearing on the inclined external shoulder 100 of the lining, so that with taking up on the gland screws 101, the throat of the lining will be contracted as indicated in the dotted lines at 102.

A special wrench, such as shown at 103 in Fig. 9 may be provided for adjusting these screws and this wrench may have a stem portion 104 of a size to form a gage for the proper size of the throat orifice.

To facilitate desired adjustments of the nozzle, the adjusting screws 88 and 93, Fig. 7, may have suitable scales 105, 106, associated with them. These scales may show the inclination and positioning of the nozzle in respect to the plug.

According to one method of operation, the nozzle is at one inclination, such as indicated in Fig. 7, for one revolution of the plug and then inclined at a different angle for one or more additional revolutions of the plug, assuring the blast reaching all internal walls of the plugs.

In the form of the invention illustrated in Fig. 10, two blast nozzles 35, 35a, are provided, inclined at different angles, possibly spaced different distances from the end of the plug and disposed to jet the abrasive at different sections of the plug, so as to reach all surfaces, and without one stream interfering with the other stream of abrasive. With such a construction as this, all



portions of the plug to be scoured will be reached in a single revolution of the plug.

What is claimed is:

1. A spark plug cleaner, comprising a rotatably mounted spark plug holder having a central opening to receive and expose the end portion of a spark plug, means for positively rotating said holder, a nozzle positioned to direct a blast of cleaning medium toward the edge portion of said spark plug opening at an angle to the axis of a plug seated in said opening, means for supplying a blast of cleaning medium to said nozzle and for at the same time initiating operation of said means for rotating said spark plug holder, a deflecting shield about the open end of said rotating holder, a carbon separating screen in the line of material deflected by said shield and an abrasive collector behind said screen.
2. A spark plug cleaner, comprising a rotatably mounted spark plug holder having a central opening to receive and expose the end portion of a spark plug, means for positively rotating said holder, a nozzle positioned to direct a blast of cleaning medium toward the edge portion of said spark plug opening at an angle to the axis of a plug seated in said opening, means for supplying a blast of cleaning medium to said nozzle and for at the same time initiating operation of said means for rotating said spark plug holder, a blast confining shield carried by said rotating spark plug holder, an air escape chamber about said rotating shield, a liquid seal dust removing air filter and a conduit extending from said air chamber into the liquid seal of said air filter.
3. A spark plug cleaner, comprising a spark plug holder, a nozzle cooperatively related to said spark plug holder and having a mixing chamber, compressed air and abrasive conduits extending to said mixing chamber and means associated with the respective conduits for imparting rotative movement to both the compressed air and the abrasive meeting in the mixing chamber of said nozzle.
4. In a spark plug cleaner, a blast nozzle having a chamber terminating in a constricted outlet, said chamber having an abrasive inlet and provided with a vane or vanes for imparting whirling motion to abrasive entering said chamber and passing to said outlet and a compressed air conduit entering said chamber and discharging through said outlet, said conduit having a vane or vanes for imparting whirling motion to compressed air flowing therethrough and discharging into said outlet.
5. A spark plug cleaner, comprising a cabinet, an abrasive container in said cabinet, an inclined carbon separating screen for said container and of a mesh to pass carbon-freed abrasive, an abrasive discharging nozzle in the cabinet above said screen, a spark plug holder mounted in the cabinet above said nozzle, an abrasive conduit extending from said abrasive container to said nozzle, a compressed air conduit extending to said nozzle and a motor driven air compressor carried by said cabinet, said compressor being of the reciprocating type and attached to said cabinet to impart vibration thereto and to the spark plug holder and inclined screen mounted in said cabinet.
6. A spark plug cleaner, comprising a cabinet, an abrasive container in said cabinet, an inclined carbon separating screen for said container and of a mesh to pass carbon-freed abrasive, an abrasive discharging nozzle in the cabinet above said screen, a spark plug holder mounted in the cabinet above said nozzle, an abrasive conduit extending from said abrasive container to said nozzle, a compressed air conduit extending to said nozzle and a motor driven air compressor carried by said cabinet, said compressor being of the reciprocating type and attached to said cabinet to impart vibration thereto and to the spark plug holder and inclined screen mounted in said cabinet.
7. A spark plug cleaner, comprising a cabinet, an abrasive container in said cabinet, an inclined carbon separating screen for said container and of a mesh to pass carbon-freed abrasive, an abrasive discharging nozzle in the cabinet above said screen, a spark plug holder mounted in the cabinet above said nozzle, an abrasive conduit extending from said abrasive container to said nozzle, a compressed air conduit extending to said nozzle and a motor driven air compressor carried by said cabinet, said compressor being of the reciprocating type and attached to said cabinet to impart vibration thereto and to the spark plug holder and inclined screen mounted in said cabinet, said nozzle being mounted in said cabinet toward the lower end of the inclined screen and inclined in substantially the same direction as said screen and a baffle at the back of said nozzle inclined downwardly toward the lower end of said inclined screen.
8. A spark plug cleaner, comprising a spark plug holder, means for directing a jet of scouring fluid into a spark plug supported in said holder and including a motor driven pump, a controller for said motor driven pump, a movable cover over said spark plug holder, means on said movable cover for effecting operation of said controller, a cabinet within which said controller is located, said cabinet having a small opening in line with said controller and said means including a small projection on said cover operable through said small opening into operative relation to said controller.
9. A spark plug cleaner, comprising an abrasive nozzle having a chamber having an abrasive opening in one end, a discharge outlet at the opposite end and an air inlet near said opposite end, an injector nozzle entered in said chamber and directed into said discharge passage, and air supply piping to said air inlet and to said injector nozzle including a two-position valve operative to direct fluid either to said air inlet or to said injector nozzle.
10. In a spark plug cleaner, a blast nozzle comprising a chamber having a discharge outlet in one end and a resilient liner in the form of a sleeve having a restricted central portion engaged in said outlet and cupped portions at opposite ends of the same, one within and the other without said chamber.
11. In a spark plug cleaner, a rotary spark plug holder, a nozzle for directing a cleaning blast at a spark plug seated in said holder, drive means for rotating said holder and means for indicating complete revolutions of said rotary holder, including a projecting pointer carried by said holder and a relatively stationary marker cooperable with said pointer, said holder being free to be turned by said pointer for the purpose



of arbitrarily positioning the same in respect to said marker.

12. A spark plug cleaner, comprising a cabinet, a rotary spark plug holder journaled in the top of said cabinet, an upstanding post on the top of said cabinet at one side of said rotary holder, a spring pressed sleeve slidably guided on said post and having a laterally projecting arm engageable over the end of a spark plug seated in said rotary holder and means within said cabinet for directing a blast of cleaning fluid at a spark plug seated in said rotating holder.

13. A spark plug cleaner, comprising in combination, a holder for a spark plug, a movable cover for enclosing a spark plug entered in said holder, means for creating a cleaning blast on a spark plug entered in the holder, a controller for said means, an actuator carried by said cover for throwing said controller and a gasket for sealing said cover in closed position, said gasket having sufficient resiliency to shift said cover in an opening direction far enough to cause said actuating means to release said controller.

14. A spark plug cleaner, comprising a spark plug holder, a blast nozzle for cleaning a plug seated in said holder, means for pivotally supporting said nozzle, means for angularly adjusting said nozzle on its pivotal support, means for bodily shifting said pivotally mounted nozzle toward and away from said spark plug holder, an enclosure about said nozzle, said adjusting means projecting to the outside of said enclosure and indicating means associated with the exposed portions of said adjusting means.

15. A spark plug cleaner, comprising a spark plug holder, a blast nozzle associated therewith, said nozzle having a discharge outlet, a compressible liner seated in said discharge outlet and means on said nozzle for variably contracting the throat portion of said liner.

16. A spark plug cleaner, comprising a spark plug holder, a nozzle positioned to direct a stream of abrasive toward a spark plug positioned in said holder, a support for said spark plug holder and abrasive nozzle, said support being mounted for vibratory movement, a motor driven air compressor connected with said nozzle and mounted on said support to impart vibratory movement thereto and a screen positioned for screening the abrasive discharged by said nozzle, said screen being mounted on said vibratory support so as to be shaken thereby during operation of said motor driven air compressor.

17. A spark plug cleaner, comprising a cabinet having a top with an opening therein, a spark plug holder rotatably mounted in line with said opening, said rotatable holder having a spark plug seat in the top of the same and having a blast confining shield at the bottom of the same and within the cabinet, a dust excluding packing between said shield and the top structure of the cabinet, motor operated belt drive connections above the cabinet top for rotating said spark plug holder and a spark plug cleaning nozzle below the cabinet top and directed into the shield carried by said rotating spark plug holder.

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