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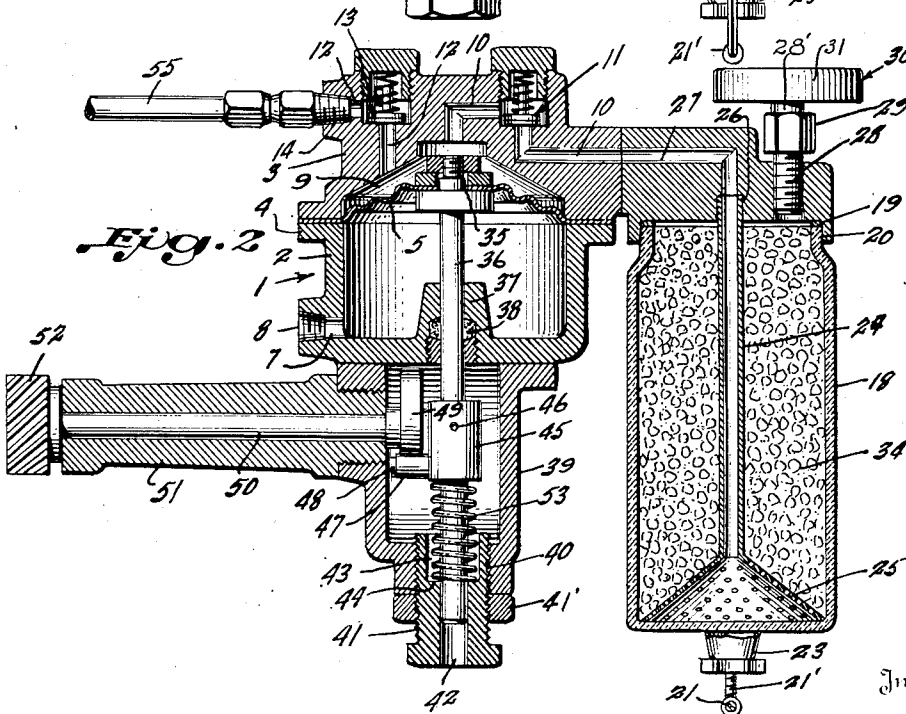
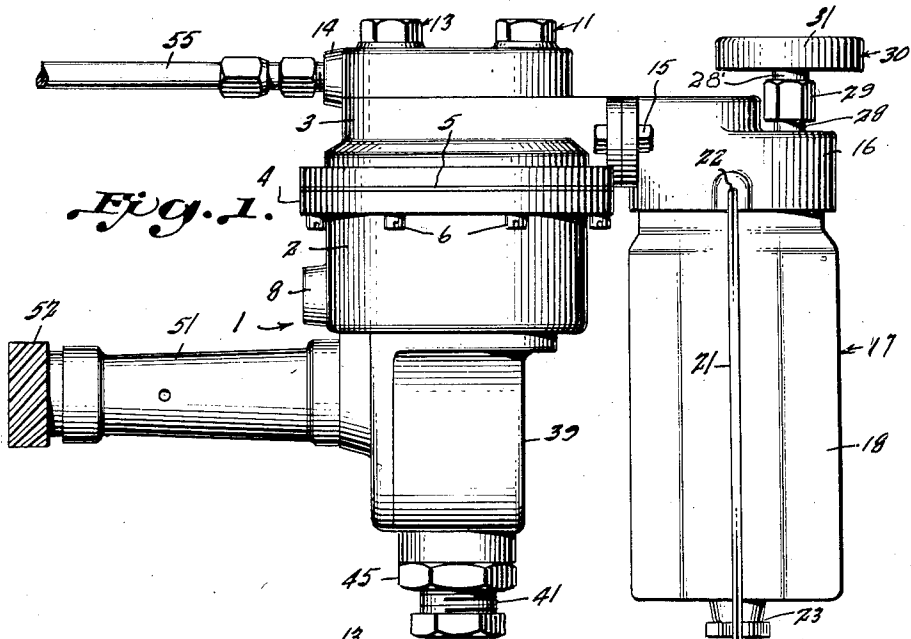
R. L. ANDERSON

2,359,959

ELECTRICAL IGNITION SYSTEM

Filed Feb. 10, 1943

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

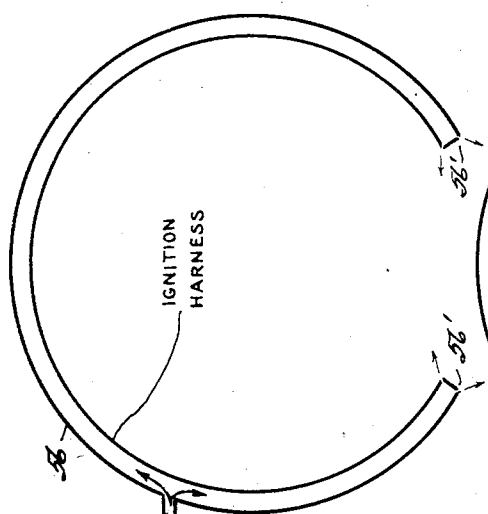


Fig. 3.

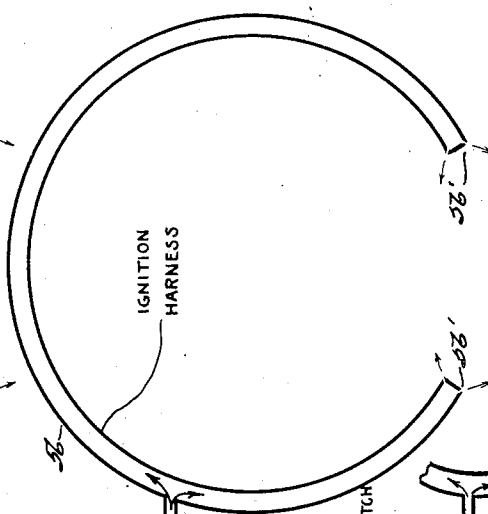


Fig. 4.

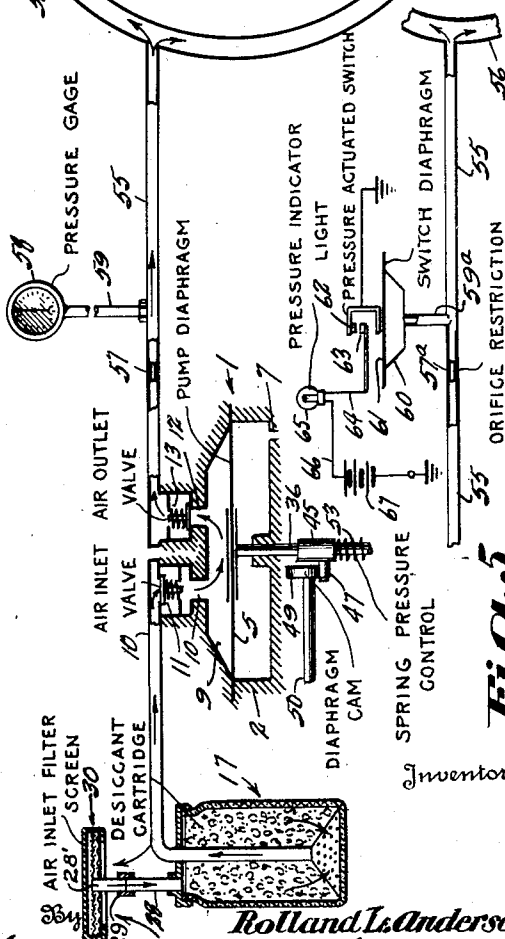


Fig. 5.

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3 Sheets-Sheet 3

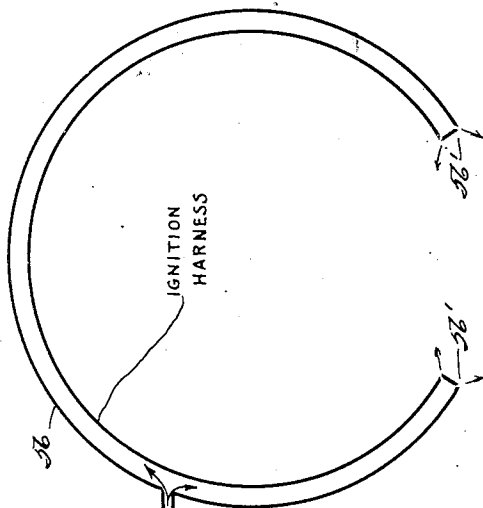


Fig. 6.

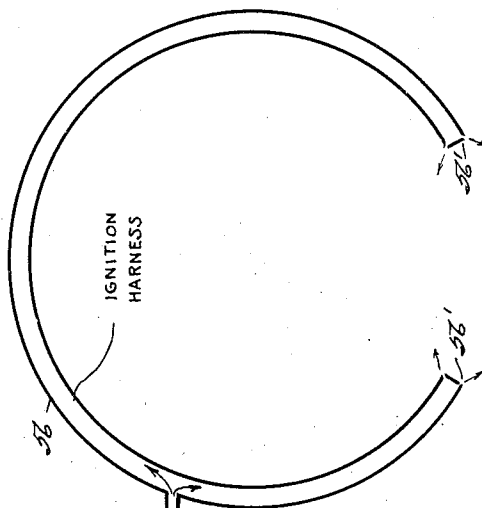


Fig. 8.

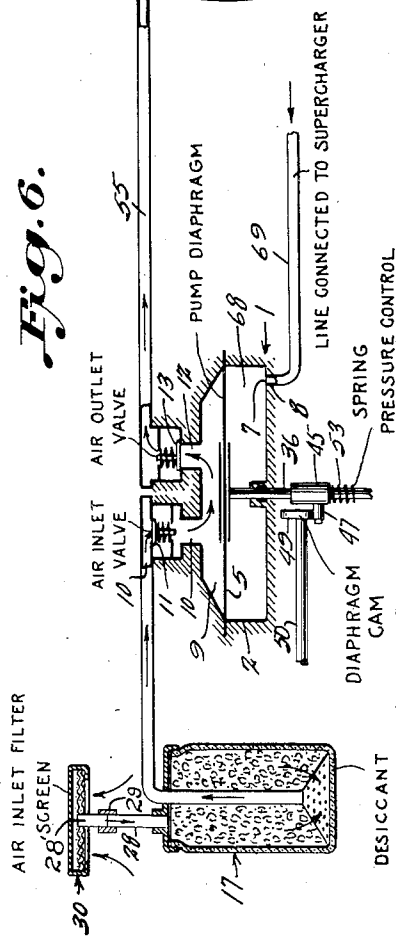
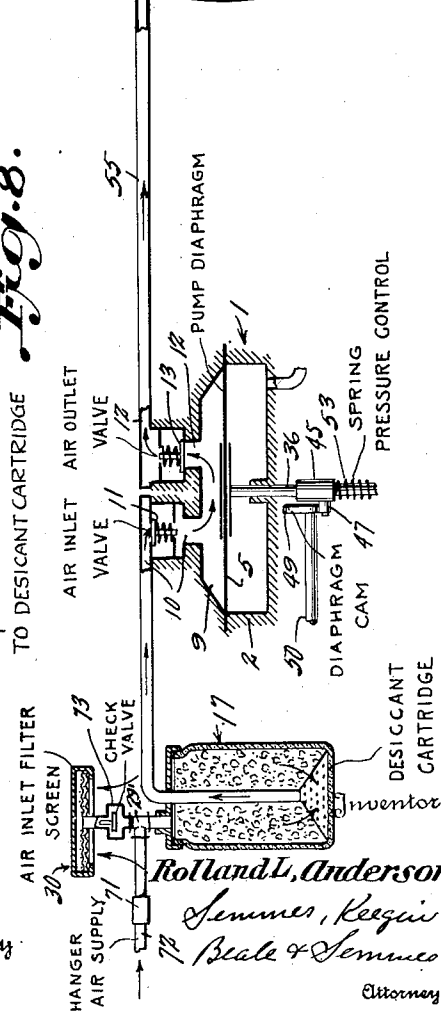


Fig. 7.



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UNITED STATES PATENT OFFICE

2,359,959

ELECTRICAL IGNITION SYSTEM

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Application February 10, 1943, Serial No. 475,415

17 Claims. (Cl. 123—148)

The present invention relates to electrical ignition systems and more particularly to a method and apparatus for supplying cleaned and dried air to a supercharged ignition system for aircraft engines at a predetermined pressure and volumetric rate.

Supercharged ignition systems employing a housing or manifold, commonly known as an "ignition harness" in which the sparkplug terminals and cables, distributors, etc., are encased at a pressure higher than the surrounding atmosphere, have been used in airplane installations for some times with beneficial results. A description of such a harness and its advantages is clearly set forth in Patent 2,213,478 to C. E. Swanson. Such apparatus, however, has not operated heretofore with optimum efficiency due to inherent characteristics of the pumps used to supply air to the harnesses.

The purpose of these pumps is two fold. First, to supply a circulation of clean dry air through the ignition harness to purge it of detrimental matter such as water vapor, oil vapor, etc.; and, second, to maintain such air at a sufficient pressure within the harness to suppress corona discharge. The purging circulation through the ignition harness may be effected either by the provision purposely created of bleed apertures or by the escape of air through inherent leakages in the harness such as at adjoining parts. The amount of such escaping air, in either case will be variable because of variable pressure differences inside and outside the harness at different altitudes of flight or by abnormal escape of air due to the enlargement of the inherent leakages. In the operation of the airplane engine, as its power increases the pressure within its cylinder, at the time of firing, increases with a consequent increase in voltage necessary to fire the sparkplugs. This increase in voltage in the ignition system increases the corona, thus requiring an increase in pressure in the harness to suppress the corona discharge. One of the reasons that the ignition harnesses have not heretofore operated at maximum efficiency is because the pumps supplying air to supercharge them have operated at a constant capacity and have therefore been unable to adapt themselves to the varying conditions above set forth.

It is therefore the principal purpose of this invention to provide a method and apparatus for pressurizing the ignition system of an aircraft engine which will automatically adapt itself to varying pressure requirements of the system.

Another object of this invention is to provide

a pump for pressurizing an ignition system, such pump having a displacement which automatically varies with respect to the pressure requirements of the ignition system.

Yet another object of the invention is to provide a pump for pressurizing an ignition system incorporating adjustable means for varying the delivery pressure of the pump.

A further object of this invention is to provide a reciprocating pump for supplying air to a supercharged ignition system, which incorporates means to operate the pump which are responsive to variation in air pressure within said supercharged system.

A still further object is to provide a pump for pressurizing an aircraft ignition system, such pump being adapted to automatically vary its compression force, and thereby vary its output pressure, to compensate for varying pressure requirements of the system.

Still another object is to provide an apparatus of the above character which incorporates means for visually indicating the volumetric output of the pump, thereby indicating abnormal conditions in the ignition harness.

A still further object is to provide an apparatus for supercharging the ignition system of an internal combustion engine which comprises a pump for supplying atmospheric air to the harness, air drying means communicating with the input side of the pump, means for admitting cleaned atmospheric air to the drying means, means for supplying air under pressure from a supplemental source through the drying means and pump casing to the harness when the pump is inoperative and means operated by the air from the supplemental source for blocking off the atmospheric air admission means when air from the supplemental source is being supplied to the harness.

Yet another object is to provide an apparatus of the above character which is simple and economical and compact in construction, yet efficient in its operation and producing optimum operating conditions for the electrical system of the engine.

Other objects and advantages will be apparent to those skilled in the art from the following description and by reference to the accompanying drawings which illustrate only preferred embodiments of the invention.

In the drawings:

Figure 1 is a side elevational view of the pump with its associated air conditioning unit.

Figure 2 is a transverse sectional view of the

structure shown in Figure 1, certain parts being shown in elevation.

Figure 3 is a schematic view illustrating the apparatus shown in Figure 1 as applied in one embodiment of the invention.

Figure 4 is a view similar to Figure 3 illustrating a pressure indicator in the air system.

Figure 5 is a view of a fragment of the air system illustrating an electrically operated pressure indicator.

Figure 6 is a schematic view illustrating a modified embodiment of the system.

Figure 7 is a fragmental view showing schematically an air cleaner installation which may be employed under certain conditions.

Figure 8 is a schematic view of a still further modified embodiment.

Referring to the drawings, Figures 1 and 2 represent one embodiment of the pump employed to supply air to the ignition harness. This pump comprises a casing 1 having a lower cup-shaped portion 2 and a cap 3. The lower portion 2 is provided with an externally flanged rim 4 between which rim and the cap 3 is secured a flexible diaphragm 5 by means of screws 6. The cup-shaped portion 2 of the housing is provided with a bleeder aperture 7 which is provided for relieving pressure in the lower portion of the casing 2 in one application of the invention which will be described later. The bleeder aperture 7 communicates with an internally threaded boss 8 provided for the attachment of a conduit used in another application of the invention, also to be later described.

The cap 3 is recessed in its lower face to form an air chamber 9 which has communicating therewith an inlet duct 10 controlled by a spring loaded check valve designated generally as 11. Also communicating with the air chamber 9 is an outlet duct 12 which is controlled by a spring loaded check valve 13. The duct 12 connects with an internally threaded boss 14.

Attached to the cap 3 by suitable means, such as shown at 15, is the cover member 16 of a desiccant cartridge 17. The cartridge 17 comprises a jar 18 which is retained against a gasket 19 fitted within a recess 20 in the lower surface of the cover member 16. A wire loop 21 pivotally carried by the cover 16 as indicated at 22 extends around and under the jar 18 and is provided with a threaded pin 21' and nut 23 which engages the lower surface of the jar 18 to maintain its engagement with the cover 16.

Centrally positioned in the jar 18 is a tube 24 which terminates at its lower end in a perforated cone 25 adapted to closely engage the bottom of the jar. The upper end of the tube 24 fits within a socket 26 formed in the cap 16, which socket communicates with a conduit 27. When the desiccant cartridge 17 is operatively connected to the pump cap 3, the conduit 27 is adapted to register with and form a continuation of the inlet conduit 10. Also provided in the cover 16 is a threaded nipple 28 to which is attached, by means of a union 29, an air strainer 30 of any suitable construction. Such a strainer may comprise, as shown diagrammatically in Figure 3, a casing 31 provided with an inlet opening 32 and which contains a series of screens 33. An outlet pipe 28' communicates with the interior of the casing 31 and is adapted to be coupled with the nipple 28 by means of the union 29.

A suitable desiccant 34 such as silica gel or activated alumina is contained within the jar 18 and atmospheric air drawn into the pump chamber passes first through the air strainer 30, down-

wardly through the desiccant material 34, the perforated cone 25, and thence upwardly through the tube 24 and conduits 27 and 10 and into the air chamber 9.

The diaphragm 5 has attached thereto, as shown at 35, an operating rod 36 which is journaled for reciprocating motion in a bearing 37 formed in the bottom of the pump housing 2. Suitable packing material 38 surrounds the operating rod 36 to form an air-tight seal between the rod and the lower portions of the pump casing 2.

Attached to the bottom surface of the pump casing 2 is a housing 39 adapted to encase the operating mechanism for the valve and has provided therein a threaded aperture 40 arranged coaxially with respect to the rod bearing 37. An externally threaded quill member 41 provided with a bore 42, which is enlarged at 43 to provide a shoulder 44, is threaded into the aperture 40 and is adapted to be secured against displacement by means of a lock nut 41'.

The diaphragm operating rod 36 extends through the housing 39 and has its lower end journaled in the bore 42. A collar 45 surrounds that portion of the rod 36, which passes through the housing 39, and is secured thereto by suitable means such as a pin 46. A roller 47, attached to the collar 45 by means of a radial pin 48, serves as a follower for a cam 49 attached to one end of a shaft 50 which is journaled in a sleeve 51, secured to and extending laterally from the housing 39. The opposite end of the shaft 50 is provided with means to impart torque thereto such as indicated by the pinion 52.

Any suitable power may be employed to operate the pump. Preferably the pump housing 1 may be suitably attached to one of the accessory pads of the airplane engine, the gear 52 being driven by a suitable part of the engine but as an alternative means of driving the pump, the shaft 50 may be suitably coupled to an auxiliary motor to operate the pump. One of these pumps may be provided for each engine or the output of the pump provided with a suitable manifold and used to supply air to the ignition harness of more than one engine.

Surrounding the operating rod 36, and having its opposite ends in respective engagement with the collar 45 and the shoulder 44 of the quill 41, is a helical compression spring 53 which serves normally to force the operating rod 36 upwardly, (in the position of the pump shown in Figure 2) to cause the diaphragm 5 to displace air within the chamber 9. The force exerted by the spring 53, and as a consequence, the output pressure of the pump may be adjustably regulated by means of the screw threaded quill 41, that is, the compression force of the spring is increased by screwing this quill further into the housing and its compression force is decreased by opposite rotation of the quill, the adjusted position of the quill being locked by means of the lock nut 45.

In operation, as the shaft 50 is rotated in either direction, and during one half of its rotation, the cam 49, engaging the following roller 47, causes the operating rod 36 to be moved to flex the diaphragm 5 to increase the volume of the chamber 9. This draws air from the outside atmosphere through the strainer 30 and desiccant 34, thus conditioning the air; and thence through conduits 24, 27 and 10, past the check valve 11 and into the chamber 9. This movement of the cam compresses the spring 53; and, during the second half of the cam cycle, the energy stored

in the spring is released to force the rod 36 upwardly to flex the diaphragm in the opposite direction and reduce the volume of the chamber 9 to force the air therein out through the conduit 12 past the check valve 13.

The above construction constitutes, in effect, an automatically variable displacement pump. The lost motion drive, provided by the interaction of the cam 49 and spring 53 imparts a stroke, or displacement movement, to the diaphragm 5 which will vary with respect to the pressure differential obtained on opposite sides of the diaphragm. For example, should the spring 53 be adjusted to impart a predetermined compression force on the diaphragm, the air pressure on the spring side of the diaphragm remaining constant, the length of stroke and hence the displacement of the pump will automatically vary with the pressure imposed on the opposite side of the diaphragm. In addition, the air pressure in the casing 2 may be regulated to add to or subtract from the force exerted by the spring 54 and thereby also control the output pressure of the pump. The advantages of such pump operation in the installations about to be set forth will be readily appreciated.

Referring now to Figure 3, there is shown schematically an installation of one embodiment of the invention, wherein the pump 1 is connected to the ignition harness of an internal combustion engine by means of a conduit 55. This harness is of a type disclosed in the above mentioned Patent 2,213,478 and includes a substantially closed manifold 56 which encases the sparkplug cables of the engine. A portion of the air supply to the harness from the pump is vented, as shown at 56', to create a circulation of air through the harness which serves to sweep out water vapor and other gaseous products which may have a detrimental effect on the ignition system.

It is usual to permit this air to escape through leakages around joints, etc. in the harness while an optimum operating pressure is maintained in the harness and it has been estimated that approximately 15 to 20 cubic feet of air per hour is necessary to compensate for this leakage. As has been set forth, these leakages may become enlarged in service due to vibration of the engine and other reasons, or the amount of air escaping from the harness may vary with differences in outside atmospheric pressure and the output volume of the pump supplying air to the harness should be such that it will compensate for this variation in escaped air. The pump comprising this invention will automatically function in this manner as will be obvious from the following description of its operation.

In operation, the cam 49 is set in rotation and, during the first half of the cam's revolution, the diaphragm 5 is displaced downwardly with respect to the air chamber 9, and cleaned and dried air is drawn past the check valve 11 into the air chamber 9. During the latter half of the cam's rotation the cam moves away from its follower 47, and the spring 53 displaces the diaphragm 5 upwardly into the chamber 9, reducing the volume of the chamber, and forcing the air out past the check valve 13 through the conduit 55, and into the ignition harness. The pump continues to operate thus until the air pressure in the harness 56 has been built up to the predetermined operating pressure controlled by the compression force of the spring 53, which has been adjusted

for example, to deliver an output pressure of the pump of 5 pounds per square inch.

At the beginning of the above operation of the pump, the air pressure in the chamber 9 is substantially that of the outside atmosphere, thereby permitting the spring 53 to effect a full stroke of the pump, or in other words, move the diaphragm until the roller 47 engages the lowermost position of the cam 49. As the pressure in the harness 56 builds up, a back pressure is imposed on the upper face of the diaphragm 5 which acts against the force exerted by the spring 53. As this back pressure increases, and since the spring 53 is set to exert a predetermined force, the stroke of the pump will be shortened and the volumetric output of the pump will be reduced.

As air is supplied to the harness, a portion of this air escapes, tending thereby to reduce the pressure in the harness. However, the pump, operating normally, compensates for this escaped air and the predetermined internal pressure is maintained. Should the amount of this escaped air become abnormal through enlargement of the leakages, reduction in atmospheric pressure, or other reasons, the pressure within the pump 56 will be lowered with a consequent reduction of the back pressure on the upper face of the diaphragm 5. This increases the pressure differential between that reacting on the upper face of the diaphragm and the pressure of the spring reacting on the lower face, permitting the stroke of the pump to be increased to make up for this increase in escaped air from the harness.

Under certain conditions of aircraft operation, for instance when the airplane drops from a higher to a lower altitude, and there is a tendency for moisture to condense in the chilled harness, it may be necessary to increase the circulation of dried air through the harness to remove this moisture. Means for creating this increased circulation are not disclosed in the present application, as not forming a part thereof, but may comprise conveniently located controlled orifices in the harness. When such purposely created leakages are effected, the operation of the pump, as above set forth, will also compensate to maintain the correct operating pressure of the harness.

Another important feature of the pump in addition to the automatic control of its output volume is that its pressure output may be also regulated to adapt the pump for a variety of operating conditions. To accomplish this the output pressure of the pump 1 may be easily adjusted by manipulation of the thimble 41 which serves to increase or decrease the operating pressure of the spring 53.

It is often advantageous for the pilot of the airplane to know the operating conditions of the harness and the pump, and to provide for such a situation, as shown in Figure 4, a restricted orifice 57 is placed in the outlet conduit 55 leading from the pump to the harness 56. A visual indicator such as a pressure gauge 58 may be located in the cockpit of the airplane and connected with the line 55, adjacent the discharge end of the orifice 57, by means of a pipe line 59. As air is supplied to the harness by the pump, it is bled through the restricted orifice 57, thereby reducing the pressure in the line 59, which reduction in pressure is indicated on the gauge 58. Should the output volume of the pump 1 be increased, due to increased leakage in the harness 56, such increase in the flow of air through the conduit 55 will be indicated on the pressure

gauge 58, and thereby indicate an abnormal condition in the harness. In addition, the gauge 58, functioning as above, provides a flow meter to indicate the operating condition of the pump.

In lieu of the gauge 58, a modified form of indicator may be provided as illustrated in Figure 5. In this modification, a pipe 59a communicates with the conduit 55 adjacent the discharge end of an orifice 57a and connects with an air chamber 60 which has associated therewith a flexible diaphragm 61. Attached to the diaphragm 61 is a contact member 62 adapted to engage, when the pressure in the line 59a is reduced below normal, with a contact 63 connected by a conductor 64 to one terminal of an indicator lamp 65. The opposite terminal of the lamp 65 is connected by a conductor 66 to one terminal of a source of current, such as a battery 67, the opposite terminal of which is grounded. The contact member 62 is likewise grounded and when the contact points 62 and 63 engage, current will be supplied to light the lamp 65. As long as the system is operating normally, the lamp is unlit, but as soon as the abnormal conditions occur, as set forth in the description of Figure 4, the diaphragm 61 is flexed downwardly to close the contact members 62 and 63 to light the lamp 65 and thereby indicate abnormal conditions in the system.

Referring now to Figure 6 there is shown schematically an installation which comprises a still further embodiment of the invention. The form herein shown may be considered a preferred embodiment as it is more flexible and adapts itself, to the operating power of the engine in addition to the pressure fluctuations in the ignition harness.

As heretofore set forth, one of the principal purposes of supplying air under pressure to the ignition harness is to suppress thereby corona discharge. This corona discharge occurs in the ignition harness and is a function of electrical potential gradients in excess of certain critical values and the density of the air in the region where such discharges occur. Since increases in the operating power of an internal combustion engine increases the pressure in its cylinders, and, as a consequence, the voltage necessary to fire the sparkplugs also increases, the tendency for corona discharge likewise increases, thereby requiring an increase in air pressure in the harness to suppress this discharge. This variation in required pressure in the harness may be automatically taken care of by the pump 1 as shown in Figure 6. Here, instead of being open to the atmosphere (as shown in Figure 2), the interior of the housing 2 below the diaphragm 5 comprise a pressure chamber 68. A conduit 69, one end of which is secured into the boss 8, is adapted to connect the pressure chamber 68 with a convenient point on the pressure side of the engine supercharger such as the intake manifold of the engine. Thus, it will be seen that as the engine operates at different operating power, and as a consequence its supercharger develops greater or less pressure, the pressure in the chamber 68, reacting on the lower face of the diaphragm 5 will also be increased or reduced and thereby add to or subtract from the operating pressure of the spring 53 to vary the output pressure of the pump in accordance with the operating power of the engine.

In the operation of this embodiment of my invention, the air flow from the atmosphere through the pump to the ignition harness is the

same as that described above with reference to Figure 2. If desired, however, the air drawn into the pump, instead of being taken directly from the outside atmosphere, may be introduced from the supercharger itself. This may be necessary in installations for aircraft flying at high altitudes, for example above 15,000 feet to assure an adequate supply of air for the harness requirements. Such an air connection is shown diagrammatically in Figure 7, where a pipe line 70 connects the strainer 30a with the pressure side of the engine supercharger, the outlet connection 33 from the strainer leading to the desiccant cartridge 17 as described above.

As an example of the operation of this embodiment of the invention, the spring 53 is adjusted to a compression which will provide a maximum output pressure of the pump 1 of six pounds per square inch. Considering the airplane as taking off at a level where the barometric pressure is 29" Hg and the engine operating at a power at which its supercharger develops a manifold pressure of 45" Hg. Thus there would be a positive pressure of 16" Hg developed in the chamber 68 and applied to the under side of the pump diaphragm 5, or approximately 8 pounds per square inch. This, in turn, added to the above 6 pounds per square inch output pressure of the pump increases the internal pressure in the ignition harness to 14 pounds per square inch for this operating power of the engine.

As the airplane attains greater altitude and is operating at cruising speed with a manifold pressure of 25" Hg and it is flying at an altitude where the barometric pressure is 27" Hg, the pressure in the chamber 68 reacting in the diaphragm 5 will now be 25" Hg, or 2" below the pressure of the surrounding atmosphere. This reduces the pressure on the under side of the diaphragm 5 to approximately -1 pound per square inch, which in turn deducts 1 pound per square inch from the output pressure of the pump, and, as a consequence, the pressure in the ignition harness would now be five pounds per square inch. These differences in manifold pressure and atmospheric pressure may continue to vary as flight and operating conditions vary until the manifold pressure of the engine is reduced to 12" Hg below the surrounding atmospheric pressure, at which time the pressure in the ignition harness would be at zero pounds per square inch.

When the manifold pressure is lower than 12 inches of mercury below the surrounding atmosphere, the pump diaphragm 5 would be held back against the spring 53 and the pump would remain inoperative as long as this condition is present. It is to be noted that such conditions would attain only during idling conditions of the engine. No negative pressure would occur in the ignition manifold during these conditions, the pressure only dropping to zero, or in other words be balanced with the surrounding atmosphere.

Thus, it will be seen that such an installation would provide ignition harness pressurizing pressures which vary automatically from 0 at 12" Hg manifold pressure to 14 pounds per square inch at 45" Hg manifold pressure for engine operation at a barometric pressure condition of 29 inches of mercury.

It is within the scope of this invention to also provide conditioned air for purging and pressurizing the ignition harness at times when the airplane engine is idle. To accomplish this, the

union 29 attached to the air cleaning nipple 28 is replaced by a T fitting 29' which may be coupled, by means of a coupling 71, to an air line 72 which is connected with a suitable source of compressed air such as the airplane hangar air supply. A check valve 73 is interposed between the T 29 and the air cleaner 30. When air is admitted through the line 72, the check valve 73 operates to block off the air screen 30, and air then flows down through the desiccant 34, and thence through the pump 1 to the ignition harness 56.

Thus, it will be seen that I have provided a means for pressurizing the ignition system of an internal combustion engine which is automatic in its operation to provide for varying changes in the pressure requirements of the system. While I have shown only preferred embodiments of the invention, it must be understood that many changes may be made therein by those skilled in the art without departing from the spirit of the invention or exceeding the scope of the appended claims.

I claim:

1. A method of pressurizing the ignition housing of an internal combustion engine, said housing being subject to leakage, comprising introducing air into the housing at a predetermined pressure while controlling the volume of such introduced air by the magnitude of said leakage.
2. A method of pressurizing the ignition housing of an internal combustion engine, said housing being subject to leakage, comprising cleaning and drying atmospheric air and introducing such cleaned and dried air into the housing at a predetermined pressure while controlling the volume of such introduced air by the magnitude of said leakage.
3. A method of pressurizing the ignition housing of an internal combustion engine provided with an engine supercharger said housing being subject to leakage, comprising introducing air into the housing, controlling the volume of such introduced air by the magnitude of said leakage, and controlling the pressure of such introduced air by the pressure developed by said engine supercharger.
4. An apparatus for pressurizing the ignition housing of an internal combustion engine said housing being subject to changes in internal pressure caused by leakage therefrom, comprising a pump for delivering air to the housing, displacement means in the pump, and means responsive to the pressure in the housing for operating the displacement means to deliver a controlled volume of air to the housing.
5. An apparatus for pressurizing the ignition housing of an internal combustion engine with conditioned air, said housing being subject to changes in internal pressure caused by leakage therefrom, comprising a pump for delivering air to the housing, a conduit for introducing atmospheric air to the pump, a desiccant in the conduit for drying the air, an air cleaning member at the entrance of the conduit, displacement means in the pump, and means responsive to the pressure in the housing for operating the displacement means to deliver a controlled volume of air to the housing.
6. An apparatus for pressurizing the ignition housing of an internal combustion engine said housing being subject to changes in internal pressure caused by leakage therefrom, comprising a pump for delivering air to the housing, a reciprocating displacement member in the pump, and means responsive to the pressure in the housing for varying the stroke of the reciprocating displacement member to thereby govern the volume of air delivered to the housing.
7. An apparatus for pressurizing the ignition housing of an internal combustion engine said housing being subject to changes in internal pressure caused by leakage therefrom, comprising a pump for delivering air to the housing, an air chamber for the pump, a displacement member within the air chamber, lost motion means for moving the displacement member in one direction to admit air to the chamber, and yieldable means responsive to the pressure in said housing for moving the displacement member in the opposite direction to deliver a predetermined volume of such introduced air into the housing.
8. An apparatus for pressurizing the ignition housing of an internal combustion engine said housing being subject to changes in internal pressure caused by leakage therefrom, comprising a pump for delivering air to the housing, an air chamber for the pump, a displacement member associated with the air chamber, cam means for moving the displacement member in one direction to admit air into the chamber, and compression spring means responsive to the pressure in said housing and exerting a force in opposition to the cam means for moving the displacement means in the opposite direction to deliver a predetermined volume of air into the housing.
9. An apparatus for pressurizing the ignition housing of an internal combustion engine said housing being subject to changes in internal pressure caused by leakage therefrom, comprising a pump for delivering air to the housing, an air chamber for the pump, a flexible diaphragm associated with the air chamber, cam means for flexing the diaphragm in one direction to admit air into the chamber, and compression spring means responsive to the pressure in said housing and exerting a force in opposition to the cam means for flexing the diaphragm in the opposite direction to deliver a predetermined volume of air into the housing.
10. An apparatus for pressurizing the ignition housing of an internal combustion engine, said housing being subject to changes in internal pressure caused by leakage therefrom, comprising a pump for delivering air to the housing, displacement means in the pump, compression means yieldably responsive to the pressure in the housing and exerting an operating force on said displacement means to deliver a controlled volume of air to the housing, and supplemental means cooperating with the compression means to control said operating force and control thereby the output pressure of the pump.
11. An apparatus for pressurizing the ignition housing of an internal combustion engine, said housing being subject to changes in internal pressure caused by leakage therefrom, comprising a pump for delivering air to the housing, displacement means in the pump, compression means yieldably responsive to the pressure in the housing and exerting an operating force on said displacement means to deliver a controlled volume of air to the housing, and adjustment means for the compression means to vary the operating force thereof and predetermine thereby the output pressure of the pump.
12. An apparatus for pressurizing the ignition housing of an internal combustion engine, said housing being subject to changes in internal pressure caused by leakage therefrom, comprising

ing a pump for delivering air to the housing, displacement means in the pump, compression means yieldably responsive to the pressure in the housing and exerting an operating force on said displacement means to deliver a controlled volume of air to the housing, and air pressure means responsive to the operating power of said internal combustion engine and cooperating with said compression means to control the operating force of the compression means and thereby control the output pressure of said pump.

13. An apparatus for supplying air under pressure to the ignition housing of an internal combustion engine equipped with a supercharger, comprising a pump having a casing, a flexible diaphragm dividing the casing into an air chamber and a pressure chamber, means for admitting air to the air chamber, additional means for conducting such air to the ignition harness, compression means in the pressure chamber, said compression means adapted to exert a force to move the diaphragm and thereby displace air from the air chamber into the ignition housing, and conduit means connecting the pressure chamber with said supercharger to vary the pressure differential in the air chamber and pressure chamber and vary thereby the force exerted by the compression means.

14. An apparatus for pressurizing the ignition housing of an internal combustion engine, said housing being subject to variations in internal pressure caused by variations in leakages therefrom, comprising a pump having an outlet for delivering air to the housing, displacement means in the pump, means responsive to the pressure variations in the housing for operating the displacement means to deliver a controlled volume of air to the housing, a conduit connecting the outlet of the pump with the housing, and pressure operated means responsive to the volumetric output of the pump associated with said conduit for indicating the magnitude of said leakage.

15. An apparatus for supplying air under pressure to the ignition system of an internal combustion engine comprising a pump having an inlet and an outlet for delivering atmospheric air to the housing, an enclosed passageway having an outlet connected with the pump inlet and an inlet communicating with the atmosphere, air

drying means in the passageway, a source of supplemental air under pressure, a conduit for detachably connecting said source with the passageway between the drying means and the inlet to the passageway, and pressure responsive valve means adjacent the inlet to the passageway, said valve means adapted to be closed by the pressure of said supplemental air to block the inlet to the passageway whereby only said supplemental air may be supplied to the harness when the pump is inoperative.

16. An apparatus for pressurizing the ignition housing of an internal combustion engine, said housing being subject to variations in internal pressure caused by variations in leakages therefrom, comprising a pump having an outlet for delivering air to the housing, displacement means in the pump, means responsive to the pressure variations in the housing for operating the displacement means to deliver a controlled volume of air to the housing, a conduit connecting the outlet of the pump with the housing, an electric circuit, electric indicating means in the circuit and switch means associated with the conduit and responsive to the airflow therethrough, said switch means adapted to close the electric circuit to the indicating means upon a predetermined maximum air flow through the conduit to thereby indicate leakage from the housing in excess of a predetermined maximum.

17. An apparatus for pressurizing the ignition housing of an internal combustion engine for aircraft, said engine being equipped with a turbo supercharger and said housing being subject to changes in internal pressure caused by leakages therefrom, comprising a pump having an inlet and an outlet, conduit means connecting the outlet of the pump with said housing, displacement means in the pump, means responsive to changes in pressure in the housing for operating the displacement means to thereby vary the volume of air delivered by the pump to the housing in accordance with said pressure changes, and additional conduit means connecting the inlet of the pump with the air delivery side of said turbo supercharger for assuring an adequate air supply for the housing at high altitudes.

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