Jan. 27, 1925. 1,524,333

M. A. BRANDT ET AL

MUFFLER

Filed Nov. 25, 1921 3 Sheets-Sheet 1

Fig. 1.

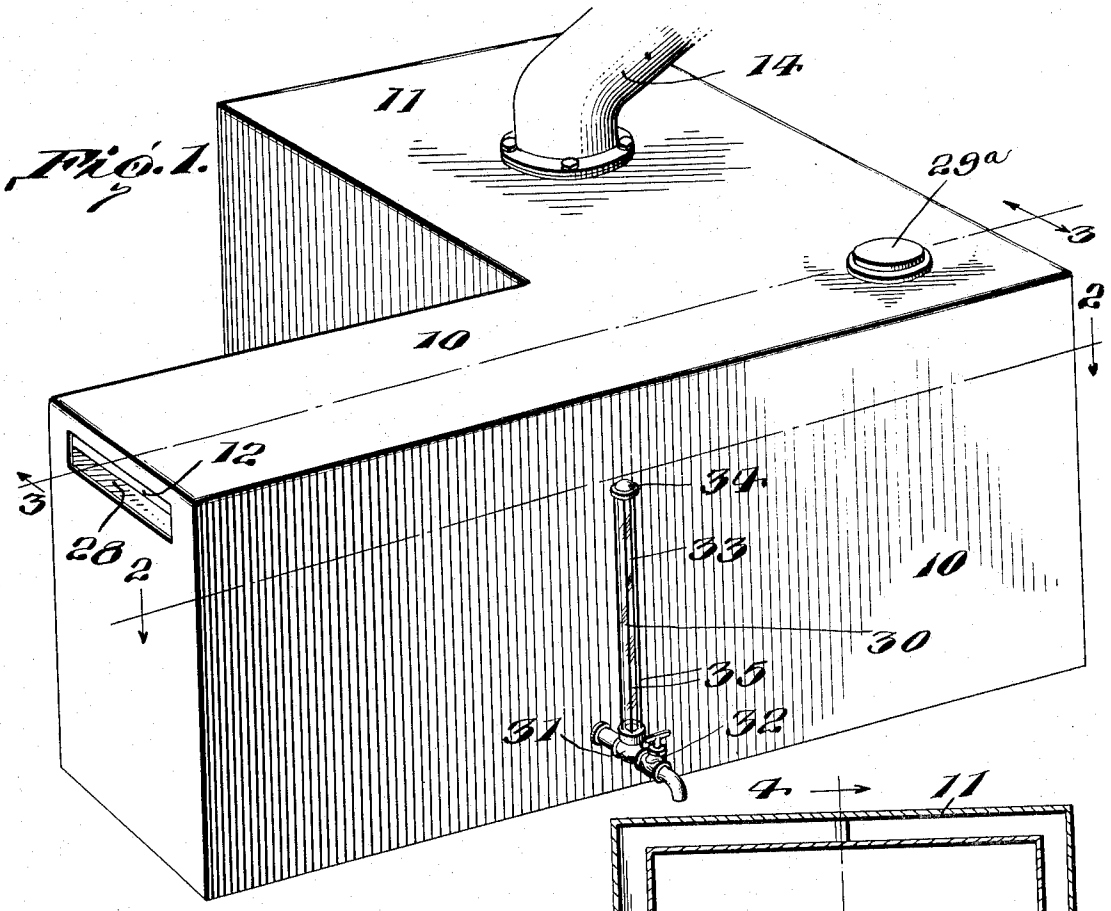
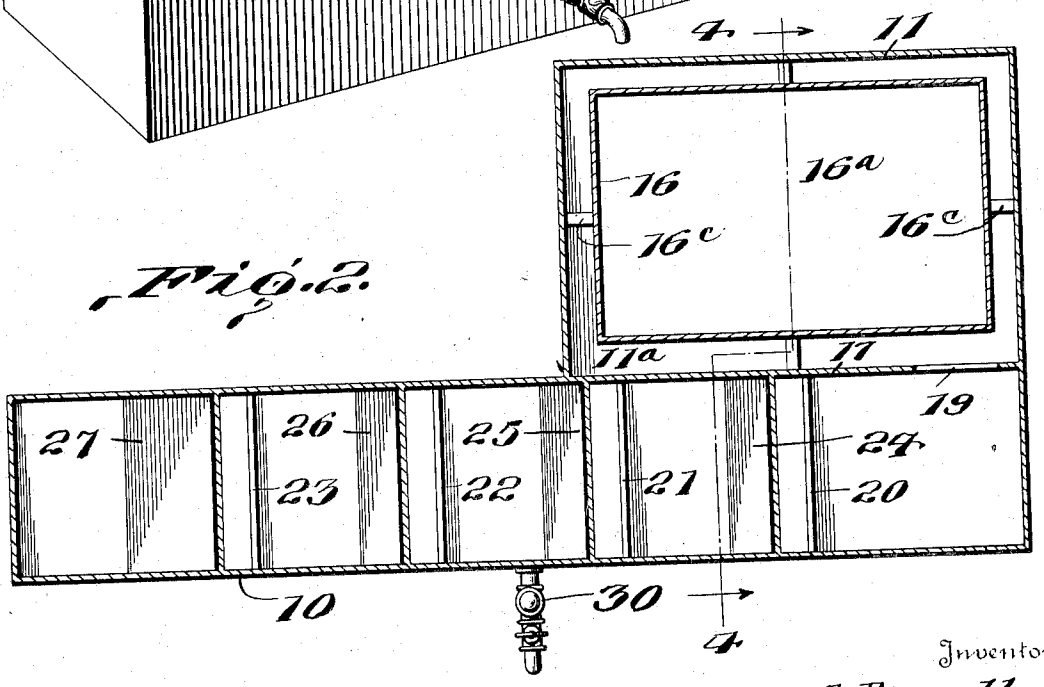


Fig. 2.



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Fig. 3.

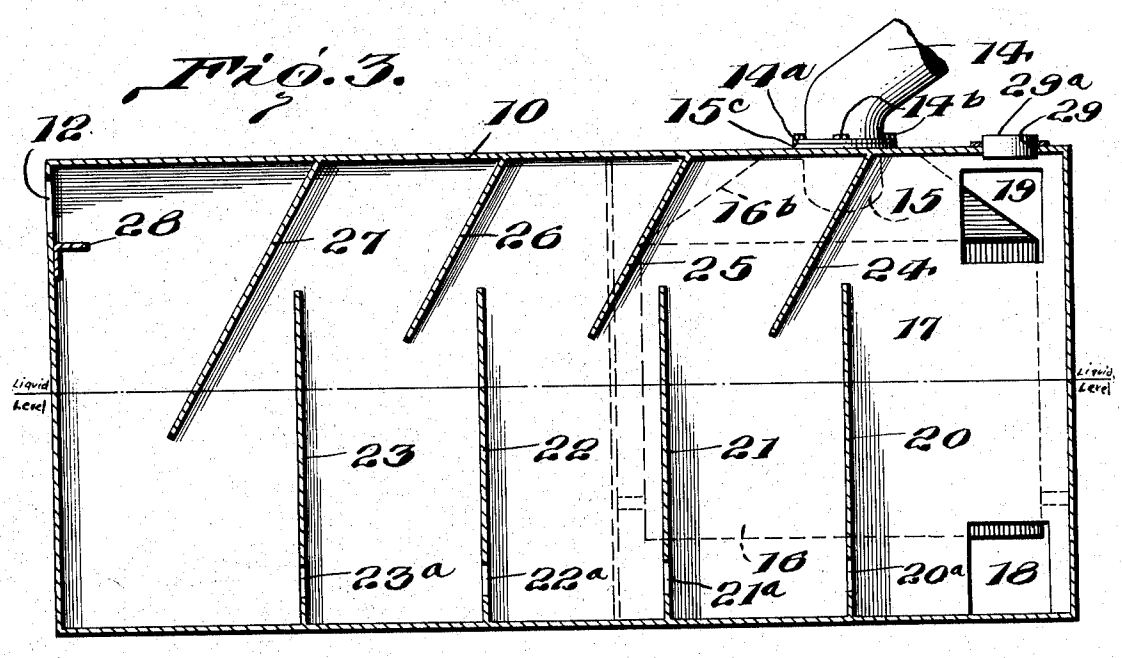
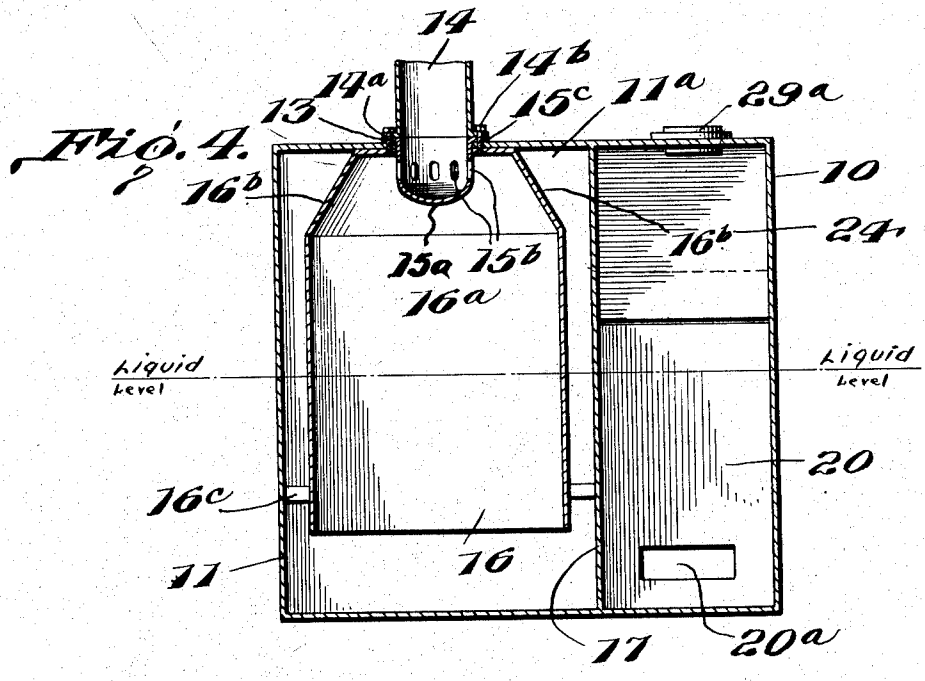


Fig. 4.



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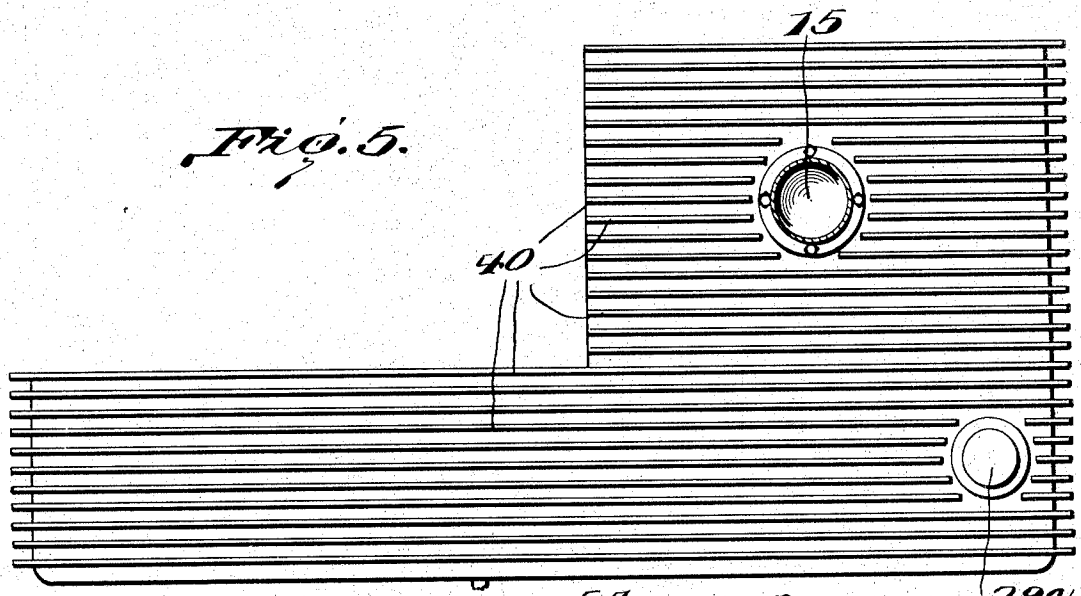
Jan. 27, 1925. 1,524,333

M. A. BRANDT ET AL

MUFFLER

Filed Nov. 25, 1921 3 Sheets-Sheet 3

Fig. 5.



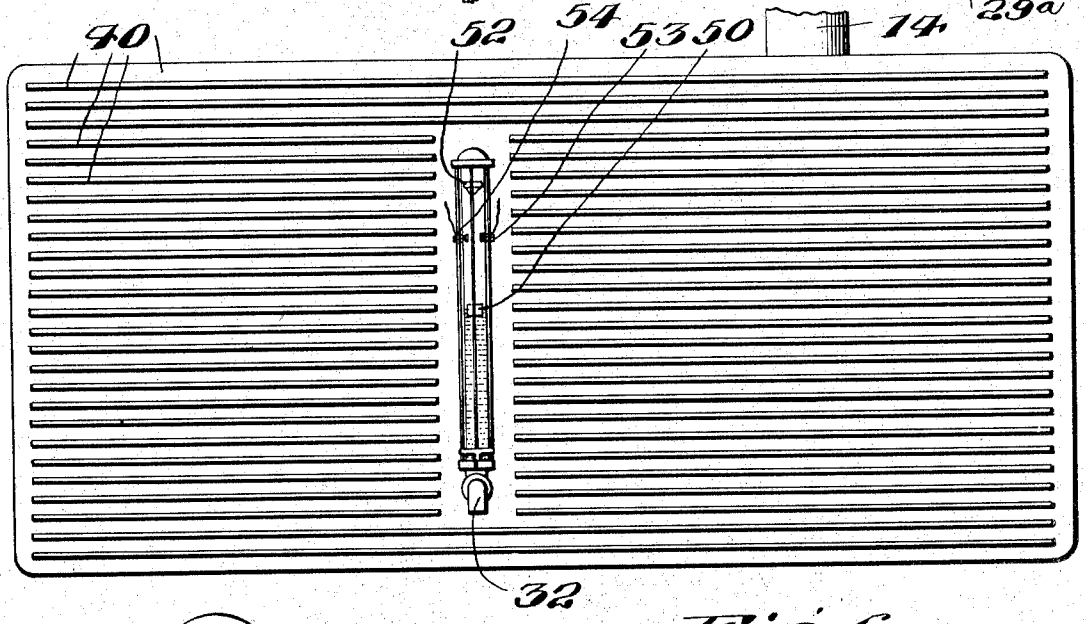


Fig. 6.

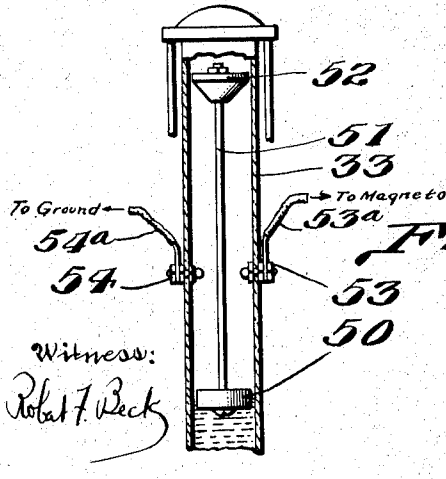


Fig. 7.

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UNITED STATES PATENT OFFICE.

MAURICE A. BRANDT, GUY R. SHEPPARD, AND CLARENCE N. RYAN, OF NORFOLK, VIRGINIA.

MUFFLER.

Application filed November 25, 1921. Serial No. 517,545.

To all whom it may concern:

Be it known that we, MAURICE A. BRANDT, GUY R. SHEPPARD, and CLARENCE N. RYAN, all citizens of the United States of America, and residents of Norfolk, county of Norfolk, Virginia, have invented certain new and useful Improvements in Mufflers, of which the following is a specification.

This invention relates to certain improvements in mufflers for internal combustion motors; and the nature and objects of the invention will be readily understood by those skilled in the art in the light of the following explanation and detailed description of the accompanying drawings illustrating what we at present believe to be the preferred embodiments or mechanical expressions of our invention from among various other forms, embodiments, combinations and constructions within the spirit and scope thereof.

Those skilled in and familiar with the use and operation of internal combustion motors are well aware of the characteristics, inherent qualities and nature of the exhaust gases created and discharged from such motors during operation thereof. The exhaust gases from internal combustion motors are discharged in such a highly heated state, with frequently occurring discharge of incandescent or burning particles of matter, such as carbon or other products of combustion, with the exhaust gases, that there is the ever present possibility of such exhausted gases igniting any inflammable material or gases in the vicinity of or in proximity to the point at which an internal combustion motor is being operated. Further, these exhaust gases are usually of an obnoxious odor and are discharged from a motor accompanied by considerable noise or sound, as well known and understood by those skilled in the internal combustion motor art. With the advent of internal combustion motor driven tractors and various other internal combustion motor operated devices, for industrial purposes, it has often been desired to operate such tractors and devices for hauling and supplying power for operating machinery and various other purposes, in the presence of inflammable stocks or materials and explosive or combustible gases, for example as, in coal mines, on docks, in oil refineries, oil fields, lumber yards, cotton works, and warehouses, factories and other buildings and places where inflammable stocks, materials or gases are stored or liable to be encountered. However, due to the above referred to characteristics and nature of the exhaust gases from internal combustion motors, it has been found exceedingly dangerous, and in numbers of instances prohibited by insurance underwriters, to operate such motors in the vicinity of or around inflammable materials and in places where combustible and explosive gases are present or liable to be encountered.

Therefore, it is one of the main objects of the present invention to provide means for treating and handling the exhaust gases from internal combustion motors in such a manner as to remove therefrom the several highly objectionable characteristics thereof and to thus discharge the exhaust gases in a cool fumeless and non-explosive and non-combustible state and to thereby permit the safe operation of internal combustion motors in proximity to and around inflammable material and inflammable and explosive gases without possibility of ignition or explosion thereof by the exhaust gases.

It is a further object of this invention to provide means for treating and handling the exhaust gases from internal combustion motors, in such a manner as to remove the objectionable and dangerous characteristics of such gases, as discharged from a motor, as well as to silence or materially reduce the noise or sound of such motors in operation, without the creation of any material back pressure causing loss of power to a motor with which said means is operatively connected.

It is a further object of this invention to provide means in the form of a muffler for internal combustion motors, in which the exhaust gases from a motor are caused to pass through and over a body of liquid to remove the objectionable and dangerous characteristics from the exhaust gases as discharged from the motor, and which muffler is so arranged that the body of liquid for treating the exhaust gases acts as

a cooling medium for the muffler and the exhaust gases passed therethrough.

It is a further object of this invention to provide means in the form of a muffler for internal combustion motors, which will effectively silence the noise accompanying the discharge of the exhaust gases from such motors during operation thereof.

It is a further object of this invention to provide means for handling and treating the exhaust gases discharged from internal combustion motors, by causing such gases to pass through and over a body of liquid in such a manner that the gases are cooled and the dangerous characteristics removed therefrom by contact with the body of liquid before being discharged to atmosphere.

It is a further object of the invention to provide means in the form of a muffler for internal combustion motors in which the exhaust gases from a motor are caused to pass into and through a series of expansion chambers to prevent back pressure into the exhaust manifold and to then pass the expanded gases through a series of tortuous passages in which a body of liquid is confined so that the gases come into contact with the liquid and are discharged to atmosphere in a cooled state with the dangerous characteristics thereof removed.

It is a further object of this invention to provide a muffler for internal combustion motors, in which the exhaust gases are caused to pass through and over a body of liquid confined within the muffler to assist in removing the dangerous and undesirable characteristics from the gases before discharging them to atmosphere, and in which automatic means is provided for rendering a motor with which the invention is connected inoperative upon reduction of the quantity of the liquid within the muffler to a point at which it becomes ineffective in performing the required function in treating the exhaust gases.

It is a further object of this invention to provide a muffler for internal combustion motors, so constructed and arranged as to prevent the entry of gases on the exterior of the muffler from entering into the muffler and causing explosions therein upon contact with the exhaust gases from a motor with which the muffler is operatively connected.

It is a further object of this invention to provide internal combustion motor mufflers with cooling means in the form of exterior heat radiating fins or ribs, so as to reduce the temperature of the muffler and the exhaust gases passing therethrough from a motor by direct radiation of the heat from the discharge gases to the atmosphere.

With the foregoing and various other objects in view, our invention consists in certain novel features in construction and in arrangements of elements as more fully and particularly set forth and specified hereinafter.

Referring to the accompanying drawings:

Fig. 1 is a perspective view of a muffler constructed in accordance with and embodying features of our invention.

Fig. 2 is a horizontal section taken on the line 2—2, Fig. 1.

Fig. 3 is a vertical section taken on the line 3—3, Fig. 1.

Fig. 4 is a vertical transverse section taken on the line 4—4, Fig. 2.

Fig. 5 is a top plan view of a muffler embodying the invention, and particularly disclosing an arrangement of heat radiating blades or fins

Fig. 6 is a side elevation of a muffler constructed as shown in Fig. 5.

Fig. 7 is a detail vertical section through the liquid gauge, and showing the means for rendering a motor inoperative upon reduction in the body of liquid in a muffler of the invention.

In the accompanying drawings, we have illustrated one form and embodiment of our invention which is particularly adapted for use on and in connection with internal combustion motor driven tractors. However, the illustrated embodiment is purely by way of example of one form, arrangement and construction by means of which the features and principles of our invention are mechanically expressed to meet the requirements of a particular application, it being understood of course, that the invention is applicable to internal combustion motors and the various applications thereof generally, and that we do not intend or desire to limit the invention to the particular embodiment illustrated herewith to fulfill the requirements of the referred to application.

The illustrated embodiment of the invention comprises a rectangular hollow body forming the box-like main casing 10 provided at a forward end portion with the lateral extension 11 from one side thereof and forming the intake chamber of the muffler. The muffler casing 10 with the lateral extension 11 is mounted on a motor with the lateral extension 11 and adjacent end of the casing 10 forming the forward end of the muffler and with the casing 10 thereof extending rearwardly therefrom. A port or aperture 13 is formed through the top wall of the extension 11 and this port is connected and in communication with the exhaust manifold of the motor (not shown) by means of the conduit 14 which discharges the exhaust gases from the motor through the port 13 into the extension 11 of the casing 10. A depending apertured cup or discharge head 15 is mounted in the port 13 and extends a distance inwardly within the extension 11 in line with the port 13 through

the top wall thereof. This cup or discharge head 15 is formed with the interiorly concave bottom or lower end closure 15^a, and a series of spaced apertures or ports 15^b around and through the side wall of the discharge head. The discharge head 15 extends upwardly through the top wall of the extension 11 and is provided with the flange 15^c fitting down onto the exterior surface of the top wall of the extension 11. The lower discharge end of the exhaust conduit 14 is provided with a radial annular flange 14^a which fits down onto, against and is secured to the flange 15^c of the discharge head by means of the bolts or other suitable fastening means 14^b. Any suitable or desired packing (not shown) may be interposed between and around the connected discharge head, conduit and upper wall of the extension 11, in order to provide an air tight, leak proof fitting and connection at this point.

A hood or bell 16 is mounted within the lateral extension 11 of the casing 10, and forms the primary expansion chamber 16^a into which the exhausted gases are discharged from the conduit 14, through the discharge head 15. The hood or bell 16 is provided with a closed upper end having an opening therethrough which fits up over the depending discharge head and against the upper wall of the extension 11. In the present instance the bolts 14^a which secure the conduit 14 and head 15 in position on the extension 11, are extended through the upper closed end of the bell 16 and secure the same in position depending from the upper wall of the extension 11, around and surrounding the discharge head 15. The upper end portions 16^b of the side walls of the bell 16 are inclined upwardly and inwardly toward the upper wall of the extension, so that a passage is formed around and over the upper end thereof between the walls of the extension 11 and the hood or bell 16. In mounted secured position within the extension 11, the hood or bell 16 depends downwardly from the upper wall of the extension 11 and terminates a distance from and above the bottom wall of the extension 11 thus forming a space or secondary expansion chamber 11^a around and surrounding the depending bell 16, and primary expansion chamber formed thereby. The lower end of the depending hood or bell 16 is open and unobstructed so that the primary expansion chamber 16^a and the secondary expansion chamber 11^a are in communication. Any suitable or desired spacing and bracing members 16^c are interposed between the lower end portions of the walls of the bell 16 and the adjacent walls of the extension 11.

A bulkhead 17 is formed and interposed between the main body or casing 10 and the lateral extension 11 containing the expansion chambers 16^a and 11^a. This bulkhead 17 is provided with a port 18 formed through the lower portion adjacent the forward edge thereof and providing a passage communicating with the extension 11^a and the interior of the main body or casing 10 of the muffler. A second port 19, substantially in line with the lower port 18, is provided through the upper portion of bulkhead 17 and forms a passage communicating with the interior of the casing 10 from the upper portion of the secondary expansion chamber 11^a of the extension 11. A series of vertically disposed slush plates 20, 21, 22 and 23, are mounted on the bottom wall of the casing 10, transversely of and extending across the interior of the casing 10, and spaced apart throughout the length of the casing 10. These slush plates extend upwardly a distance into the interior of the casing 10, terminate a distance from and below the top wall thereof, and are secured along their side edges to the opposite side walls, respectively, of the casing 10. Suitable ports 20^a, 21^a, 22^a and 23^a, are provided centrally through the lower end portions of the slush plates 20, 21, 22 and 23, respectively, thus forming communicating passages between the spaces or compartments into which the interior of the casing 10 is divided by the series of spaced vertical slush plates.

A series of spaced depending rearwardly inclined baffle plates 24, 25, 26 and 27, are mounted within the casing 10 and depend from the upper wall thereof in a certain relation with respect to the series of upwardly extending vertical slush plates mounted within the casing 10. The series of inclined baffle plates 24, 25, 26 and 27 are secured to the under side of the upper wall of the casing 10, at points above and forwardly of the series of vertical slush plates 20, 21, 22 and 23, respectively, and are inclined rearwardly so as to extend over and across and spaced a distance above the upper ends of the respective slush plates above which they are mounted. The baffle plates 24, 25, 26 and 27 extend transversely across the interior of the casing 10 and have their opposite side edges secured to the opposite side walls of the casing 10, respectively, in a manner similar to the mounting and securing of the series of slush plates. The baffle plates extend downwardly and rearwardly and terminate a distance below the upper ends of their respective slush plates, so that in effect, tortuous passages are formed between the baffle plates and the slush plates, respectively, extending from the forward end to the rear end of the casing throughout the length thereof. It will be noted that the rear baffle plate 27 adjacent the rear or discharge end of the casing 10, extends

a greater distance downwardly below the upper end of the rear slush plate 23, for a purpose appearing hereinafter. The rear end of the casing 10 is provided with a discharge opening 12 in the form of a slot extending transversely across the upper portion thereof. An angle member 28 is secured transversely across the interior of the rear end wall of the casing 10 and slightly below the discharge opening 12. One flange of the angle member 28 extends substantially horizontally and forwardly from the end wall a distance below the discharge opening 12, and the other flange thereof is suitably secured to the end wall. The object of this flange member 28 is referred to and explained hereinafter.

An opening 29 is provided through the top wall of the casing 10 at the forward portion thereof and a removable closure or cap 29^a is mounted in said opening. The muffler constructed as hereinbefore described is supplied with a body of liquid through the filling opening 29, and in the present instance the level of this body of liquid is indicated by the liquid level line shown in Figs. 3 and 4 of the accompanying drawings. Due to the ports through the slush plates in the casing 10 and the lower port 18 in the bulkhead 17 between the expansion chamber 11^a and the casing 10, the liquid supplied through the filling opening 29 will flow into the extension 11 and into the spaces or compartments between the slush plates in the casing 10, so that, the body of liquid fills the compartment 10 and the extension 11 up to the indicated or desired level. In this connection the slush plate ports and the lower port in the bulkhead 17, act as "level seekers" and maintain the body of liquid in the muffler the same throughout. As is clearly seen by reference to the accompanying drawings, the body of liquid in the extension 11 extends up around and immerses the lower open end of the depending hood or bell 16 and forms a liquid seal between the primary expansion chamber 16^a and the secondary expansion chamber 11^a, so that, gases in passing therebetween are forced through the body of liquid. In the compartment 10 the body of liquid immerses the lower portions of the slush plates 20, 21, 22 and 23, and terminates a distance below the upper ends thereof, while the rearwardly inclined baffle plates, with the exception of baffle plate 27, terminate a distance above the level of the body of liquid. The rear end baffle plate 27 extends rearwardly and downwardly into the body of liquid with its lower end portion immersed thereby. Thus a liquid trap is formed between the discharge opening 12 in the rear end of the casing 10, and the interior of the muffler.

Any suitable or desired liquid level gauge 30 may be mounted on the muffler to indicate the level of the body of liquid within the muffler. In the present instance the gauge 30 is mounted on the outer side of the muffler and in communication with the body of liquid therein through the pipe 31 which terminates in a cock 32 by means of which the liquid can be drained from the muffler when desired. The gauge 30 comprises the vertically disposed transparent tube 33 having a vented closure 34 closing the upper end thereof and secured thereon by the exterior guard rods 35. The operation of the foregoing gauge is well known and understood, and hence it is not deemed necessary to describe the same herein.

In Figures 5 and 6, a muffler of the invention is disclosed provided with a series of spaced parallel heat radiating blades or fins 40 mounted on the exterior of the muffler and covering the upper and lower sides, outer side, and forward and rear ends thereof. These blades are arranged extending from front to rear of the muffler and vertically of the front and rear ends to provide spaces therebetween for the passage of air and thus increase the heat radiating surfaces of the muffler and materially aid in maintaining the same cooled. Any suitable or desired arrangement of the heat radiating blades or fins 40 may be utilized without departing from the spirit and scope of the invention.

The present invention includes means adapted to be connected with the motor with which a muffler of the invention is in operation, for rendering the motor inoperative when the level of the body of liquid in the muffler falls to the danger point, that is, when the body of liquid decreases in quantity sufficiently to render further operation of the motor dangerous. One form of such means is illustrated, more or less diagrammatically in Fig. 7, of the drawings, and is mounted on and controlled by the hereinbefore referred to liquid level gauge 30. A float 50 of cork or any other suitable material, is placed in the liquid tube 33 and floats on the column of liquid therein. A vertically disposed wire or rod 51 is fixed in the float 50 and extends upwardly a distance therefrom within the tube above the column of liquid, and is provided with a copper, or other suitable electrical conducting material disk 52, on its upper end. A pair of contact posts or pins 53 and 54 are mounted at diametrically opposite points through the liquid tube 33 and extend a slight distance therewithin. One of the contact pins 53, is connected by a wire 53^a to the magneto of the motor ignition system (not shown) and the opposite post 54 is grounded by means of a wire or like electrical conductor 54^a. The position of the contact posts 53 and 54 in the tube 33, is such, that when the level of the liquid in the muffler falls to the dan-

ger point the column of liquid descends causing the float 50 with rod 51 to descend until the disk 52 contacts with the posts 53 and 54, thus closing a circuit through wires 53[a] and 54[a], which grounds the motor ignition system and renders the motor inoperative until the body of liquid within the muffler is replenished. The increase of liquid in the muffler raises the column of water in tube 33 and the disk 52 is thereby raised out of contact with posts 53 and 54, and the circuit to ground is broken which renders the motor ignition system again operative. In the foregoing manner operation of a motor with an insufficient supply of liquid in a muffler is automatically prevented and the possibility of fires and explosions through carelessness or inadvertence overcome.

The operation of a muffler constructed as hereinbefore described, is as follows. The muffler casing 10 and extension 11 are suitably mounted on and in connection with a motor and the motor exhaust manifold (not shown) is connected with the inlet port 13 in the extension 11, by means of the conduit 14. The desired quantity of liquid is supplied to the muffler through the filling opening 29 and the closure 29[a] therefor is secured in and effectively closes the filling opening 29. As explained, the liquid passes through the port 18 in the bulkhead 17 into the extension 11 and through the various slush plate ports in the casing 10, so that the level of the body of liquid in the casing 10 and extension 11 is the same throughout. With the motor in operation the exhaust gases are discharged from the conduit 14 into the apertured cup or discharge head 15 and are there broken up by the spaced apertures or ports 15[b], through the side of the head 15. From the head 15 the gases are discharged into the primary expansion chamber 16[a], formed by the depending hood or bell 16, and expand within the chamber 16[a], thereby overcoming back pressure through the conduit 14 into the motor. The body of liquid in the extension 11 extends up into the expansion chambers 11[a] and 16[a] and surrounds and immerses the lower depending end portion of the hood or bell 16, so that a liquid seal is formed at the open unobstructed lower end of the primary expansion chamber 16[a]. The gases, after discharge and expansion in the expansion chamber 16[a], are forced and pass downwardly through the body of liquid at the lower end thereof and then pass upwardly through this body of liquid and around the depending bell 16 into the secondary expansion chamber 11[a] therearound and surrounding the primary expansion chamber 16[a]. The gases after entry into the secondary expansion chamber 11[a], pass upwardly, over and across the upper secured end of the depending hood or bell 16 and into the forward end of the casing 10 above the body of liquid therein, through the port 19 in the bulkhead 17. Upon entry into the forward end of the casing 10 the gases pass rearwardly, strike the rearwardly inclined baffle plate 24 and are deflected downwardly and rearwardly over and across the upper end of the vertical slush plate 20, and under the lower end of the baffle plate 24, above and over the body of liquid therebelow with which they come into contact and then upwardly to and striking the rearwardly inclined baffle plate 25 and vertical slush plate 21 associated therewith and spaced therefrom. In this manner the gases pass rearwardly through the tortuous passages formed between the vertical slush plates, and rearwardly inclined baffle plates until they reach the end baffle plate 23, which extends into and is immersed in the body of liquid. The position and arrangement of the end baffle plate 23, is such that, a liquid trap is formed between the tortuous passages in the casing 10 and the discharge outlet 12, to atmosphere, and the rearwardly flowing gases are forced or deflected downwardly through the body of liquid by the baffle plate 23, pass through the liquid around and under the immersed lower end of this baffle plate and upwardly and outwardly through the discharge opening 12, to atmosphere. It is apparent from the foregoing, that a liquid trap is formed at the discharge end of the muffler and that all the exhaust gases are forced to pass through this liquid trap before discharge to atmosphere. This feature provides a safe guard against the entry of gases from the exterior or surrounding atmosphere into the muffler, with the motor with which the muffler is connected at rest, and thus prevents entry and accumulation of gases within the muffler which would be ignited or exploded upon starting operation of the motor and discharge of heated exhaust gases into the muffler. The foregoing arrangement and construction further provides against discharge of any exhaust gases to atmosphere in a dangerous condition, which condition might not have been removed during passage of the gases through the liquid and passages within the muffler.

The provision of the angle member 28 mounted as hereinbefore described, prevents splashing or spraying of liquid from casing 10 through the discharge opening 12 by the action of the gases passing therethrough or from vibration or shocks to which the muffler is subjected in operation and use.

By the provision of the expansion chambers 16[a] and 11[a] formed in extension 11, the exhaust gases are immediately expanded upon discharge into the muffler, so that back pressure causing loss of power in the motor

is prevented, as well as insuring complete control of the gases in their passage through the muffler and the prevention of undue agitation and disturbance of the body of liquid confined within the muffler. Therefor, it is apparent that the invention provides means for handling and treating the exhaust gases from internal combustion motors in such a manner that the objectionable and dangerous characteristics of such gases are removed therefrom and that by the use of a muffler constructed to embody the features of this invention, internal combustion motors can be successfully operated, without danger of fire or explosion, in proximity to inflammable materials and inflammable and explosive gases.

The body of liquid within the muffler not only cools and lowers the temperature of the exhaust gases but materially aids in maintaining the muffler structure cool. With the use of the heat radiating blades or fins disclosed in Figs. 5 and 6, the cooling of the body of liquid, the muffler structure and the gases passing therethrough is more rapidly accomplished and it becomes possible to maintain much lower temperatures in the muffler. These heat radiating flanges 40 can be formed separately and secured to the muffler casing or may be formed integral therewith.

The means for rendering a motor inoperative upon failure of the supply of liquid in the muffler provides an effective automatic guard against operation of a motor under dangerous conditions. The operation of this means has been briefly described hereinbefore.

In the illustrated example of the invention, the muffler disclosed is constructed of sheet material, preferably sheet steel, and the various elements thereof, such as baffle plates, bulkheads, and slush plates are secured and fastened in position by welding. However, it is to be understood that we do not wish or intend to limit our invention to the particular material or manner of constructing and assembling the invention as described, it being apparent that the same could be formed of cast material, or any of a number of well known materials suitable to the conditions encountered in operating a muffler. It will also be apparent that the invention is capable of various applications numbers of which have been referred to hereinbefore, and to which may be added applications to internal combustion motor driven boats, and to motors used on and for propelling dirigible aircraft in which the sustaining medium is a gas which is frequently inflammable, such as hydrogen.

It is evident that various changes, modifications, substitutions and departures may be resorted to without departing from the spirit and scope of this invention, and hence we do not wish to limit our invention to the exact disclosures hereof.

Desiring to protect our invention in the broadest manner legally possible, what we claim is:

1. In a muffler, a primary expansion chamber, means for discharging exhaust gases thereinto, a secondary expansion chamber in communication with said primary chamber, a confined body of liquid interposed in the path of flow of the gases between said chambers, a casing in communication with said secondary expansion chamber and having a discharge outlet to atmosphere, and a series of baffle plates mounted in said casing forming tortuous passages for the exhaust gases in passing through said casing from said expansion chambers to said discharge to atmosphere.

2. In a muffler, a casing having an exhaust gas inlet at one end and an exhaust gas discharge to atmosphere at the other end thereof, a series of spaced baffle plates within said casing depending from the upper wall thereof and extending thereacross, the said baffle plates inclined downwardly toward the discharge end of said casing and terminating a distance above the bottom wall thereof, a body of liquid in said casing and having its level below the lower ends of said baffle plates, and the baffle plate adjacent the discharge from said casing extended with the lower end thereof immersed in the body of liquid within the casing.

3. In a muffler, a casing having an exhaust gas inlet at one end and an exhaust gas discharge to atmosphere at the other end thereof, a series of spaced vertically disposed slush plates extending upwardly a distance from the bottom wall of the casing, said slush plates having ports through the lower end portions thereof, a series of spaced baffle plates depending from the upper wall of said casing and inclined downwardly toward the discharge end of said casing, across and a distance above said slush plates, respectively, a body of liquid within the casing having the same level throughout due to said slush plate ports and a distance below the lower ends of said depending baffle plates and the end baffle plate adjacent said discharge to atmosphere extending a distance into the body of liquid to form a liquid trap at the discharge end of the casing.

4. In a muffler for internal combustion motors, a primary expansion chamber, a secondary expansion chamber surrounding said primary chamber, said primary expansion chamber formed with a reduced outer end portion within the surrounding secondary chamber, means for discharging exhaust gases into said primary expansion chamber embodying a cup-like apertured member closed at the inner end and depending into

said primary chamber at the outer reduced end thereof, and the inner end of said primary expansion chamber open and discharging into said secondary expansion chamber.

5. In a muffler for internal combustion motors, a primary expansion chamber having an intake for exhaust gases, a secondary expansion chamber surrounding said primary chamber and in communication therewith, a casing formed with a series of tortuous passages therein in communication at one end with said secondary expansion chamber and discharging to atmosphere at the other end, and a liquid seal formed in said casing at the discharge end of said tortuous passages.

6. In a muffler for internal combustion motors, a primary expansion chamber having an intake for exhaust gases, a secondary expansion chamber in communication with said primary expansion chamber to receive exhaust gases therefrom, a casing formed with a series of tortuous passages therein in communication at one end with said secondary expansion chamber and discharging to atmosphere at the other end thereof, a liquid seal at the discharge end of said tortuous passages and a liquid seal between said primary and secondary expansion chambers, the said liquid seals formed by and embodying a single body of confined liquid within the muffler.

7. In a muffler for internal combustion motors, a casing having an intake for exhaust gases at one end and a discharge to atmosphere at the other end, a body of confined liquid in the casing, a series of tortuous passages formed in said casing between the intake and the discharge thereof and above the body of confined liquid therein, whereby exhaust gases pass therethrough over and in contact with said body of liquid, and a liquid seal formed by said body of liquid at the discharge end of said casing to prevent entry of gases therein from atmosphere.

8. In a muffler for internal combustion motors, a casing formed with an intake for exhaust gases and a discharge to atmosphere, a body of confined liquid within the casing, a series of spaced baffle plates depending within the casing between the intake and discharge, said plates inclined toward the discharge and terminating a distance above the body of liquid to form tortuous passages between the intake and the discharge above said body of liquid, and one of said baffle plates adjacent the discharge from said casing extended into the body of liquid to form a liquid seal preventing entry of gases into said casing through the discharge thereof.

9. In a muffler for internal combustion motors, a primary expansion chamber having an intake for exhaust gases, a secondary expansion chamber surrounding said primary chamber and in communication therewith, a casing in communication with and receiving exhaust gases from said secondary expansion chamber, a body of liquid in said casing and said secondary expansion chamber, said body of liquid forming a liquid seal between said primary and secondary expansion chambers, said casing having a discharge to atmosphere and formed with tortuous passages therein above said body of liquid between said secondary chamber and the discharge to atmosphere, and a liquid seal formed by said confined body of liquid in the casing at the discharge to atmosphere to prevent the entry of gases into the casing.

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