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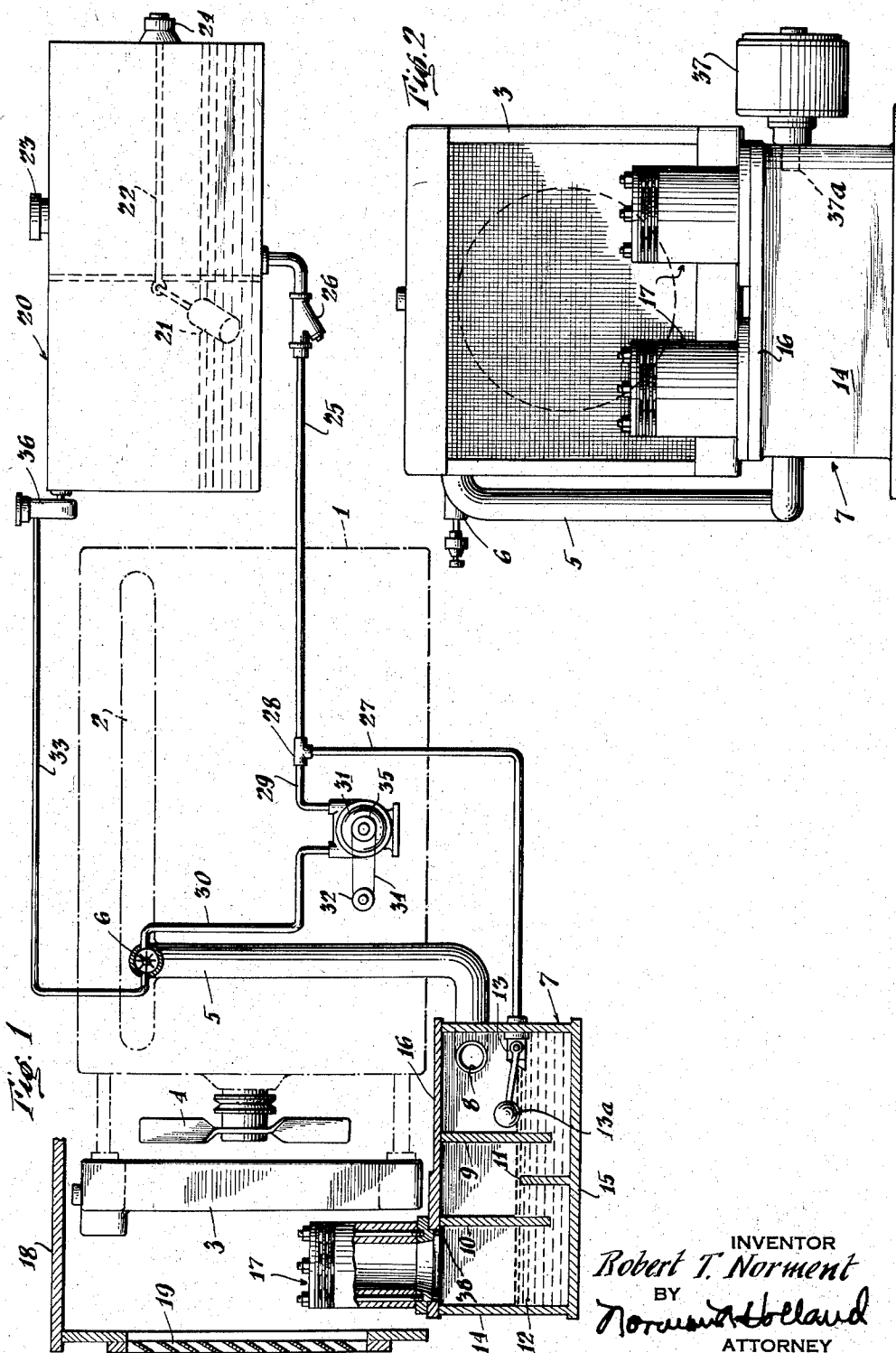
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MEANS FOR SAFELY EXHAUSTING HOT GASES

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2 Sheets-Sheet 1



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Fig. 3

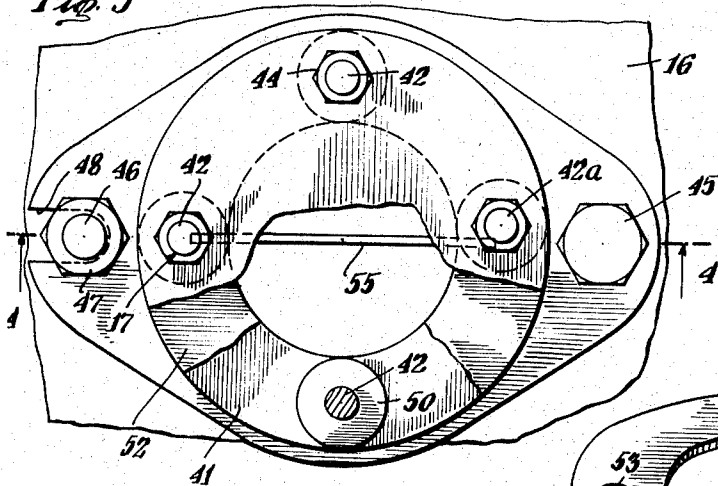


Fig. 5

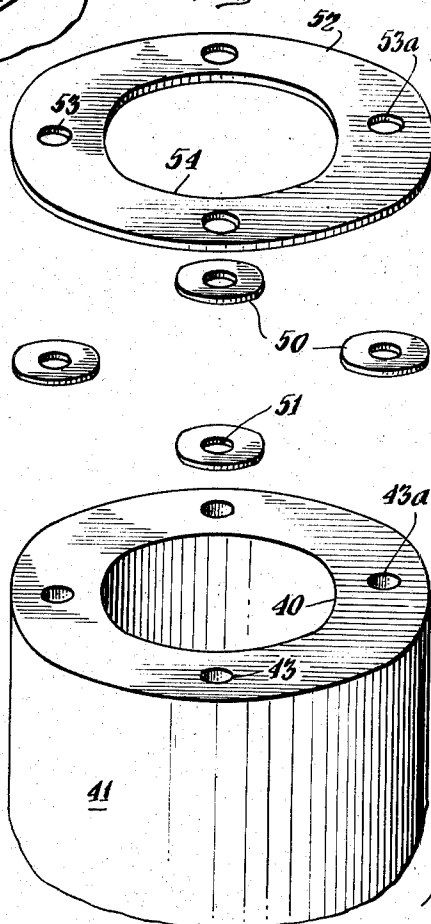
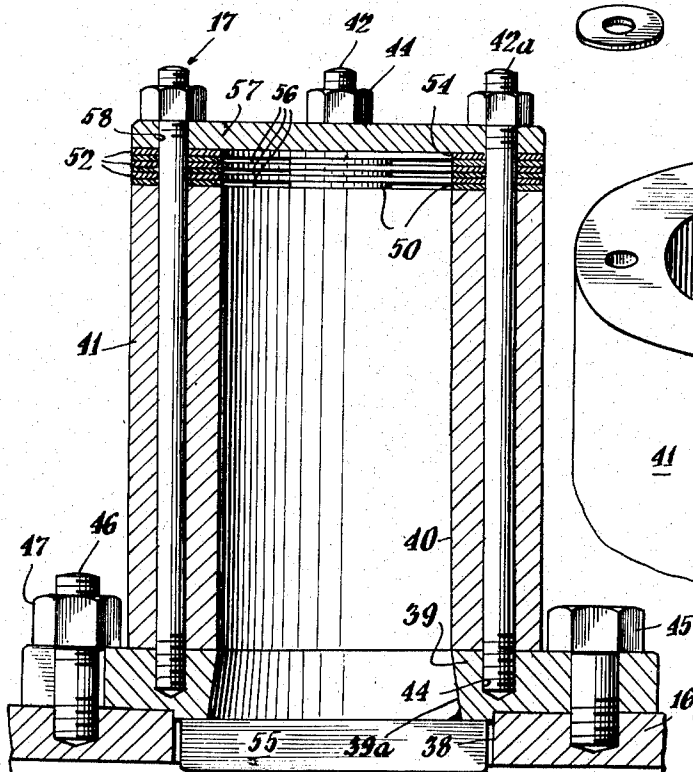


Fig. 4



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MEANS FOR SAFELY EXHAUSTING HOT GASES

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2 Claims. (Cl. 183—25)

The present invention relates to an exhaust system and more particularly to a means for safely exhausting hot gases using flame traps and cooling devices to prevent flames or hot gases from issuing from the exhaust and to maintain the exhaust system itself at a relatively cool temperature. One important use for such a system is with internal combustion motors used in underground mining operations. Normal exhaust systems are dangerous in such a situation because exhaust flames, hot exhaust gases, or hot spots in the exhaust system are liable to ignite explosive gases present in the mines, resulting in dangerous explosions. Such an exhaust system is also desirable in other uses, such as for trucks or other motor applications used in the vicinity of inflammable gases or chemicals.

The exhaust system allows the use of gasoline or diesel motors in many applications where previously more expensive or less adaptable types of drive systems such as battery driven or electric trolley type systems were thought to be necessary. More especially, the well known advantages of diesel motors such as low fuel cost, simplicity and operating reliability are made available for use in situations where the hot diesel exhaust gases previously made such a use dangerous.

An object of the invention is to provide a cooling means for hot exhaust gases.

Another object of the invention is to provide a flame trap for a gas exhaust system.

Another object of the invention is to provide an exhaust system for internal combustion engines which cools the exhaust gases and traps exhaust gas flames.

Another object of the invention is to eliminate hot spots in exhaust gas systems.

A further object of the invention is to provide a relatively simple, efficient and reliable exhaust gas system of the water cooled, flame trap type.

A still further object of the invention is to provide an exhaust system for internal combustion engines which may be used in an explosive surrounding atmosphere.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein:

Fig. 1 is a side elevational view partially in section of one embodiment of the exhaust system of the invention;

Fig. 2 is a front elevational view of the system of Fig. 1 with the motor hood removed;

Fig. 3 is an enlarged detailed plan view partially cut away of the flame trap;

Fig. 4 is a sectional view of the flame trap taken along the line 4—4 of Fig. 3; and

Fig. 5 is an exploded perspective view of a portion of the flame trap of Fig. 3.

The exhaust system of the invention will first be described generally with particular reference to Fig. 1. A conventional internal combustion engine such as a gasoline or diesel motor is shown at 1 having an exhaust manifold 2, a radiator 3 and a cooling fan 4.

The hot exhaust gases from manifold 2 pass through the exhaust system of the invention to the surrounding atmosphere. The principal components of the exhaust system comprise exhaust pipe 5, a water baffle chamber 7, and flame traps 17. The exhaust pipe 5 has a built-in cooling spray and connects between manifold 2 and the chamber 7 and cools the hot exhaust gases while leading them from the manifold 2 to the chamber 7 where the gases are further washed and cooled. The gases now pass outwardly from chamber 7 through flame traps 17 which permit the passage of the cooled gases but which prevent the outward passage of any flames. The components of the system will now be described in greater detail.

Exhaust pipe and water spray

As noted above, pipe 5 connects the conventional motor exhaust manifold 2 to a chamber 7. A nozzle 6 is mounted in the upper end of pipe 5 to admit a spray of water into the pipe and through the exhaust gases just as they enter the pipe from manifold 2. This injected or sprayed water cools the exhaust gases as well as the pipe 5. The cooling of the gases provides a first step in the exhaust conditioning to eventually allow it to be admitted to the atmosphere. The cooling of the pipe 5 prevents the formation of hot spots on the pipe itself which might tend to ignite surrounding explosive atmosphere. Water injection nozzle 6 is a conventional spray type nozzle. Water is supplied to nozzle 6 from a supply tank 20 through line 25, pressure pump 31 and line 30. Pump 31 supplies the water to nozzle 6 at sufficient pressure to force it through the nozzle in a finely distributed spray. The water pressure is controlled by having a return line 33 connected between the nozzle 6 and the tank 20 through a relief valve 36. Valve 36 is set to open, allowing water to by-pass nozzle 6 and to return to tank 20 when pump 31 raises the water pressure above a given value. Pump 31 is driven by a suitable power take-off from motor 1 by drive sprocket 32 through the intermediation of chain 34 and sprocket 35. Tank 20 is filled through a suitable cap 23 and has a water level indicator 24. Indicator 24 may be of any suitable type. An actuating float 21 is shown which turns rod 22 radially as float 21 is rotated by water level changes to move a suitable indicator needle on indicator 24.

Water baffle chamber

The partially cooled exhaust gases enter chamber 7 from pipe 5 through an aperture 8 in the chamber wall 14. Chamber 7 comprises a watertight tank having a bottom 15; side walls 14, and a top 16. A series of vertical baffles 9, 10, and 11 each at least partially submerged in water 12 cause the gases entering at aperture 8 to proceed through a tortuous path to exit aperture 38 in top 16. Thus the gases from pipe 5 pass into chamber 7 and downwardly through the water 12 to pass baffle 9. The gases then have to move upwardly in water 12 over submerged baffle 11 and then downwardly again to pass baffle 10 and finally upwardly toward exit aperture 38.

Water is supplied to the chamber 7 both from the portion of the spray from nozzle 6 which is not evaporated and from a water inlet pipe 27 from tank 20 and connected to the chamber 7 by a float operated inlet valve 13. More water is evaporated and carried out of chamber 7 by the exhaust gases passing therethrough than enters it

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from pipe 5. The level is maintained by inlet valve 13 controlled by float 13a. Thus, float 13a maintains water 12 at a level slightly above baffle 11. Chamber 7 additionally cools the exhaust gases entering it from pipe 5 as well as provides a scrubbing action to remove any particles such as carbon particles or deposit flakings from the engine cylinder or manifold portions. In addition, the chamber may be used to absorb certain undesired gas contents such as the aldehyde contents in the exhaust gas by adding a solution of hydroquinone and sodium sulfite to water 12.

An alarm unit 37 is mounted on side 14 of chamber 7. A conventional thermostat 37a within the chamber 7 is set to turn on the alarm when the exhaust gas temperature passes a given point.

Flame traps

The cooled and washed exhaust gases pass out of chamber 7 through flame traps 17 mounted on the top 16 of chamber 7. The gases which emerge from the upper portion of flame traps 17 are discharged in front of radiator 3 and into the air blast from fan 4 which is blowing air outwardly toward louver section 19 through radiator 3.

Flame traps 17 are designed to allow the exhaust gases to pass freely into the atmosphere while at the same time preventing the passage of any flames. This prevents the emergence of flames from chamber 7 into the outer atmosphere due to explosions in chamber 7 or to the failure of the water sprays at nozzle 6 or a loss of water 12 in chamber 7.

The details of flame trap 17 are shown in Figs. 3, 4, and 5. A flange-like base 39 is used to attach the flame trap 17 to top 16 of chamber 7. Base 39 has an aperture 39a cooperating with aperture 38 of top 16 to allow the exhaust gases to pass upwardly into trap 17. Base 39 is attached to top 16 with an airtight fit by a suitable bolt 45 at one end and a stud 46 and nut 47 at the opposite end cooperating with slot 48. The stud 46 and slot 48 facilitate the removal and mounting of the base 39 as stud 46 provides a guide rod to locate trap 17 on top 16. A hollow cylindrical body member 41 extends upwardly from base 39 and has an inner aperture 40 with a cross section corresponding generally to the cross section of aperture 39a in base 39.

Adjacent to the top 57 of body member 41 are the exhaust gas outlets 56 formed between annular rings 52 spaced by shims 50. The parts of trap 17 are positioned and held in place by rods 42 which are threaded into tapped holes in base 39 and which pass through appropriately spaced apertures 43 in body member 41, 51 in shims 50, 53 in rings 52 and 58 in top 57. Nuts 44 tightened on the threaded tops of rods 42 hold the parts of trap 17 in tight fitting relationship so that airtight connections are made between all adjacent parts, except for gas outlets 56. In the initial assembly the base 39, the body member 41, rings 52, shims 50 and top 57 are all carefully shaped and finished to provide for airtight fits. In order to retain these parts with their same orientation with respect to rods 42 upon disassembly and reassembly, one rod, such as 42a, is spaced unevenly with respect to the other rods 42 so that the parts will fit together in only one position and will not be inverted or turned upon reassembly.

The unequally spaced holes in rings 52 also require the rings 52 to be always mounted with the same side up. Since it is desirable to fasten shims 50 to one side of rings 52, the unequally spaced holes prevent inadvertent inversion of a ring 52 which would place two shims together and leave a dangerously large outlet 56.

The extended aperture 40 in the center of body member 41 directs the exhaust gas upwardly to the top of the trap 17 in a generally straight flow. A narrow fin 55 mounted across aperture 38 in top 16 assists in causing the exhaust gas flow to have a generally straight flow. When the exhaust gas reaches the top 57, it is turned

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at right angles so that it may pass outwardly through outlets 56 between plates 50. Outlets 56 are characterized by their large horizontal cross section and their extremely small height. Ignited gases passing through outlets 56 are thus forced into close contact with rings 52 and are rapidly extinguished thereby. The flame trap action of trap 17 occurs as follows. Flames originating in chamber 7 or trap 17 spread upwardly toward top 57 and outlets 56. These flames which have a direction generally axially of aperture 40 due to its relatively great length and to fin 55 are turned at right angles adjacent to top 57 to pass radially outward through outlets 56. As the flames are turned and enter the narrow outlets, they are extinguished by the closely spaced rings 52 before they emerge from the outer edge of outlets 56.

The preferred embodiment is shown with three rings 52 providing three outlets between each pair of rods 42 or a total of twelve outlets. With an inside ring diameter of about three inches and an outside diameter of about six inches, a spacing of fifteen thousandths of an inch between rings 52 by shims 50 has been found to provide a desirable combination of venting and cooling to allow the passage of gas and to provide at the same time for sufficient flame quenching action.

Other numbers of rings and spacings can be used depending on the desired gas flow and the trap size.

Gases flowing out of outlets 56 mix with the large volume of air being blown out through louver 19 on the protective vehicle hood 18 and are thus further diluted by the air flowing from radiator 3.

Operation

The water supply for chamber 7 operates independently of the running of motor 1 so that the water 12 is kept at the correct level at all times. Thus, whenever the level of water 12 drops, valve 13 opens and water flows in by the force of gravity from raised tank 20.

When motor 1 is started, causing exhaust gas to flow into pipe 5, pump 31 connected to the motor simultaneously pumps water through nozzle 6 into pipe 5. The exhaust gas as well as pipe 5 are cooled by this spray. The partially cooled gas from pipe 5 now enters chamber 7 where it is forced to pass through water 12 by baffles 9, 10, and 11. This further cools the exhaust gas and removes carbon and other particles therefrom. If desired, water 12 can be chemically treated to remove objectionable contents from the exhaust such as by the addition of hydroquinone and sodium sulfite solution to water 12 to reduce the aldehyde contents in the exhaust gas.

Should nozzle 6 or water supply 12 fail, the temperature of the gas in chamber 7 will rise. In this case thermostat 37a will operate at a predetermined temperature to give warning of the dangerous temperature rise of the exhaust gas. Alarm 37 which may be a conventional bell or buzzer suitably enclosed to eliminate any spark hazard will sound.

The exhaust gases leave chamber 7 through the outlets 56 in the top of traps 17 which pass the gases and trap any flames in the gases. These outlets are mounted in front of radiator 3 so that air from fan 4 will mix with and further dilute the exhaust gas.

It will be seen that the present invention provides a new and useful exhaust system which will allow the operation of inexpensive and readily available motor units in areas containing explosive atmospheres. The exhaust system provided is relatively simple and at the same time reliable and efficient. Suitable safeguards are provided to provide for a warning after failure of the system to operate adequately. Only an insignificant amount of power is required from the motor to operate the single pump in the system. The only attention required for routine maintenance of the exhaust system is the occasional addition of water to the system supply tank.

As various changes may be made in the form, construction and arrangement of the parts herein without

departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. An exhaust gas safety system comprising a downwardly sloping exhaust pipe and water storage means, a nozzle connected to said water storage means and mounted on the upper end of said pipe adapted to spray water into the gases passing into said pipe, a first conduit interposed between said water storage means and said nozzle, a second water conduit interposed between said nozzle and said water storage means to convey excess water back to the water storage means, a water chamber mounted on said exhaust pipe whereby exhaust gases will be conveyed to said water chamber, at least one baffle mounted in and extending across said water chamber, said baffle being partially submerged in the water to direct the exhaust gases into contact with the water, a third water conduit connecting said water chamber to said first water conduit to convey water from said water storage means to said water chamber, a regulator within said water chamber and mounted on said third water conduit and normally closing the same, said regulator being adapted to open said third water conduit when the water gets below a predetermined level to permit water to enter the water chamber, an outlet on said water chamber on the opposite side of said baffle from the conduit connection, a flame trap on said water chamber having an opening communicating with said outlet, and a fan adjacent said flame trap to disperse gases emerging therefrom.

2. An exhaust gas safety system comprising a downwardly sloping exhaust pipe and a water storage means, a nozzle connected to said water storage means and mounted on the upper end of said pipe adapted to spray water into the gases passing into said pipe, means for conducting water from said water storage means to said

nozzle, means for conveying excess water back to the water storage means, said exhaust pipe being connected to a water chamber, at least one baffle mounted in and extending across said water chamber, said baffle being partially submerged in the water to direct the exhaust gases into contact with the water, means for conveying water from said water storage means to said water chamber, a regulator within said water chamber normally closing the last-mentioned water conveying means, said regulator being adapted to open said water conveying means when the water gets below a predetermined level to permit water to enter the water chamber, an outlet on said water chamber on the side of said baffle opposite said regulator, a flame trap on said water chamber having an opening communicating with said outlet, and a fan adjacent said flame trap to disperse gases emerging therefrom.

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