June 28, 1932. H. T. KOSTERMAN 1,864,915

MUFFLER

Filed June 14, 1929

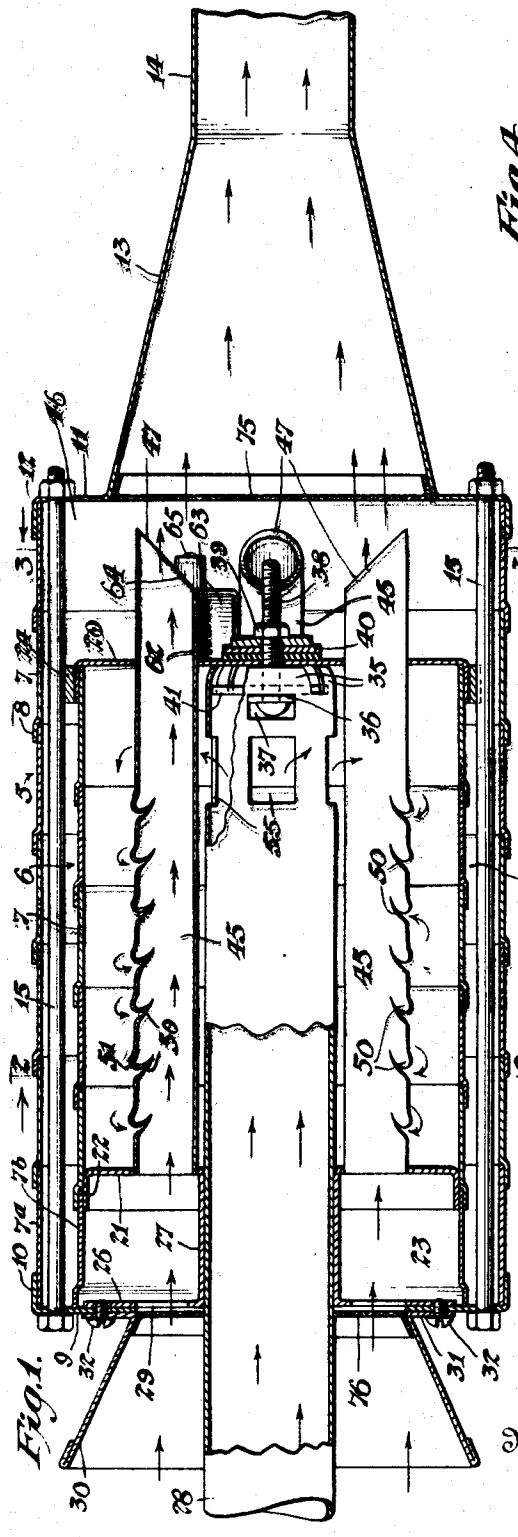


Fig. 1.

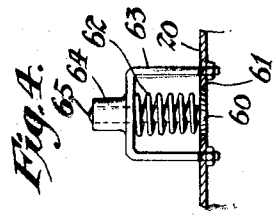


Fig. 4.

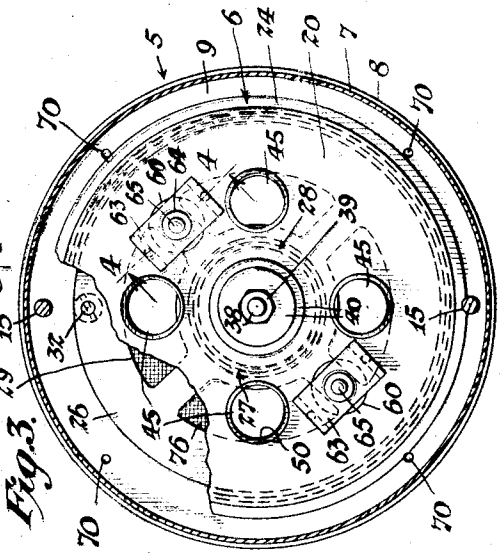


Fig. 3.

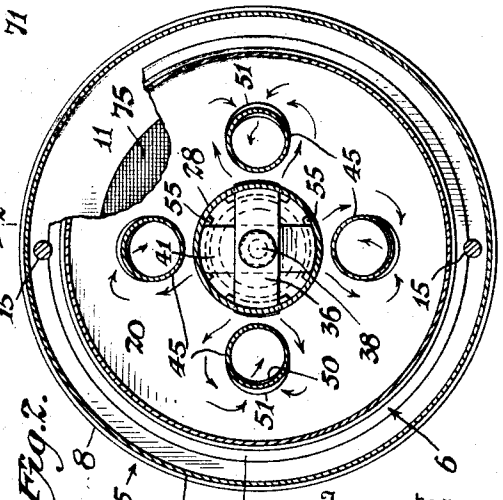


Fig. 2.

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UNITED STATES PATENT OFFICE

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MUFFLER

Application filed June 14, 1929. Serial No. 370,841.

My invention relates to mufflers for internal combustion engines, and its general object is to provide muffling apparatus which may be substituted for the ordinary exhaust muffler to perform the usual muffling functions and in addition, to reduce back pressure, and also more-or-less dilute and purify the exhaust gases or "convert" obnoxious components thereof, and to cool the exhaust gases to a relatively low temperature and thus reduce fire risk. The reduction of back pressure substantially increases engine efficiency.

To these ends the invention structure consists, as briefly described, in a muffler comprising an outer and an inner casing, a main exhaust pipe leading into the inner casing, air passages or pipes running through the inner casing and discharging into a rear portion of the outer casing, with apertures in the main exhaust pipe through which the hot gases are discharged against localized portions of the air pipes to create hot zones or "spots" therein, and injector nozzle formations in the air pipes through which the exhaust gas is discharged into the pipes in a rearward direction to mingle with air therein, the mutual conditions of air and gas flow serving to expedite the movement of the exhaust gas and to reduce back pressure; and as the combined exhaust gas and additional air pass the hot spots in the air pipes, if the temperature is sufficiently high, additional combustion or oxidation will occur, whereby there is a tendency to consume carbon particles, and to convert carbon monoxide to carbon dioxide, and thus reduce the volume of the dangerous or obnoxious components of the finally exhausted gases and consequently lowering the pressure.

The characteristics and advantages of the invention are further sufficiently explained in connection with the following detailed description of the accompanying drawing, which shows one representative embodiment. After considering this example, skilled persons will understand that many variations may be made without departing from the principles disclosed, and I contemplate the employment of any structures that are properly within the scope of the appended claims.

In the drawing:

Fig. 1 is a longitudinal section of a muffler embodying the invention in one form.

Fig. 2 is a section at 2—2, Fig. 1.

Fig. 3 is a section at 3—3, Fig. 1.

Fig. 4 is a sectional detail at 4—4, Fig. 3.

The structure includes as principal parts an outer casing or jacket 5 and an inner casing 6, which is conveniently identified as a gas chamber. These casings are desirably composed of annular sheet-metal sleeves or sections 7, one end of each section being pressed to form a sleeve socket 8 to receive the end of the next section. By this arrangement the casings may easily be assembled in any desired lengths, in adapting the muffler to engines of various types or cylinder dimensions. The jacket is completed by a centrally apertured front plate 9 having a flange 10 which telescopes over the front end of the forward casing section 7^a, and a back plate 11 having a flange 12 to receive the rear end of the rear casing section, and a generally funnel-shaped discharge passage 13 leading to the final discharge pipe 14. The parts of the jacket are held together by through bolts 15.

The inner casing or gas chamber is closed at its rear end by a plate 20 having an annular flange to receive the rear end of the rear casing section 7. The front end of the gas chamber is closed by a plate 21 having a peripheral flange 22 frictionally fitting within the casing. Forward of plate 21 is an annular casing section 7^b, the front edge of which rests against or is connected to front plate 9, thus forming within the front end of the jacket an air chamber 23 separated from the gas chamber by plate 21.

The sections 7 composing the jacket may in most cases be connected merely by friction fit, but on account of greater pressure in the gas chamber 6, its annular sections may be positively secured together, as by welding. To support the rear end of the gas chamber in relation to the jacket, a ring 24 may be placed about the flange and back plate 20, this ring having notches to receive segments of the through bolts 15.

A plate 26 is placed against the inner face of plate 9, and has a sleeve 27 extending to plate 21 and fitting over pipe 28, which is the engine exhaust pipe or a continuation thereof, thus properly supporting the front end of the structure on the exhaust pipe. The plate 26 has apertures 29 for passage of air to chamber 23. An air intake funnel or nozzle 30 is placed at the front end of the jacket, surrounding the exhaust pipe. This funnel has a flange 31 lying against the front face of plate 9, and plate 9, the funnel flange and plate 26 are secured together by bolts or screws 32.

The rear plate 20 of the gas chamber may be properly centered on and secured to the rear end of the exhaust pipe in various ways. In the particular arrangement shown, the rear end of the pipe is pressed or swaged in, and slotted to provide segments 35, the ends of which rest against the inner face of plate 20. A holding plate or strip 36 is passed through opposite slots 37 in the pipe, and a bolt 38 passes through the center of the holding strip and through plate 20, and is secured by a nut 39, with interposed washers 40, one of which may if necessary be of asbestos. An additional holding strip 41 may if desired be located within the exhaust pipe at a right angle to strip 36.

Air pipes, or mixing pipes 45 pass through the gas chamber close to the exhaust pipe. The front ends of these air pipes are inserted in holes in plate 21; near their rear ends they pass through holes in plate 20, and the rear ends of the pipes terminate in the rear chamber 46 of the jacket 5, these ends being preferably cut off on an angle as at 47, tending to confine the discharge from the pipes in directions toward the discharge funnel 13. Pipes 45 are uniformly spaced in a circular direction and their number may be varied, four being shown in the present embodiment. Openings are provided in pipes 45 for entrance of gases from the gas chamber, and preferably these openings are as shown in radially outward portions of the pipes and are also formed as nozzles directed rearward, this being done by making diagonal slots 50 in the pipe wall and bending the wall at the rear of the slots as at 51 to provide injector nozzles directed inward and rearward toward the pipe axis.

All, or the major part, of the exhaust gas from the engine is discharged from pipe 28 through apertures 55, near its rear end, and directed toward, the closing adjacent inner walls of the air pipe 45, thus producing hot spots in the pipes, with effect referred to later. Other apertures may be provided in pipe 28, in other locations, if desired.

To provide for relief of unduly high pressure in the gas chamber 6, safety valves may be provided such as the poppet valves 60 seated in apertures 61 in plate 20 and normally held in their seats in the apertures 61 by springs 62 engaging yokes 63 secured to the plate and which also provide guide sleeves 64 for the valve stems 65. If pressure in chamber 6 rises beyond a predetermined point the poppet valves will open and gas will blow directly into chamber 46, thus preventing any possibility of rupturing the gas chamber.

Desirably in some cases small apertures 70 are provided in front plate 9, thus admitting air to the annular space 71 between the jacket and gas chamber 6. A certain amount of air will pass through the apertures 70 and between the walls of the outer and inner casings, thus keeping the outer casing cool and also providing a certain amount of air directly to the rear chamber 46 to dilute gases therein or to assist in the conversion of carbon or carbon-monoxide.

Desirably in some cases I place a screen 75 of wire mesh in the opening of the rear plate 11 or at the front end of the discharge funnel 13, and the mesh of this screen may be of such fineness as to make it a Davy screen, preventing the passage of any flame therethrough and out of the discharge pipe. I may also place a similar screen 76 at the rear end of the air-supply funnel 30, to screen out dust from entering air and also to act as a Davy screen in case of accumulation of pressure sufficient to cause hot gases to issue from the air funnel.

In operation, the hot exhaust gas from the engine is discharged through apertures 55 against inner segments of the air or mixing pipes 45 near rear portions thereof thus highly heating restricted zones of the air pipes and forming hot spots. The exhaust gas fills chamber 6 and enters pipes 45 through nozzles 50. At the same time and especially if the car is moving forward, there is definite air pressure at the front of the air funnel 30, and air passes through the funnel and into chamber 23 and rearward through pipes 45 thus producing in the pipes forcible air draft which tends to draw the exhaust gas in through the nozzle 50. The exhaust gas is thus mixed with an ample amount of pure air, and the combined air and gas passes the hot spots, which in case of sufficiently high temperature will produce combustion or oxidation of oxidizable components of the exhaust gas such as carbon or carbon monoxide, and thus reduce all or a portion of these obnoxious materials to carbon dioxide. The gas is then discharged from the pipes into the discharge funnel 13 and issues at the rear end of the discharge pipe 14 in a substantially purified and smokeless condition. If the car is not moving forward, or in other conditions where there is not definite air pressure at the front of funnel 30, the discharge of exhaust gas from chamber 6 through nozzle 50 rearwardly into pipes 45, produces an ejector effect and air is drawn in through the supply funnel, and chamber 23, into the pipes and

discharged along with the exhaust gases as above referred to. While the hot exhaust gas heats pipes 45 and produces hot spots as above mentioned, the gases are at the same time greatly cooled and heating of the entire muffler structure is correspondingly reduced.

A supply of air to the space 71 adjacent the jacket wall 5 through holes 70 keeps the jacket at very low temperature so that in most cases the hand can be placed on the jacket while the engine is running.

The definite air flow through the muffler induced by forward movement of the car, and the ejector effect thereof in pipes 45 between successive explosions, greatly accelerates the flow of exhaust gas, and not only reduces back pressure, but has a positive tendency to "pull" the exhaust away from the engine exhaust ports; and engine efficiency is thus materially increased.

The flow of air and gases is so controlled that the muffler has a greatly improved "silencing" function, without creating back pressure, and on the contrary, with substantial reduction thereof, as above noted.

I claim:

1. A muffler comprising a jacket, a gas chamber therein, an exhaust pipe leading through the gas chamber, and air pipes running through the gas chamber and discharging rearward thereof, said air pipes having apertures through which gas passes from the gas chamber and mingles with air in the air pipes, the exhaust pipe having relatively large apertures at the rear end adjacent the air pipes whereby exhaust gases impinge on the pipes and produce hot spots therein heating the gas to oxidize the carbon monoxide to carbon dioxide.

2. A muffler comprising a jacket, a gas chamber therein, an exhaust pipe leading through the gas chamber, and air pipes running through the gas chamber and discharging rearward thereof, said air pipes having apertures through which gas passes from the gas chamber and mingles with air in the air pipes, the exhaust pipe having relatively large apertures at the rear end and adjacent the air pipes whereby exhaust gases impinge on the pipes and produce hot spots therein, heating the gas to oxidize the carbon monoxide to carbon dioxide, and the openings in the pipes being arranged as injector nozzles directed inward and rearward toward the pipe axis.

3. A muffler comprising a casing, a gas chamber therein, an exhaust pipe leading through the gas chamber, and air pipes running through the gas chamber and discharging rearward thereof, said air pipes having apertures through which gas passes from the gas chamber and mingles with air in the air pipes, the forward portion of the gas chamber being extended to form an air chamber within the front portion of the casing with which the front ends of the air pipes communicate.

4. A muffler comprising a casing, a gas chamber therein, an exhaust pipe leading through the gas chamber, and air pipes running through the gas chamber and discharging rearward thereof, said air pipes having apertures through which gas passes from the gas chamber and mingles with air in the air pipes, the exhaust pipe having apertures adjacent the air pipes whereby exhaust gases impinge on the air pipes and produce hot spots therein, the forward portion of the gas chamber being extended to form an air chamber within the front portion of the casing with which the front ends of the air pipes communicate.

5. A muffler comprising a casing, a gas chamber therein, an exhaust pipe leading through the gas chamber, and air pipes running through the gas chamber and discharging rearward thereof, said air pipes having apertures through which gas passes from the gas chamber and mingles with air in the air pipes, the forward portion of the gas chamber being extended to form an air chamber within the front portion of the casing with which the front ends of the air pipes communicate and an air-supply funnel at the front end of the casing and leading to the air chamber.

6. A muffler comprising a casing, a gas chamber therein, an exhaust pipe leading through the gas chamber, and air pipes running through the gas chamber and discharging rearward thereof, said air pipes having apertures through which gas passes from the gas chamber and mingles with air in the air pipes, a forward portion of the gas chamber extending to form an air chamber within the front portion of the casing and with which the front ends of the air pipes communicate, the rear portion of the casing constituting a chamber rearward of the gas chamber and enclosing the discharge ends of the air pipes.

7. A muffler comprising a casing, a gas chamber therein, an exhaust pipe leading through the gas chamber, and air pipes running through the gas chamber and discharging rearward thereof, said air pipes having apertures through which gas passes from the gas chamber and mingles with air in the air pipes, a forward portion of the gas chamber extending to form an air chamber within the front portion of the casing and with which the front ends of the air pipes communicate, the rear portion of the casing constituting a chamber rearward of the gas chamber and enclosing the discharge ends of the air pipes, and a discharge passage leading from the rear end of the casing.

8. A muffler comprising a casing, a gas chamber therein, an exhaust pipe leading through the gas chamber, and air pipes running through the gas chamber and discharging rearward thereof, said air pipes having

apertures through which gas passes from the gas chamber and mingles with air in the air pipes, a forward portion of the gas chamber extending to form an air chamber within the front portion of the casing and with which the front ends of the air pipes communicate, the rear portion of the casing constituting a chamber rearward of the gas chamber and enclosing the discharge ends of the air pipes, and a discharge passage of funnel form leading from the rear end of the casing.

9. A muffler comprising a casing, a gas chamber therein, an exhaust pipe leading through the gas chamber, and air pipes running through the gas chamber and discharging rearward thereof, said air pipes having apertures through which gas passes from the gas chamber and mingles with air in the air pipes, a forward portion of the gas chamber extending to form an air chamber within the front portion of the casing and with which the front ends of the air pipes communicate, the rear portion of the casing constituting a chamber rearward of the gas chamber and enclosing the discharge ends of the air pipes, and a discharge passage leading from the rear end of the casing, and a screen substantially at the front of the air chamber.

10. A muffler comprising a casing, a gas chamber therein, an exhaust pipe leading through the gas chamber, and air pipes running through the gas chamber and discharging rearward thereof, said air pipes having apertures through which gas passes from the gas chamber and mingles with air in said air pipes, the forward portion of the gas chamber being extended to form an air chamber within the front portion of the casing with which the front ends of the air pipes communicate, and a screen substantially at the front of the air chamber.

In testimony whereof I affix my signature.

HENRY T. KOSTERMAN.