June 4, 1929. S. A. SNELL 1,715,630

MUFFLER

Filed Feb. 26, 1926

Fig. 1,

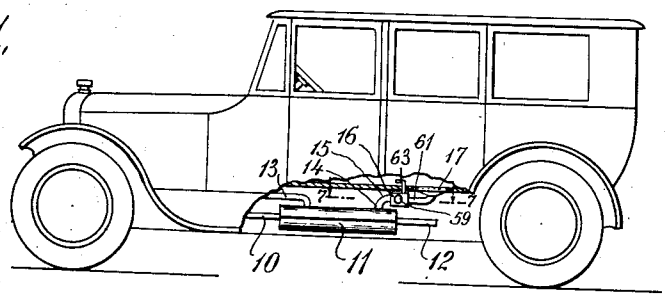


Fig. 2,

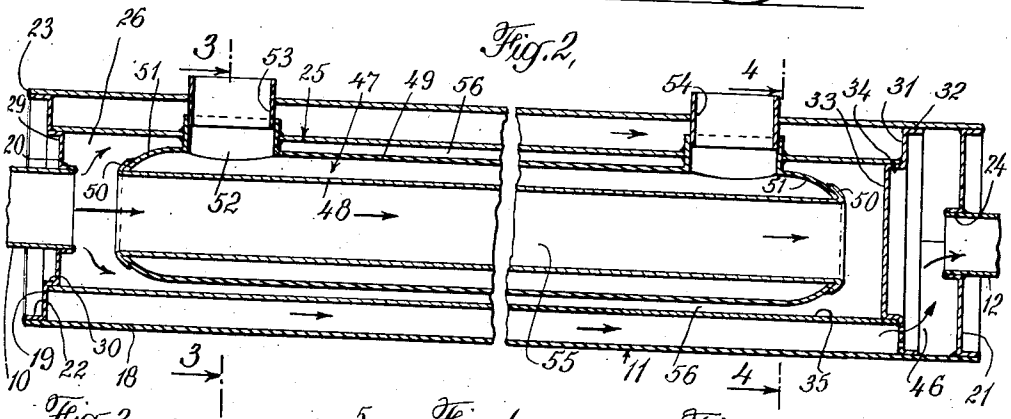


Fig. 3,

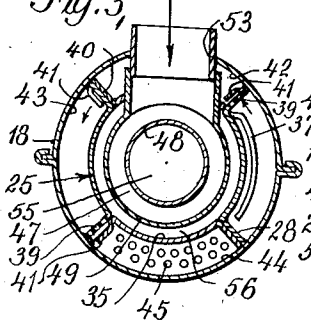


Fig. 4,

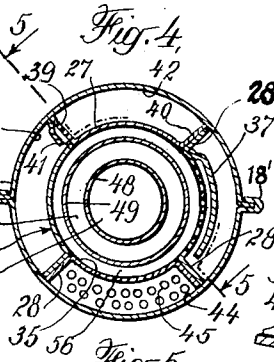


Fig. 6,

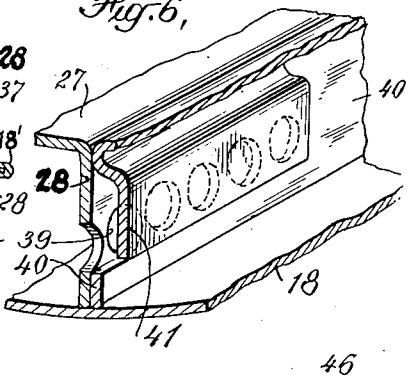


Fig. 5,

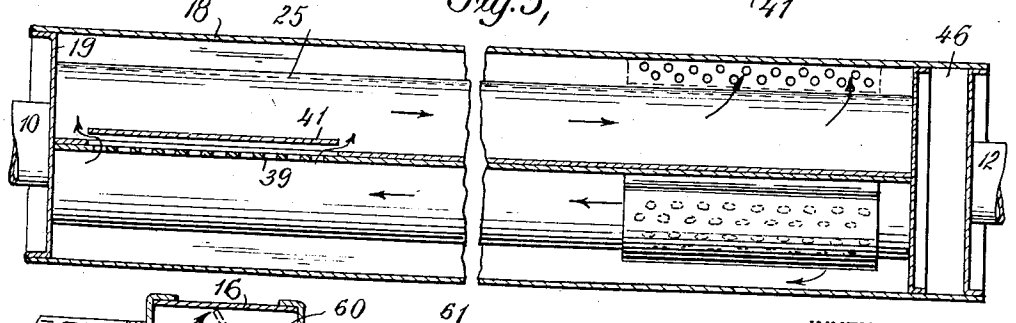
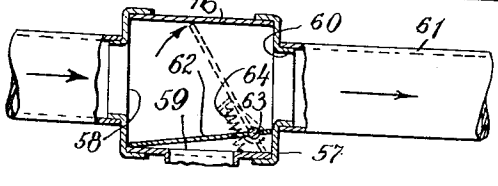


Fig. 7,



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UNITED STATES PATENT OFFICE.

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MUFFLER.

Application filed February 26, 1926. Serial No. 90,770.

This invention relates to a muffler for use with motor cars, and has to do more particularly with a muffler so arranged and constructed that it may be used, when desired, to supply heated air for discharge into the body of the car.

Mufflers which are employed to regulate the escape of exhaust gases from an internal combustion engine to the atmosphere, so that a minimum of noise due to the rapidly recurring explosions is audible, perform their functions best when the gases are discharged from them at a pressure approximating atmospheric. Ordinarily, these mufflers comprise a succession of chambers in which the expansion of the hot compressed gases takes place, and the chambers are either arranged one within another, or else placed end to end within a casing, gases from the exhaust line entering the first chamber and flowing through the chambers successively to the discharge outlet from the last chamber. In the first construction, in which the chambers are placed one within another, only the outside chamber can radiate heat to the atmosphere, while in the second construction, it is customary, in order to make the muffler compact, to form the chambers within a casing in such a manner that each chamber has but a small radiating surface. With either arrangement therefore, the gases are discharged from the muffler at a relatively high temperature, and but little reduction in pressure is secured due to the cooling of the gases within the muffler casing. These mufflers are therefore not as effective as they should be, and furthermore a considerable pressure is usually maintained within them, which places a back pressure on the motor and involves a loss of power.

In recent motor car development, closed vehicles now coming into widest use require some means for heating the interior of the car for winter use, and the heat contained in the exhaust gases from the motor is commonly utilized for the purpose, the gases being led through a heater connected to the exhaust line. In this heater the gases pass in heat exchange relationship with air which flows through the heater and through a line discharging into the car body. These heaters have heretofore taken the form of a structure wholly distinct from the muffler, and the separate heaters and mufflers have been connected successively in the exhaust line. The use of separate heaters and mufflers on the car involves considerable expense, both for the cost of material and for the installation of the devices.

The present invention is directed to the provision of an improved muffler so constructed and arranged that the exhaust gases pass through a succession of expansion chambers, and these expansion chambers are provided with large surfaces over which the gases flow in thin layers, thus causing a rapid drop in the temperature and pressure of the gases which results in an improved muffling effect. The novel muffler is further arranged so that air which passes through it for the purpose of reducing the temperature of the exhaust gases may be utilized for heating the car and the passages through which the air flows are so constructed and disposed within the muffler as to offer but slight resistance to the flow of exhaust gases, and furthermore, air to be heated is kept out of contact with the exhaust gases. In this new muffler heat is withdrawn from the gases, thus serving to lower the temperature and improve the muffling action and at the same time the heat is taken up by air which may, if desired, be led to the interior of the car. This single device, which is of simple construction and of low cost, consequently supplants the separate heaters and mufflers heretofore employed, and its use affords a considerable saving in the cost of materials and of installation.

The new muffler consists of a casing within which is a lengthwise passage, connected at one end to the exhaust line from the motor. Surrounding this passage is a plurality of expansion chambers, together forming a cylinder, these chambers extending substantially throughout the length of the casing, and having their outer defining walls in contact with the atmosphere. The chambers are shallow so that the gases flow therethrough in thin, wide streams. From the end of the passage opposite to that through which the gases enter, is an opening leading to one of the chambers and from the opposite end of this chamber is an aperture leading into the cham-

ber next adjacent. The chambers are all connected in this way, so that the gases flowing from the passage, traverse the casing a number of times, flowing back and forth through the chambers successively. From the last chamber is an outlet to the atmosphere.

For the purpose of cooling the exhaust gases, a hollow walled tube is placed within the passage within the casing, and connections are provided by which air is led into the space between the walls of the tube and one end thereof and withdrawn at the other. The tube is spaced from the walls of the passage so that the gases flow through and around the tube, so that the air flowing through the tube in the form of a thin, annular stream, rapidly absorbs heat from the gases, owing to the large conducting surfaces which separate the air and gases. The outlet from this tube is connected to a line by which the heated air may be led to the interior of the car, and as a further improvement, the invention includes a control mechanism for use with the device by which the flow of heated air to the car may be regulated.

For a better understanding of the invention, reference will be made to the accompanying drawing, in which

Fig. 1 is a view of a closed motor car illustrating the use of the improved combined heater and muffler,

Fig. 2 is a vertical sectional view through the device,

Figs. 3 and 4 are sectional views on the lines 3—3 and 4—4 respectively,

Fig. 5 is a sectional view on the line 5—5 of Fig. 4,

Fig. 6 is an enlarged perspective view of a detail of the device, and

Fig. 7 is a plan view, partly in section, showing the improved control mechanism.

Referring now to the drawings, the closed motor car illustrated conventionally, is provided with the usual exhaust line 10, leading from the exhaust manifold of the motor. In this line is disposed the muffler 11, through which the exhaust gases pass, these gases being discharged through a line 12, extending to any convenient point at the rear of the vehicle and discharging the gases to the atmosphere. Through the side walls of the casing are air inlet and outlet connections 13 and 14 respectively, the outlet connection leading to a conduit 15, in which is a control device 16 beyond which the conduit leads to a register 17, disposed in the floor of the vehicle in the usual way. The air intake 13 may similarly be connected to a conduit (not shown) extending to any convenient point on the vehicle, through which air is admitted to the heating element within the device.

The interior structure of the device is illustrated in Fig. 2, and the device is seen to consist of a casing 18, preferably of cylindrical form, made of sheet metal stamped or otherwise formed to appropriate shape. This casing may be made of two semi-cylindrical members, provided with contacting edge flanges seamed together and welded as shown at 18′ or otherwise secured together. A plate 19 forms the end wall of the casing and in this plate is an opening 20, provided with flanges in which may be received the end of the exhaust line 10. A similar plate 21 is disposed at the other end of the casing, and both plates are preferably of a general cup shape having peripheral flanges 22 which lie in contact with the inner walls of the casing and are welded or otherwise secured thereto along their edges, as at 23. The rear plate 21 has a central flanged opening 24, in which may be inserted the end of a pipe 12 forming the discharge line. The opening 20 forms an inlet for the exhaust gases and the opening 24 an outlet.

Within the casing is a partition 25, extending lengthwise thereof and defining a passage 26. This partition is made of sheet metal, preferably of cylindrical form, and is conveniently constructed of four arcuate plate members 27, having radial flanges 28 along their lateral edges. Four of these members are placed together to complete the cylinder, their edge flanges lying in contact, and the flanges are then secured together by welding, or in any other convenient manner. The end plate 19 has a cup-shaped depression 29, at its center, forming a circular shoulder 30, over which the partition formed of the plate members is slipped. This shoulder supports the end of the partition securely within the casing. Within the casing, adjacent the end plate 21 is a somewhat similar plate 31, having a peripheral flange 32 which lies in contact with the inner wall of the casing 18. This plate 31 has a central depression 33, providing a shoulder 34, similar to the shoulder 30, the partition slipping over the shoulder and being supported thereby with reference to the casing wall.

The flanges 28 on the plate members divide the space between the partition 25 and the casing 18 into a plurality of expansion chambers, of which there are four in the device illustrated. These chambers lie side by side and extend substantially the length of the device. The distance between the partition and the casing is relatively small, and the chambers are quite wide so that the gases, in their flow through the chambers, as will be described, take the form of thin streams and give up heat rapidly through the outer casing wall, by reason of the large extent of the surface of this wall which defines each chamber.

The gases flowing from the exhaust line 10 into the passage 26, flow to the plate 31, which is blank. One of the plates 27 has a number of holes in it at the end adjacent the plate 31,

these holes providing an opening through which the gas may flow from the passage 26 into the expansion chamber defined by the plate 27, its side flanges, and the casing 18. On the face of the plate within the chamber so defined is a baffle plate 37, this being formed of an arcuate piece of metal secured by welding, or other convenient means, to the face of the plate and extending in front of the holes so as to cause deflection of the gases flowing through the holes toward one side of this expansion chamber. This baffle plate is arranged so that its free end lies lowermost, and the gases flowing around its edge keep the space between the baffle and plate 27 clear of carbon accumulations. The gases flow in a generally diagonal direction lengthwise of the chamber to the forward end of the device, and at this end apertures are provided through the side flange 28, through which the gases may enter the next adjacent expansion chamber.

As illustrated more clearly in Fig. 6, the flange 28 is provided with a plurality of apertures 39, while the adjacent flange 40, of the next plate, has a portion 41 bent out of its plane so as to form a tongue or baffle which is placed in opposition to the apertures. With this arrangement, the gases flowing from the chamber beneath the plate 35 pass through the side walls of this chamber into the next chamber 42, around the edge of the baffle. The gases flow through this chamber rearwardly of the device, thence through similar apertures and around a similar baffle into the next expansion chamber 43. In this chamber the gases pass forwardly and at the forward end of the device they flow through similar apertures in the wall defined by the flanges and around a baffle into the chamber 44, through which the gases travel toward the rear. In each chamber the baffle is arranged with its free edge lowermost so that carbon accumulation is prevented. That part of the plate 31 which defines the rear end of the chamber 44, is provided with a plurality of outlet openings 45, and the gas flows out through these openings into the outlet chamber 46, which is defined by the plates 21 and 31 and the casing wall. In this chamber the gases flow toward the outlet pipe 12, and are thence discharged to the atmosphere.

It will be seen that with this arrangement the gases from the motor pass through the exhaust line 10 into the passage 26, which may be considered the first expansion chamber for the gases. From this chamber the gases flow successively through a series of arcuate expansion chambers formed in the space between the partition 26 defining the central passage and the outer casing wall. These passages are wide and shallow, and extend substantially the length of the device so that the gases flow through the chambers in thin streams which pass over surfaces of considerable extent, thus permitting large quantities of the heat contained in the gases to be radiated into the atmosphere.

The total area of the apertures through which the gases flow from the passage into the first arcuate chamber, and thence from one of these arcuate chambers to the next, is gradually diminished, and the impulses within the flowing gas stream are thus gradually damped so that the noise resulting from the explosions of the motor is effectively muffled. This muffling effect is increased as the gases are discharged into the atmosphere at a pressure approximating atmospheric, and in the present device the rapid cooling of the gases reduces the pressure materially.

The gases in the first expansion chamber defined by the passage 26, give up heat to a stream of air flowing through this passage in indirect contact with the gases and the air stream is conducted through the passage in such a way that the heated air may be led into the car for heating the latter. In order to heat the air out of direct contact with the gases, there is provided a hollow walled tube 47, within the passage 26. The tube is made of an inner tubular member 48, and an outer tubular member 49 of somewhat greater diameter. The ends of the tube 48 are provided with reversely turned flanges 50, and the ends of the tube 49 are turned inwardly toward the tube 48 as at 51. The flanges 50 overlie the inwardly curved ends 51 and the parts may be secured together by welding, so that an air-tight space is provided between the tubes. Near one end of the hollow walled tube is a flanged opening 52, the flange being formed by extrusion of the metal and projecting through the partition 25, being secured thereto by welding. In the flange is received the end of a pipe 53, which extends through the casing wall. This pipe forms the air inlet and the flange secured to the partition 25 serves to support the double walled tube within the partition in spaced relation thereto. At the opposite end of the double walled tube is another pipe 54 connected to a flange formed around an opening in the tube wall 49, and extending through casing 18 in the same way as the pipe 53. This pipe 54 forms the air outlet connection.

The double walled tube 47 has a length somewhat less than the distance between the end of the line 10 and the plate 31, and it is held within the passage defined by the partition in spaced relation to the walls of the latter. The tube has an open center, and gases entering the passage from the pipe 10 in part pass through the center of the tube, forming a columnar stream flowing through the space 55. Another portion of the gases is diverted around the sloping ends of the outer tube 51, into the annular space 56, so that the air flowing in the chamber formed between the walls of the tube is heated by in-

direct contact with the columnar stream of air flowing through the space 55 and the annular stream flowing through the space 56. Thus the air is effectively raised in temperature and similarly the gases entering the first expansion chamber from the exhaust line, are rapidly lowered in temperature, and accordingly in pressure.

The air inlet 13 connected to the tube 53 in any convenient manner, leads air into the space between the double walls of tube 47, the air flowing through this space and being discharged through the pipe 54 and the air outlet 14. The air, heated by its passage through the heating device, flows through the conduit 14 to the register within the car, and in this conduit is a control mechanism comprising a chamber 57, made of metal in any convenient manner. The chamber has an opening 58, through which the air from the conduit 15 enters the chamber, in the side wall of the chamber is an opening 59, leading to the atmosphere, and in the end wall opposite the opening 58 is an opening 60 which is connected to a conduit 61 leading to the register 17. Within the chamber is pivotally mounted a damper plate 62, provided with a handle 63 which extends through the floor of the car in any convenient position. A spring 64 secured to the damper plate acts to maintain it at either end of its travel about the pivot but prevents its being placed in an intermediate position. This damper plate is arranged so that it may be swung either to close the opening 59 or the opening 60, and as illustrated in Fig. 7, the plate 62 closes the opening 59 so that the heated air from the conduit 15 passes through the chamber of the mechanism into the conduit 61 to the register 17. In the opposite position of the damper, as illustrated in dotted lines in Fig. 7, the air is diverted through the chamber and flows out the opening 59 to the atmosphere. This permits regulation of the heating effect within the car body, and in summer weather, or when the temperature is comparatively high, the flow of air into the car may be entirely shut off. At the same time air passes through the air-heating chamber disposed within the passage 26, and thus acts to absorb heat from the gases within this first expansion chamber and assists in giving the desired muffling effect, resulting from the drop in pressure of the gases.

The improved muffler with the heater incorporated in it is of comparatively simple construction, and the several parts may be made of metal stamped or otherwise shaped to proper form. The casing, the partition, and the air-heating chamber are all made of sections which may be quickly secured together at low cost by welding, and the muffler may be readily installed so as to form a section of the exhaust line in the usual way. Since the heater and muffler are combined within a single structure, the weight of the device is considerably less than that of a separate heater and muffler, and the cost is much less than that of the two devices separately produced. The new device gives a highly effective muffling action, by reason of the succession of expansion chambers through which the gases flow, and this muffling action is increased by reason of the drop in temperature of the gases flowing through the device. The heat given up by the gases is utilized to heat air which may be delivered to the car for heating the interior thereof when desired, the heater being arranged so that it permits a loss of heat from the gases in the first expansion chamber or passage, where the gases would otherwise lose no heat.

I claim:

1. A muffler for use with an internal combustion motor which comprises the combination of a casing, a partition within the casing defining a passage spaced from the casing wall, an inlet for leading exhaust gases from the motor into said passage, an opening from the passage into the space between the partition and the casing wall, an outlet from this space, means for positively leading the gases along a tortuous path between the opening and the outlet involving a series of successive passes of the gases from end to end of the casing, and an air chamber within the passage terminating short of the ends thereof and having an inlet and an outlet passing through the casing wall between the ends thereof, the circulation of air through this chamber acting to lower the temperature and pressure of the gases in the passage.

2. A muffler for use with an internal combustion motor, which comprises the combination of a casing, a partition within the casing defining a passage spaced from the casing wall, an inlet for leading the exhaust gases from the motor into said passage, a plurality of expansion chambers in the space between the partition and the casing wall, an opening from the passage into one of the chambers, an outlet from another of the chambers, the chambers being connected through apertures so arranged that the gases flow through the chambers successively and from end to end of the casing in passing from the opening to the outlet, and an air chamber within the passage between the ends thereof and having an inlet and an outlet passing through the wall of the casing, the circulation of air through this chamber serving to lower the temperature and the pressure of the gases in the passage.

3. A muffler for use with an internal combustion motor which comprises the combination of a casing, a partition within the casing defining a passage spaced from the casing wall, an inlet for leading the exhaust gases from the motor into the passage, a plurality of expansion chambers arranged side by side

in the space between the partition and the casing wall, an opening from the passage into one of the chambers, an outlet from another of the chambers, the chambers being connected through apertures so arranged that the gases flow through the chambers successively and from end to end of the casing in passing from the opening to the outlet, and an air chamber disposed within the passage and out of contact with the gases flowing through the expansion chambers, this air chamber having inlet and outlet connections permitting air to flow therethrough, whereby the air acts to lower the temperature and pressure of the gases in the passage.

4. A muffler for use with an internal combustion motor which comprises the combination of a casing, a partition within the casing defining a passage spaced from the casing wall, an inlet for leading the exhaust gases from the motor into the passage, a plurality of expansion chambers arranged side by side in the space between the partition and the casing wall, these chambers extending substantially throughout the length of the casing, an opening from the passage into one of the chambers, an outlet from another of the chambers, the chambers being connected through apertures so arranged that the gases flow through the chambers successively and from end to end of the casing in passing from the opening to the outlet, and an air chamber disposed within the passage between the ends thereof and having an inlet and an outlet passing through the side wall of the casing, the circulation of air through the chamber serving to lower the temperature and pressure of the gases in the passage.

5. A muffler for use with an internal combustion motor which comprises the combination of a casing, a partition within the casing defining a passage spaced from the casing wall, an inlet for leading the exhaust gases from the motor into the passage, a plurality of expansion chambers arranged in the space between the partition and the casing wall, adjacent chambers having a defining wall in common, an opening from the passage into one of the chambers, an outlet from another of the chambers, the chambers being connected through apertures so arranged that the gases flow through the chambers successively and from end to end of the casing in passing from the opening to the outlet, and a double walled annular air chamber within the passage terminating between the ends thereof and having an inlet and an outlet passing through the casing wall, the circulation of air through the chamber acting to lower the temperature and pressure of the gases in the passage.

6. A muffler for use with an internal combustion motor which comprises the combination of a casing, a partition within the casing defining a passage spaced from the casing wall, an inlet for leading the exhaust gases from the motor into the passage, a plurality of expansion chambers arranged in the space between the partition and the casing wall, adjacent chambers having a common defining wall separating them, an opening from the passage into one of these chambers, an outlet from another of the chambers, apertures in the common defining walls through which adjacent chambers are in communication, these apertures being at opposite ends of adjacent chambers so that the gases flow through the chambers successively in passing from the opening to the outlet, and a double walled air chamber within the passage terminating short of the ends thereof and having inlet and outlet connections passing through the side wall of the casing, the circulation of air through the chamber serving to lower the temperature and pressure of the gases in the passage.

7. A muffler for use with an internal combustion motor which comprises the combination of a casing, a partition within the casing defining a central passage, an inlet for leading exhaust gases from the motor into the passage, a series of expansion chambers arranged side by side and together enclosing the central passage, an opening from the passage into the first chamber in the series, connections between successive chambers arranged at opposite ends thereof, whereby the gases from the passage flow through the chambers successively in alternating directions and from end to end thereof, an outlet for the gases from the last chamber of the series, and a double walled tubular air chamber within the passage terminating short of the ends thereof and having inlet and outlet connections passing through the side wall of the casing at a distance from the ends thereof, the circulation of air through the chamber acting to lower the temperature and pressure of the gases in the passage.

8. A muffler for use with an internal combustion motor which comprises the combination of a cylindrical casing, a tubular partition lying within the chamber and defining a passage lengthwise of the casing and spaced from the casing wall, an inlet for leading exhaust gases from the motor into the passage, means in the passage for lowering the temperature and pressure of the exhaust gases admitted thereto, a plurality of expansion chambers lying in the space between the casing and the partition, an opening from the passage into one of the chambers, a gas outlet from another of the chambers, apertures connecting the chambers and so arranged that the gas in flowing from the opening to the outlet traverses the chambers successively, and baffle plates within the chambers adjacent the apertures for deflecting the gas flow.

9. A muffler for use with an internal com-

bustion motor comprising the combination of a casing, a partition therein defining a central passage spaced from the casing wall, a plurality of flanges connecting the partition and casing and forming expansion chambers, an inlet in the casing for leading exhaust gases into the passage, an opening leading from the passage at one end thereof into one of the expansion chambers, an outlet for the gases from another of the chambers, apertures through which the chambers are in communication, these apertures being so arranged that the gases, in flowing from the opening to the outlet, traverse the chambers consecutively, and baffle plates within the chambers adjacent the apertures for deflecting the gas flow.

10. A muffler for use with an internal combustion motor comprising the combination of a casing, a partition therein defining a central passage extending lengthwise of the casing, a plurality of flanges connecting the partition and casing and forming a series of expansion chambers extending lengthwise of the casing and lying side by side, an inlet in the casing for leading exhaust gases into the passage, an opening leading from one end of the passage into one of the expansion chambers, an outlet for the gases from another of the chambers, apertures through which the chambers are in communication, these apertures being arranged alternately at opposite ends of the chamber so that the gases in flowing from the opening to the outlet traverse the chambers consecutively, and baffle plates within the chambers adjacent the apertures for deflecting the gas flow.

11. A muffler for use with an internal combustion motor comprising the combination of a cylindrical casing, a central tubular partition having an open end and a closed end lying within the casing lengthwise thereof and defining a passage, a connection between the exhaust line of the motor and the open end of the partition for leading exhaust gases into the passage, a plurality of flanges connecting the partition and casing and with the latter defining a series of expansion chambers extending lengthwise of the casing, an opening near the closed end of the partition and leading from the passage into one of these chambers, an outlet for the gases from another of the chambers, apertures through which the chambers are in communication, these apertures being so arranged that the gases in flowing from the opening to the outlet traverse the chambers consecutively, and baffle plates mounted on the flanges overlying the apertures and serving to deflect the flow of the gases therethrough.

12. A muffler for use with an internal combustion motor and having a longitudinal central chamber into one end of which exhaust gases are admitted, a plurality of passages extending lengthwise of the muffler to which the exhaust gases are admitted from said central chamber and through which they pass successively and from end to end of the casing to an outlet at the end of the muffler opposite said inlet end, and an air chamber disposed within the passage and terminating short of the ends thereof and having inlet and outlet connections passing through the casing walls at a distance from the ends thereof, the circulation of air through the chamber acting to lower the temperature of the gases in the passage.

In testimony whereof I affix my signature.

SAMUEL A. SNELL.