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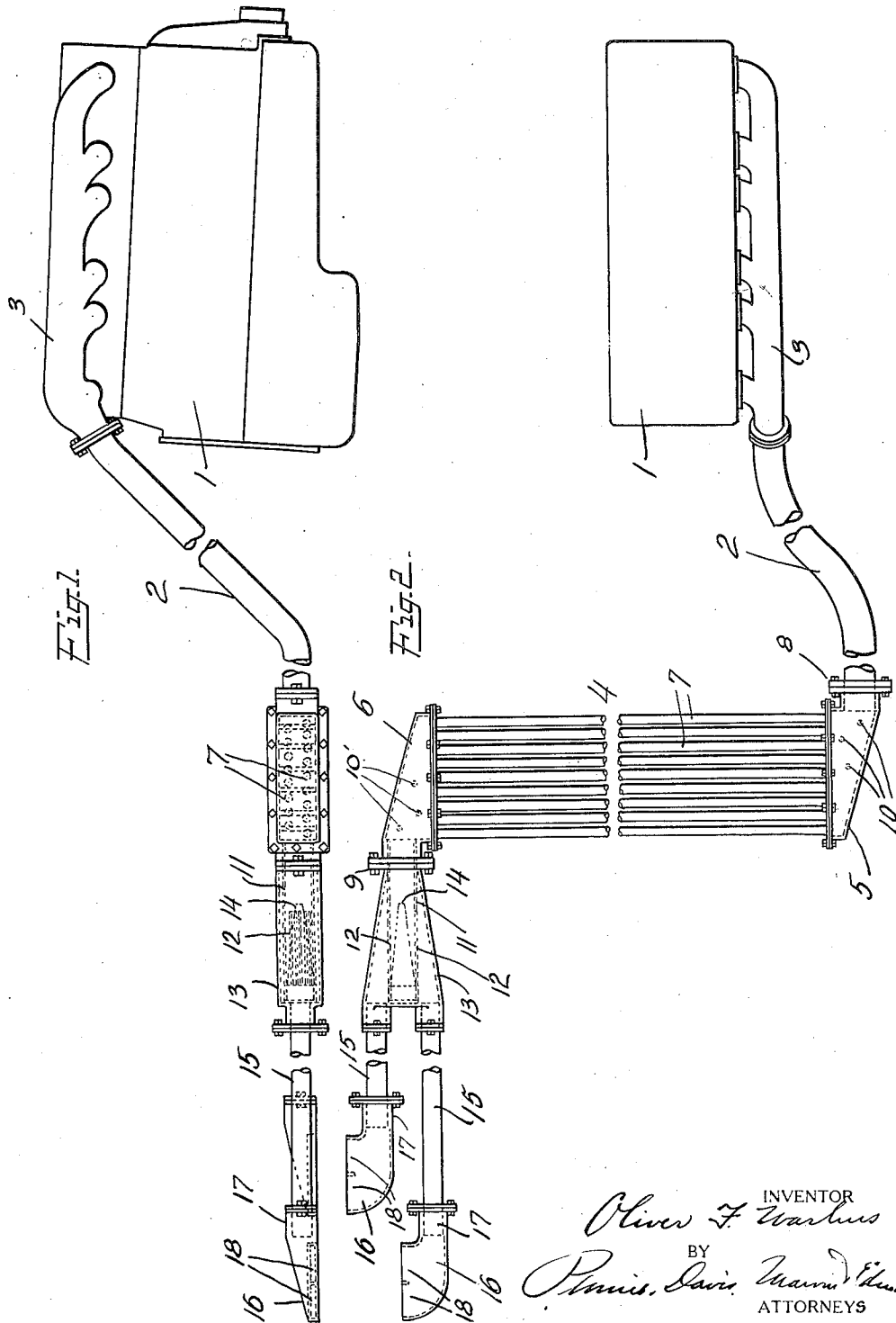
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1,708,002

EXHAUST MUFFLER

Filed March 3, 1927

2 Sheets-Sheet 1



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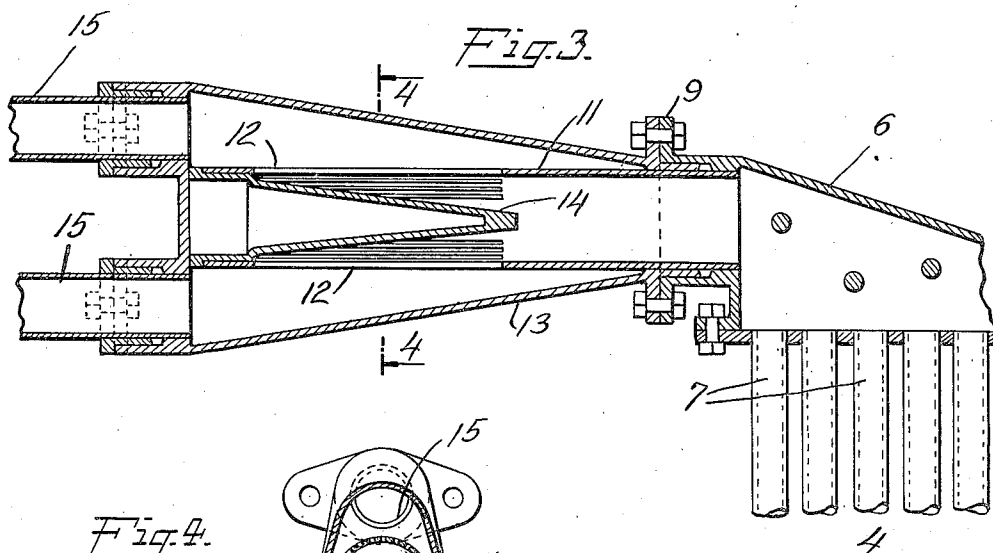
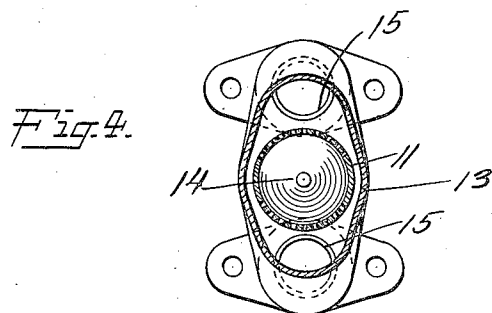
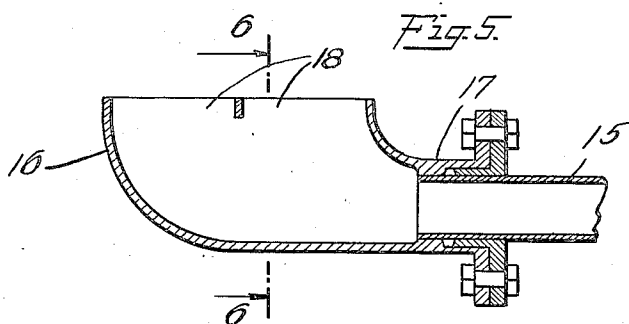
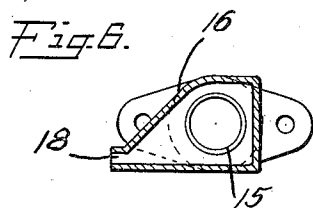
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EXHAUST MUFFLER

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

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EXHAUST MUFFLER.

Application filed March 3, 1927. Serial No. 172,219.

This invention relates to exhaust mufflers for motors.

Many attempts have been made to produce an exhaust muffler which will eliminate the noise of the exhaust gases and which will cause but little back pressure on the motor. Most of these attempts have been based upon the gradual expansion principle according to which the exhaust gases are allowed to expand gradually before they are exhausted into the atmosphere to reduce their temperature and pressure. In other attempts devices have been employed to break up or sub-divide the stream of gases in order to reduce the noise of the exhaust. So far as I am aware no one has produced a practical type of exhaust muffler operating upon either of these principles that will reduce the exhaust noise to the required degree and which will not exert objectionable back pressure on the motor. It has also been attempted to reduce the temperature and pressure of the exhaust gases by passing them through a condenser and then exhausting them directly into the atmosphere. However, a condenser alone, if built within practical limits, does not muffle the exhaust noise at all times to a desirable extent.

The principal object of this invention is to provide an improved exhaust muffler which is thoroughly practical in construction, and which will substantially eliminate the noise of the exhaust without exerting any appreciable back pressure on the engine.

An exhaust muffler constructed in accordance with the invention is illustrated in the accompanying drawings, in which:—

Fig. 1 is a side elevation of an internal combustion engine and the improved exhaust muffler;

Fig. 2 is a top plan view of the construction shown in Fig. 1;

Fig. 3 is an enlarged horizontal cross section of one part of the muffler;

Fig. 4 is a transverse section taken on the line 4—4 of Fig. 3;

Fig. 5 is an enlarged horizontal cross section of one of the exhaust nozzles; and

Fig. 6 is a transverse section taken on the line 6—6 of Fig. 5.

The particular exhaust muffler shown in the drawings was especially designed for use in connection with the internal combustion engine of an automobile coach or truck, but it may be used on any vehicle where it is de-

sirable to muffle the exhaust motive fluid of the motor, and may also be used to muffle the exhaust motive fluid of any motor regardless of whether or not the motor be on a vehicle.

An internal combustion engine is represented in the drawings at 1. The engine has an exhaust pipe 2 connected with the exhaust manifold 3 of the engine.

The muffler itself comprises a condenser 4 which may include a header 5 and a header 6 between which extend a series of tubes 7. The header 5 is connected at 8 to the exhaust pipe 2, and the header 6 is connected at 9 to the device to be hereinafter described. The header 5 may be provided with a series of transverse rods 10 which serve to distribute the gases as they flow into the tubes 7. When the muffler is used on a vehicle the tubes 7 preferably extend transversely of the vehicle and are exposed to the air so that when the vehicle is in motion the air current will cool the tubes. The tubes may be cooled if desired in any other suitable way. Preferably the tubes are arranged in several horizontal rows. In the drawing two horizontal rows of tubes are shown and preferably the tubes of one row are staggered with respect to the tubes of the adjacent row as shown in Fig. 1.

The header 6, also having transverse gas distributing rods 10', communicates with a pipe 11 having a series of longitudinal slots 12, as best shown in Fig. 3. The gases leaving the header 6 pass outwardly through the slots 12 into a housing 13 which encloses the pipe 11. A conical deflector 14 assists in deflecting the gases outwardly through the slots 12. The gases then pass from the housing 13 through a pair of pipes 15 each of which is provided with an exhaust nozzle 16. The detail construction of the exhaust nozzles is not important, but each nozzle preferably comprises a casting having a circular end 17 adapted to be connected with the circular pipe 15, and a flattened or extended exhaust opening shown at 18.

The exhaust gases pass from the exhaust pipe 2 through the header 5 and are distributed to the tubes 7 where they are cooled. As the gases pass through the tubes 7 their temperature is reduced and their pressure is reduced. The combined cross sectional area of the passages in the tubes 7 is greater than the cross sectional area of the passage in the exhaust pipe 2 so that the condenser will cause no back pressure on the engine. The

fact that the combined area of the passages in the tubes 7 is greater than the area of the passage in the pipe 2 also results in some expansion of the gases which tends to reduce their temperature and pressure. When the gases reach the pipe 11 they have been diminished in volume, temperature and pressure. The gas stream in passing outwardly through the slots 12 is broken up or subdivided into a number of smaller streams. The combined cross sectional area of the slots 12 is greater than the cross sectional area of the passage in the pipe 11. Therefore, no back pressure is caused by the passage of the gases through the slots. The capacity of the housing 13 is great enough to receive the gases issuing from the slots 12 without causing any back pressure. The exhaust gases then pass through the pipes 15 the passages of which have a combined area which is preferably no less than the area of the space within the housing 13 so that no back pressure is caused by the passage of the gases through these pipes.

It has been found, in practice, that a muffler constructed as above described substantially eliminates the noise of the exhaust and that the horse-power of the engine is not at all affected by the use of the muffler, showing that the muffler causes no appreciable back pressure on the engine. The gases issuing from the exhaust nozzles 15 are only slightly higher in temperature and pressure than the atmosphere. It has been found that the condenser alone does not entirely eliminate the noise of the exhaust, especially at certain speeds of the engine. By breaking up or subdividing and expanding the stream of gas leaving the condenser in the manner described above, it has been found that practically all of the noise of the exhaust may be eliminated at all times. The use of the housing 13 and its instrumentalities by themselves without the condenser would not entirely eliminate the noise. Moreover, if these parts were used by themselves or ahead of the condenser they would cause objectionable back pressure on the engine because the gases which would then be passed through the pipe 11 and the slots 12 would have high pressure, temperature and velocity. By condensing the gases before they pass into the break-up device 11-12-13 the temperature, pressure, volume and velocity of the gases are so reduced that the break-up device causes no appreciable back pressure. It will therefore be seen that before the gases are allowed to pass through a break-up or gas expansion device which would otherwise cause back pressure on the engine they are first placed in a condition by reason of which the break-up device can perform its function without causing any back pressure.

I claim:

1. The combination with an engine exhaust

pipe of a muffler comprising a condenser adapted to be connected with said pipe and provided with a plurality of tubes through which the exhaust gases may pass in unidirectional flow, the passages in said tubes having a combined cross sectional area which is greater than the cross sectional area of the passage in said pipe, and a device having an entrance opening in communication with the condenser, a plurality of separate transverse gas deflectors and a plurality of exhaust openings through which the exhaust gases may pass to break up or sub-divide the gas stream, the combined cross sectional area of said exhaust openings being greater than the cross sectional area of said entrance opening.

2. The combination with an exhaust pipe of a muffler comprising a condenser adapted to be connected with said pipe and provided with a plurality of tubes through which the exhaust gases may pass in a unidirectional flow, the passages in said tubes having a combined cross sectional area which is greater than the cross sectional area of the passage in said pipe, a conduit one end of which constitutes an entrance opening in communication with the condenser, said conduit having a plurality of exhaust openings in its side walls through which the exhaust gases may pass radially outwardly to break up or subdivide the gas stream, the combined cross sectional area of said exhaust openings being greater than the cross sectional area of said entrance opening, and a housing surrounding said conduit for receiving all of the gases discharged by said exhaust openings.

3. The combination with an engine exhaust pipe of a muffler comprising a condenser adapted to be connected with said pipe and provided with a plurality of tubes through which the exhaust gases may pass in unidirectional flow, the passages in said tubes having a combined cross sectional area which is greater than the cross sectional area of the passage in said pipe, a conduit one end of which constitutes an entrance opening in communication with the condenser, said conduit having a plurality of exhaust openings in its side walls through which the exhaust gases may pass outwardly to break up or subdivide the gas stream, the combined cross sectional area of said exhaust openings being greater than the cross sectional area of said entrance opening, a deflector in the conduit, a housing surrounding said conduit for receiving the gases discharged by said exhaust openings and at least one exhaust pipe connected with said housing.

4. The combination with an engine exhaust pipe of a muffler comprising a condenser adapted to be connected with said pipe and provided with a plurality of tubes through which the exhaust gases may pass, the passages in said tubes having a combined cross sectional area which is greater than the cross

sectional area of the passage in said pipe, a conduit one end of which constitutes an entrance opening in communication with the condenser, said conduit having a plurality of exhaust openings in its side walls through which the exhaust gases may pass radially outwardly to break up or sub-divide the gas stream, the combined cross sectional area of said exhaust openings being greater than the cross sectional area of said entrance opening, a housing surrounding said conduit for receiving the gases discharged by said exhaust openings, and a plurality of outlet pipes connected with said housing, the combined cross sectional area of the outlet pipe passages being no less than the cross sectional area of the space in said housing.

5. The combination with an engine exhaust pipe of a header connected to the pipe, a muffler comprising a multiple tube condenser connected in parallel to the header, a conduit having an opening in communication with the other ends of the several condenser tubes, this conduit having a plurality of apertures in its surface through which the exhaust gases may pass radially outwardly to sub-divide the gas stream, the combined cross-sectional area of the apertures being greater than the cross-sectional area of the conduit opening; a core deflector in the conduit opposite the apertures, and a housing surrounding the conduit to receive all of the gases discharged by said openings.

In testimony whereof I affix my signature.

OLIVER F. WARHUS.