

J. A. & C. A. XARDELL.
 EXHAUST MUFFLER.
 APPLICATION FILED FEB. 18, 1909.

944,646.

Patented Dec. 28, 1909.
 2 SHEETS—SHEET 1.

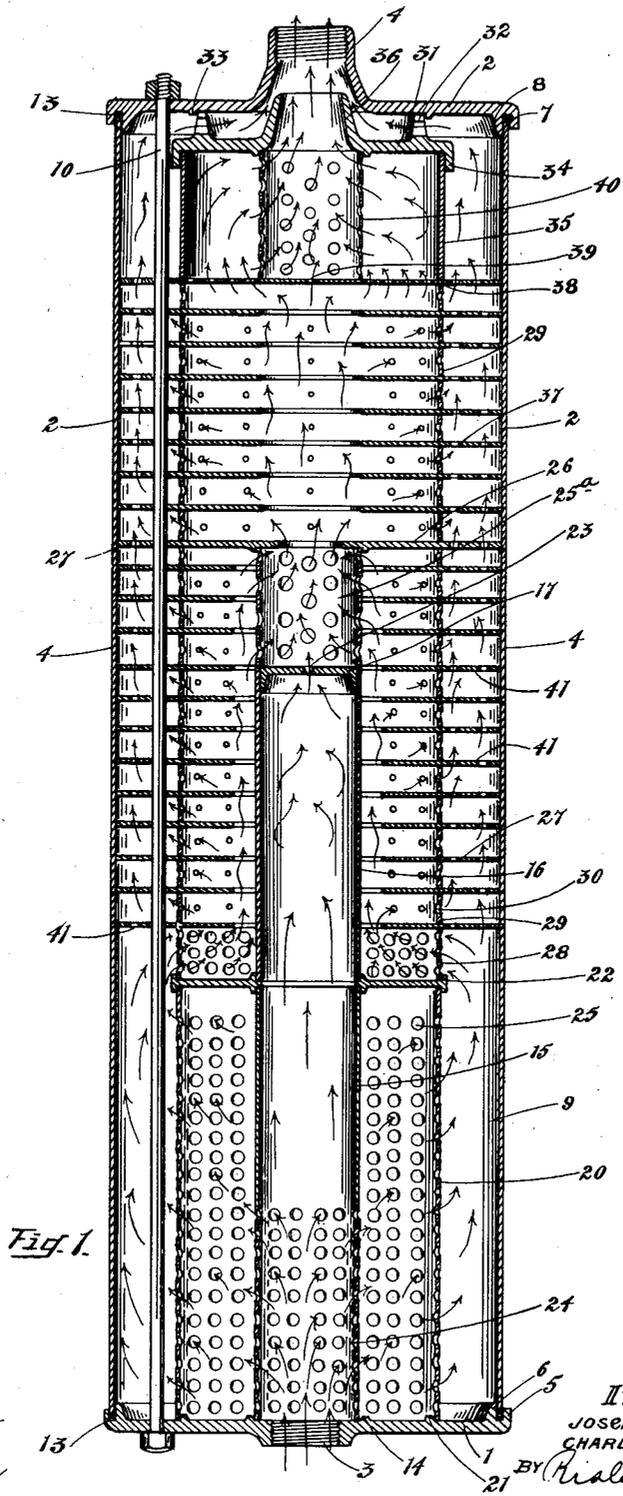


Fig. 1.

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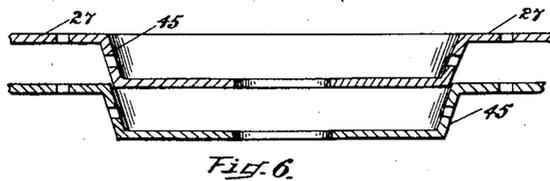
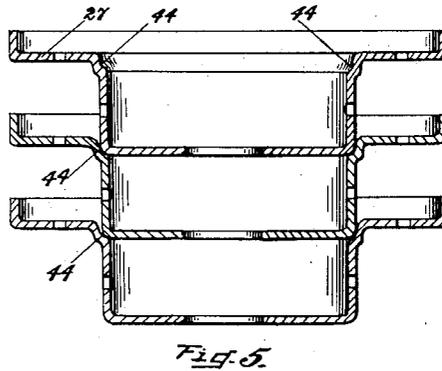
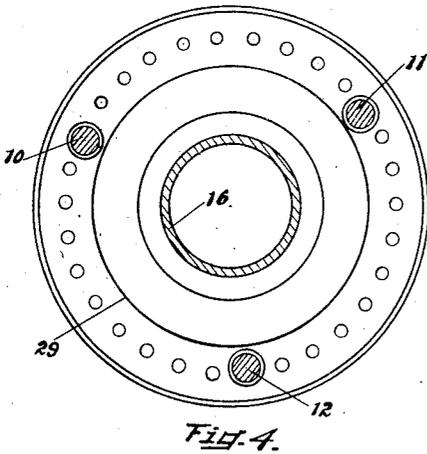
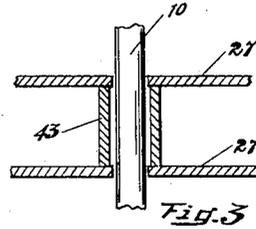
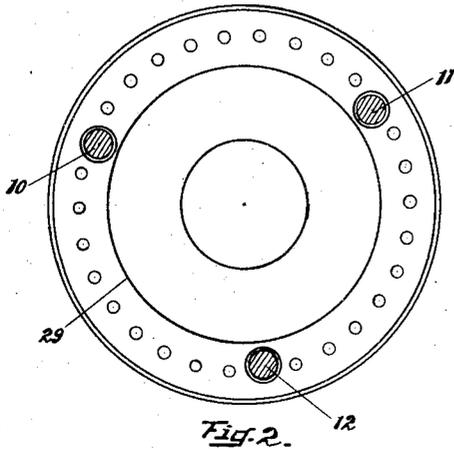
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2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

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EXHAUST-MUFFLER.

944,646.

Specification of Letters Patent. Patented Dec. 28, 1909.

Application filed February 18, 1909. Serial No. 478,640.

To all whom it may concern:

Be it known that we, JOSEPH A. XARDELL and CHARLES A. XARDELL, citizens of the United States, residing at Utica, in the county of Oneida and State of New York, have invented certain new and useful Improvements in Exhaust-Mufflers, of which the following is a specification, reference being had therein to the accompanying drawing.

Our invention relates to an improved exhaust muffler, and we declare the following is a full, clear, concise and exact description thereof, sufficient to enable one skilled in the art to make and use the same, reference being had to the accompanying drawings, in which like reference characters refer to like parts throughout.

It is well understood in the art that in constructing a device of this character one object is to provide for the discharge of the exhaust into a receptacle where the force of such discharge may be taken up so as to reduce the noise thereof to a minimum; to provide a construction wherein the expansion of the gas may readily take place and such gases be disposed of without any back pressure into the exhaust pipe or without being allowed to remain in any confined space where such a body of gas would prevent the proper escape of a succeeding jet or discharge; to provide for the reducing of the temperature of the gas between the time of its discharge into the muffler and its escape therefrom into the air. In other words, the gas exhaust is forcibly discharged in a heated condition and under high compression into one end of the muffler, and the purpose of the muffler is to provide for the exit of the gas therefrom into the atmosphere, without force, in its expanded condition and at reduced temperature. It will be understood that the term "gas" is generic and inclusive, as the device is applicable to different conditions and uses.

In the device we have invented we have a construction adapted to provide for these various conditions, as will be seen from the specification and drawings.

In the drawings Figure 1 is a longitudinal sectional view of the muffler; Fig. 2 is a cross sectional view on the line 2-2 of Fig. 1; Fig. 3 is a view of a detail; Fig. 4

is a cross sectional view on the line 4-4 of Fig. 1, and Figs. 5 and 6 are views of modified constructions.

Referring to the figures in detail, the device comprises oppositely disposed heads 1 and 2. In head 1 is an inlet opening 3, and in head 2 is an outlet nozzle or pipe 4. Each head is provided with a peripheral groove formed by abutments 5 and 6, and 7 and 8, to receive tubular casing 9 which is of cylindrical form and of suitable length and diameter and of proper material. Stay-rods 10, 11 and 12 are provided, passing through each head and lengthwise the interior of casing 9 to hold the parts together, suitable packing 13 being provided at proper points, as will be understood, where needful in other joints of the construction and need not be particularly pointed out. The head 1 has an annular abutment 14 which confines in central position against the head a tubular member of slightly larger diameter than the inlet for the exhaust. This tubular member may be made integral or of parts. In Fig. 1 it is seen that one portion is made up of a length 15 and the rest of it of a further length 16. At a point a distance from the end of part 16 is seated a head or plug 17 secured by suitable means. Around the tubular member 15 and within the casing 9 is a tubular member 20 which, as in the case of member 15, is supported at one end on the head and secured in position centrally by annular rim 21.

22 shows a transverse disk adapted to rest upon and secure the opposite ends of tubes 15 and 20, holding them in place and being centrally apertured to leave free passage for the gases from tube 15 into tube 16. In effect, the construction is the same as though parts 15 and 16 were one continuous tube with an inlet at one end for the exhaust and the plug 17 at the other end. The plug 17 has an escapement orifice 23. The tube 15 is circumferentially apertured, as indicated at 24, by a plurality of holes, the holes extending about half the distance of the length of tube 15 and about quarter of the distance of the chamber formed by tubes 15 and 16. The walls of tube 20 are likewise apertured, as at 25, substantially the length thereof.

It will be noticed that the cubical area of

the tube 15 is considerable less than the cubical area included between the walls of tube 20 and tube 15 and that the escapement orifices from the chamber or tube 15 into the surrounding space is considerable less than the escapement outlets through the walls of tube 20 into the surrounding space inclosed by the casing 9.

The extreme inner end of the central tube forms a chamber 25^a, the walls of which are pierced with comparatively large apertures. At the end of the tube is a transverse disk 26, being apertured centrally to allow free escape of the gases from chamber 25 and having circumferential apertures to be mentioned later on.

The construction of the device is such that the tube 20 would seem to be continuous from the head 1 nearly to the head 2, but the major portion of this tube is made up of parts for convenience in manufacture and to allow the transverse positioning of a plurality of disks or baffle-plates 27. These disks are spaced at suitable distances throughout the major length of the device and are positioned and assembled as follows. Resting against the disk 22 is a collar 28 apertured in much the same manner as tube 20. Upon this is placed one of the transverse disks 27, upon which is placed annular ring 29, which is one of a series and is of such diameter that when the series has been assembled the appearance and result are the same as though tube 20 had been continued. Each of these rings is apertured at points on the circumference, as shown at 30. A disk 27 is placed in position and a succeeding ring, and so on until the space has been filled extending from the disk 22 to disk 26. Each of the intervening disks between the said former disks or heads has a central aperture of a greater diameter than the central tube 16. Each disk 27 is also apertured circumferentially between the outer edge and the line where the collars 29 rest.

Adjacent the head 4 is an interior head 31 having an outer flange 32 bearing against the inner face of head 4 and held by rim 33. The edge is upset in opposite direction, as shown at 34, to receive section 35 of the intermediate tubular member. It has a central nozzle 36, the end of which lies slightly within the outlet or nozzle 4. Between the disk 26 and the outlet end are spaced a series of disks 37 circumferentially apertured the same as disks 26, but having a central aperture of less diameter; that is, substantially the diameter of the central tube. A given number of these disks are assembled, being spaced by collars 29. At proper point is placed a disk 38 which has a minute central aperture or pass 39, and a series of peripheral apertures in the space included between the lines of the collar 26 and tubular member 40 which bears at one

end on the disk 38 and at the other on inner head member 31, the collar or tube 40 being apertured centrally as seen.

By general description it will be seen that we have provided an outer casing, a tubular member of slightly smaller diameter therein, and a central tubular member of yet smaller diameter extending partly the length of the intermediate tubular member, and that the central tubular member forms a chamber having a slight outlet at one end but a plurality of outlets at the other end and for a distance therefrom into the space between the innermost and the intermediate cylinders or tubes, and that the intermediate cylinder or tube has a large number of outlets into the space between that tube and the outer tube. It is also seen that across the major portion of the device are transverse apertured disks spaced by apertured rings and centrally disposed passage chambers whereby the gas may be passed from one end to the other, being allowed to expand freely and become cool.

The operation of the device is substantially as follows: The exhaust gas is blown into the chamber tubes 15 and 16 and fills that space. A succeeding jet of exhaust impinges against the body of gas in said chamber. Immediately the jet of gas enters the chamber 15 the jet is stripped, as it were, by certain portions of the gas passing through the openings 24. The main body of the jet impinges against the body of gas in tube 15 and tube 16, which acts as a spring column. The impact compresses the body of gas but deadens the force and the sound of the discharge of the exhaust. The force of the exhaust slightly compresses the volume of the spring column, but at the same time that this takes place a large portion of the gas exhaust escapes into the surrounding space in the cylinder 20. The recoil or expansion of the gas in the chamber, compressed under force of the impact, simply tends to press the gas of the exhaust outwardly laterally through the numerous openings 24, through which the gas finds a much more ready escape than through the inlet 3, and it is found that there is substantially no back pressure since the gas has such a free escape on all sides into a chamber much larger than that in which it has been confined, since the chamber between the cylinder 15 and 20 is so much larger than the space in the cylinder 15 which has been occupied by the gas. The gas constantly tending to expand and seeking a larger space thus flows readily into the larger chamber and disperses itself there-through. From that chamber the gas finds its way through the more numerous outlets 25 into the outer chamber or space just within the casing 9. In this chamber the gases are considerably reduced in temperature in contact with the casing 9. From that chamber

the larger portion of the gases passes through the openings in collar 28 whence they pass through the straight opening which provides ready passage and which lies around the central tube 16, since the gases seek the passage of less resistance. After having reached the end of this passage the gases pass through the wall of the cylinder 25^a into the chamber thereof. The plug 17 has a slight opening

23. While the gases contained in chambers or tubes 15 and 16 tend to expand toward the inlet, they also expand at the other end and a portion passes through the outlet 23, forming a small jet of gas which tends to relieve the pressure in chambers 15 and 16 and to clear the chamber 25 and forms a suction to assist the gases in passing along the wall of tube 16 and into chamber 25 and through the same. After having passed through the chamber 25 the gases pass through the larger central space formed by the central openings in disks 37 the gas column being stripped by the contact of the disks with the outer portion thereof, until they reach the disk 38 which bars the continuous passage and disperses them to the side. The passage, however, is not completely barred since a small aperture 39 is provided through which a small jet of gas passes which tends to clear the chamber within cylinder 40. The major portion of the gases comes into this chamber through the side walls and seeks a natural and easy egress through the nozzle 36. While the most of the gases pass from the space surrounding cylinder 20 in the manner described, the annular apertures 41 in the several disks provide outlets for a portion of the gases which pass through such outlets in the successive disks until it comes to the chamber at the other end of the muffler between the casing and the intermediate cylinder and between the head 4 and 31. The volume of gases which passes out through the opening 36 being so much greater than that which passes through the small peripheral apertures and through the outermost chamber an aspirating action and vacuum is formed which keeps the gas in the outermost chamber moving promptly, which results in a vacuum effect in said chamber and consequent easy communicating of the cooling influence of the outer casing 9 to the inner parts of the device.

It will be understood that we do not confine ourselves to the details of construction of any part. We have illustrated certain forms and means, however. In Fig. 2 we show one of the spacing collars or sections 29, being formed of a band of sheet metal which is split longitudinally so that one-half is on one side and the other half on the other side on the binding bar 10. In Fig. 3, we show a small collar 43 placed between disks 27 for the purpose of spacing the disks.

Instead of having these disks formed flat, it may be preferable to dish them, as indicated in Figs. 5 and 6. In the former, the disk is cut centrally, but being formed at the upper edge of the disk with a hollow 44 in which the lower edge of the dish adjacent the superposed disk rests. If desired, these disks may be formed with sides slightly on a bevel, as at 45.

Having described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. In a device of the character described, a cylindrical chamber, a centrally disposed tube therein extending beyond the end of the chamber, said tube having lateral outlets to said chamber for a distance of about one-half the length of the chamber, substantially as described.

2. In a muffler, a series of transverse parallel plates each apertured whereby to provide a gas-passage through the series of plates, a headed imperforated tube projecting into said passage through a portion of the series and having a vent in the head opening into the passage and a transverse plate at the other end of the passage provided with a vent opening into the exhaust outlet, substantially as described.

3. In a device of the character described, a plurality of concentric tubular members providing chambers of different length, apertures connecting them for the passage of currents, means deflecting the major volume of the currents through the central portion of the device for the major part of its length, substantially as described.

4. A device of the character described having a plurality of tubular members arranged concentrically, apertures for the passage of currents from the center outwardly, means deflecting the major volume of the currents toward the longitudinal center and disintegrating the same, the said deflecting means having apertures for the passage of a relatively small volume of current lengthwise the outermost chamber, the said outer chamber having an outlet adjacent that of the central passage whereby the force of the central current exhausts said outer chamber, substantially as described.

5. In a device of the character described, a plurality of concentric members, passages for currents therebetween, means deflecting the major volume of currents into a central passage, said means having edges extending transverse the line of said central passage and contacting with the edge of the current passing therethrough and separating thereby portions of said current in its passage, substantially as described.

6. In a device of the character described, a central tubular member open at one end to receive the exhaust, forming a chamber of a size greater than the volume of the exhaust

and at the other end having a plug with a slight aperture therethrough, side openings at the receiving end for the lateral escape of the exhaust, substantially as described.

5 7. In a device of the character described, a central tubular member open at one end to receive the exhaust, forming a chamber of a size greater than the volume of the exhaust, side openings at the receiving end for the lateral escape of the exhaust, a cylindrical member inclosing the former member with a transverse wall at a point short of the inner end of the former member and side openings for the lateral escape of the exhaust, substantially as described.

10 8. In a device of the character described, a central tubular member open at one end to receive the exhaust, forming a chamber of a size greater than the volume of the exhaust, side openings at the receiving end for the lateral escape of the exhaust, a cylindrical member inclosing the former member with a transverse wall at a point short of the inner end of the former member and side openings for the lateral escape of the exhaust, an outer casing, transverse baffle-plates, annular members of substantially the diameter of the second named cylindrical member, disposed between the plates and forming a central passage way for the currents partly around a portion of the first named member and therebeyond in the center of the device, the said plates projecting into said passage, the edges of the same stripping the current of laterally escaping portions whereby to establish and maintain a given flow to the center portion, substantially as described.

15 9. In a device of the character described, the combination with an outer casing of a series of concentric tubular members forming longitudinal chambers with apertures in the walls thereof and baffle plates and walls deflecting the major volume of the currents through the center of the device with a given flow and taking the minor portion through the outermost chamber, the outlets opening into a common discharge whereby the flow from the central portion draws the current from the outer one, substantially as described.

20 10. In a device of the character described, a plurality of tubular members forming chambers and transverse members arranged therewith, the said members having apertures for the passage of currents through the device, the said latter members contacting with the edges of the current passing thereby whereby to strip the current of laterally escaping portions and decrease the column of the flow during its passage, substantially as described.

25 11. In a device of the character described, the combination with a plurality of concentric tubular members of a central tube

positioned to receive the exhaust and of a size larger than the volume of the exhaust, a plug at the inner end of the tube, an aperture through the plug whereby the pressure of gas in the inner end of the tube produces a jet through the space provided for the subsequent passage of the exhaust therethrough, substantially as described.

30 12. In a device of the character described, the combination with a plurality of concentric tubular members of a central tube positioned to receive the exhaust and of a size larger than the volume of the exhaust, an inclosing chamber, an outlet from the inclosing chamber adjacent the former outlet, a plug at the inner end of the tube, an aperture through the plug whereby the pressure of gas through the plug aperture and the central outlet creates an exhaust-suction in the inclosing chamber between the periods of exhaust discharge, substantially as described.

35 13. In a muffler, a series of transversely disposed parallel plates each apertured whereby to provide a gas-passage through the series of plates, an imperforated tube projecting into said passage through a portion of the series and having a head at the inner end, said head being provided with a vent opening into the passage beyond the head, the said tube being provided with a series of outlets at the other end whereby the exhaust of gas may pass therethrough to the said passage beyond the head of the tube, and a transverse plate at the other end of said passage provided with a vent opening into the exhaust outlet, substantially as described.

40 14. In a muffler, a gas chamber having its walls pierced for the escape of gas therefrom, a series of plates crosswise the chamber, a centrally disposed pipe extending part way the length of said chamber and having one of its ends pierced, the plates abutted against the said pipe being cut away around said pipe, and the plates in the chamber beyond said pipe being apertured to form a flue bounded on its edges by the edges of said plates whereby the lateral dispersing portions of gas passing through said chamber are carried into the spaces between said plates, substantially as described.

45 15. In a muffler, the combination with a plurality of cylindrically nested chambers, of an exhaust-receiving tube having a plug at its inner end pierced with an escapement-vent and having lateral vents at its outer end for a minor portion of its length, substantially as described.

50 16. In a muffler, the combination with cylindrical nested tubular members, of an exhaust-receiving tube of greater diameter than the exhaust opening thereto and having a plug at its inner end pierced with an escapement vent and having lateral vents at

its outer end for a minor portion of its length, substantially as described.

17. In a muffler, the combination of a plurality of transversely disposed plates, each of a given number of said plates having an aperture, the edge of which register with that of the others of said number, the said apertures forming a gas-passage bounded at separate points therein by the edges of said plates, substantially as described.

18. In a muffler, a chamber-forming member having its walls pierced for the escape of gas therethrough, a series of plates projecting inwardly from the wall of said member, the said plates being apertured whereby to provide a gas-duct lengthwise of the chamber, the said plates being spaced whereby the edge of each strips the current of gas passing through the ducts and directs portions thereof in the spaces between the plates, substantially as described.

19. In a muffler, an exhaust-receiving pipe having a major portion of its length imperforated but with a comparatively small vent at its inner end, the walls adjacent the exhaust-receiving end being perforated whereby the said pipe receives the exhaust and retains a portion of the same at its inner end, substantially as described.

20. In a muffler, the combination with longitudinally disposed chambers for the passage of gas and current deflecting means therein, of an inner pipe extending partly the length of the chambers and having its major inner portion formed to retain a volume of gas therein in position for compression by succeeding jets of exhaust and expansion between the periods of the exhaust, substantially as described.

21. A muffler having in combination with longitudinally arranged walls and transversely disposed plates, severally apertured and disposed in forming a plurality of passages for the exhaust, a centrally disposed tube substantially closed for the retention of a volume of the exhaust gas in a spring

column against the impact of succeeding discharges of exhaust, substantially as described.

22. A muffler consisting of a series of transverse plates apertured to provide a gas-duct through the series, a gas-receiving tube extending into said duct and having openings near the receiving end providing exit of gas into the said duct, substantially as described.

23. An exhaust muffler consisting of nested tubes providing an inner and an outer chamber with gas ducts from the inner tube to the outer one, a plurality of transverse plates apertured for the passage of a column of the greater volume of the exhaust under pressure through the inner chamber, the outlets of the chambers being so disposed that the discharge of the greater volume exhausts the outer chamber, substantially as described.

24. An exhaust muffler consisting of tubes nested to form an inner and an outer chamber, the inner chamber being provided with passage therethrough for the major portion of the exhaust gas, transverse plates in said chamber being cut away to form the boundary of said passage by the edges of the plates and a spring tube extending into said passage and having outlets for the escape of gas to the inner chamber, substantially as described.

25. A muffler having a perforated exhaust-receiving tube, a cylinder inclosing said tube, plates transverse the cylinder with a gas-passage around the tube and a passage extended in line thereof beyond it, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

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Witnesses:

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