

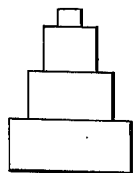
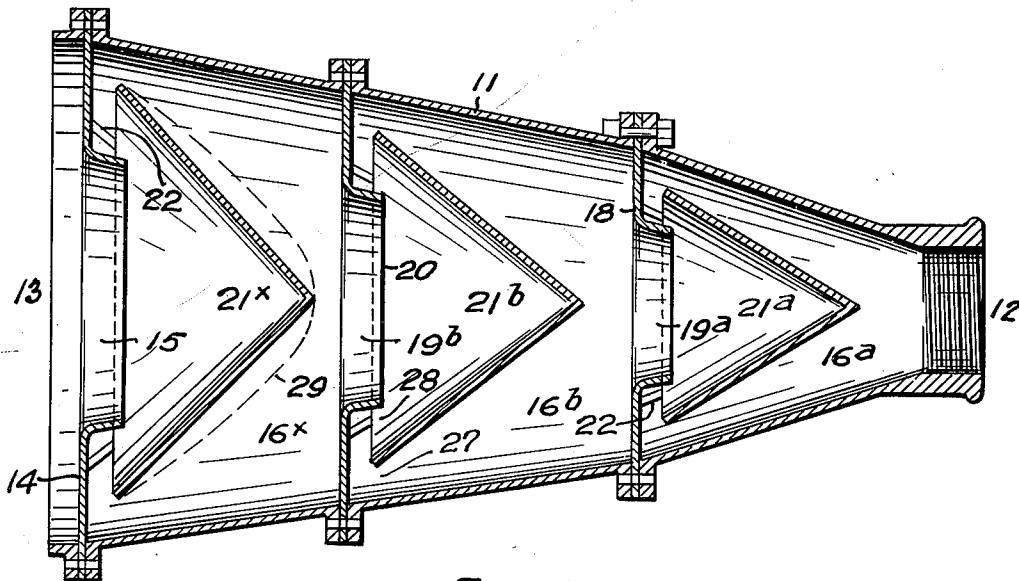
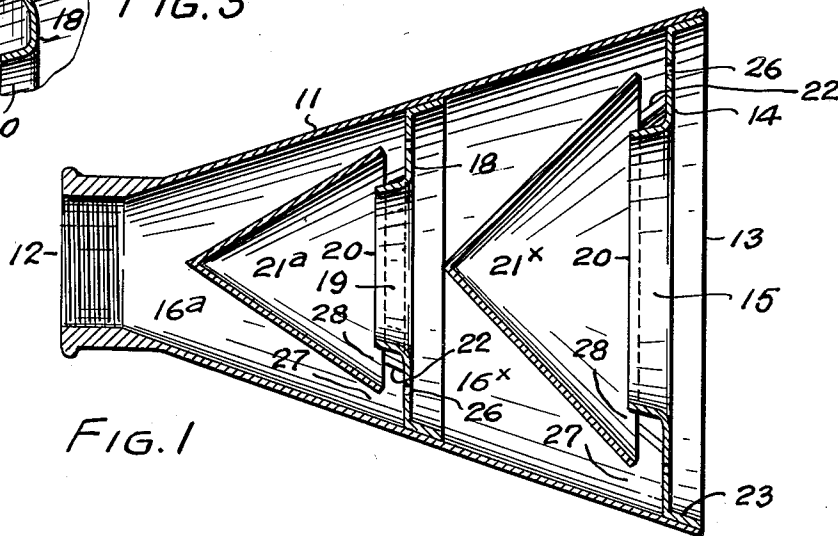
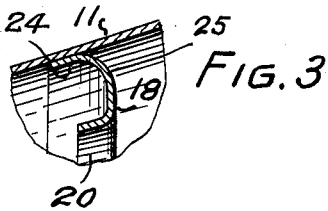
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MUFFLER

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MUFFLER

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11 Claims. (Cl. 181—57)

This invention relates to improvements in mufflers and especially to mufflers for the discharge of liquids under pressure but may be used equally for the discharge of fluids in the gaseous or vapour state.

The principal object of the invention is the provision of a muffler specially adapted for use in discharging liquids under pressure, for example in blowing down steam boilers, particularly locomotive boilers.

A further object of the invention is to provide a muffler enabling a multi-stage progressive expansion or pressure reduction in the fluid dealt with.

A still further object is to provide a muffler so constructed as to enable the aforesaid multi-stage progressive expansion or pressure and velocity reduction accompanied by intervening stages of increasing velocity, whereby the fluid in each stage tends to be exhausted by the expansion or pressure reduction of the fluid in the next succeeding stage.

Another object is to provide a muffler so constructed as to reduce the velocity of a liquid under pressure without the creation of back pressure such as would reduce the rate of discharge to materially less than the theoretical rate.

Still another object is to provide a muffler which will not become choked by accumulation therein of solid matter in suspension in the liquid being discharged.

An additional object is to provide a muffler of simple, durable and inexpensive construction.

Other objects and the advantages of the invention may be ascertained from the following description and the accompanying drawing.

The problems encountered in muffling the discharge of liquids under pressure, especially those heated above their normal boiling temperatures, are entirely different from the problems encountered in muffling the discharge of gases under pressure, especially hot gases. In consequence, mufflers suitable for discharging gases under pressure are quite unsuitable for the discharge of liquids under pressure and this is especially true in the case of liquids under pressure heated above their normal boiling temperatures.

The present invention consists essentially in the provision of a muffler specially adapted for discharging hot liquids under pressure and characterized by provision of a plurality of expansion chambers, the relative volumetric capacities of which increase from the first chamber to the last of the series, that is, from the inlet of the muffler to the outlet thereof, the muffler having

flow openings to and from the chambers of relatively increasing size from the inlet to the outlet of the muffler, in conjunction with baffle plates, masking the outlet openings of the chambers and providing a tortuous fluid flow passage through the muffler.

In greater detail the invention consists in the features and combinations of features herein described or illustrated in the accompanying drawing, together with all such modifications thereof and substitutions of equivalents therefor as are within the scope of the appended claims.

In the accompanying drawing which illustrates various embodiments of the invention, but to the details of which the invention is not confined as other embodiments and modifications are possible and contemplated;

Fig. 1 is a central longitudinal sectional view of a muffler constructed according to the invention and presenting an elementary embodiment of the invention providing for only two stages of expansion in the muffler.

Fig. 2 is a view similar to Figure 1 but showing provision for more than two stages of expansion in the muffler and also showing various modifications of detail as compared with Figure 1.

Fig. 3 is a fragmentary sectional view illustrating a further modification of detail.

Fig. 4 is an elevation of a modified form of muffler.

Referring more particularly to the drawing, 11 designates the body, casing or shell of a muffler which may be, and preferably is, of frusto-conical form, as shown, but may be of any other suitable form such as the stepped type shown in Figure 4. The frusto-conical or tapered form is preferred as it provides for a progressive expansion of fluid in each stage as well as from stage to stage, as will be hereinafter more fully explained. The body is provided at its smaller end with an inlet 12, adapted in any suitable way for attachment to a fluid conduit or to the outlet of a fluid receptacle. The body may have a straight taper, as shown in Figure 1, or the taper may be different in different parts of the body, preferably greater at the inlet end, as shown in Figure 2. Also the body may be formed in a single piece as in Figure 1, or in a plurality of sections as in Figure 2.

The discharging or large end 13 of the body is provided with a partial closure which, in the frusto-conical form illustrated, is an annular plate 14, the central discharge opening 15 of which is several times the area of the inlet 12. As illustrated, the area of the discharge opening

15 is about for times that of the inlet 12 but may be more or, within limits, less than four times.

The interior of the body is divided into a plurality of chambers 16, that at the inlet end being designated *a* and that at the outlet being designated *x*. There may be only two such chambers, as shown in Figure 1, or there may be any suitable number of chambers intervening between the end chambers. Figure 2 shows one such intervening chamber designated *b* but it will be understood there may be more than one.

The adjacent chambers are separated by a partition 17 which, in the conical form of body illustrated, is an annular plate 18, having a central opening 19 communicating the adjacent chambers 16. In the two-chambered form of Figure 1 there is naturally only one partition, but in the three-chambered form of Figure 2 there are two partitions distinguished by the letters *a* and *b*. Each opening constitutes an outlet for the chamber on one side of the partition and an inlet for the chamber on the other side. In every case, the area of an opening 19 is intermediate between the area of the inlet of the chamber on one side and the area of the outlet of the chamber on the other side so that the openings through the muffler are progressively larger from the inlet 12 to the outlet 15, both inclusive. The progression of the areas of these openings may be irregular as in Figure 1 or regular as in Figure 2.

Each of the openings 15 and 19 is preferably surrounded by a wall 20, extending toward, and preferably tapering slightly toward the inlet end of the muffler.

In each chamber of the muffler there is provided a baffle 21, which is preferably of open base conical form and disposed with its apex adjacent to the inlet of the chamber and its base covering the outlet of the chamber and spaced radially outward from the wall 20 radially inward from the body 11 and away from the adjacent annular plate 14 or 18, as the case may be. As will be seen, these baffles are arranged co-axially with the chambers containing them and with the openings which they cover and are so disposed that the walls 20 project slightly into the interiors thereof. The baffles are supported in any suitable way, preferably by feet 22, at the bases thereof connected to the adjacent plate 14 or 18.

The plates 14 and 18 may be secured in the body in any suitable way. For example, the outer peripheries of the plates may be formed with flanges 23 projecting opposite to the walls 20 and adapted to the taper of the body, to which they are secured by bolts, rivets, welding or in any other suitable way. Alternatively, the outer peripheral portions of the plates may be clamped between adjacent sections of the body, as shown in Figure 2. As a further alternative, the outer peripheries of the plates may be provided with flanges 24 projecting in the same direction as the walls 20 and adapted to the form of the body, as shown in Figure 3. In this form the flanges 24 may curve gradually toward the plate, as at 25 so as to provide, in effect, a fillet between the plate and body. The plates 14 and 18 may be provided with a plurality of small drainage openings 26 when the nature or location of use renders this advisable.

It will be observed that in each chamber 16 the apex of the baffle is spaced inwardly from the chamber inlet, so that there is a portion of circular cross-section adjacent the inlet, leading to a portion of annular cross-section between the

baffle and the outer wall of the chamber and extending to the base of the baffle. The walls 20 project slightly into the base portions of the baffles.

The dimensions and conical taper of the baffles relatively to the dimensions and taper of the body and the dimensions of the flow openings 15 and 19 are preferably such that in each chamber 16 certain characteristics obtain, namely:—(a) the cross-sectional area, whether circular or annular, increases gradually to a transverse plane intermediate the apex and the base of the baffle and thereafter gradually decreases to the base of the baffle at which point, designated 27, the annular cross-sectional area is still considerably larger than the area of the chamber inlet; (b) the area of the narrowest annular passage, designated 28, between the wall 20 and the under side of the baffle is somewhat less than the area of the passage 27 and somewhat less than the cross-sectional area inside the lower part of the baffle, but larger than the area of the inlet; (c) the area of the outlet is less than the adjacent cross-sectional area under the baffle. These relationships are important in a muffler designed for the discharge of liquids under pressure and especially those heated above their normal boiling temperatures.

When a liquid under pressure and heated above its normal boiling temperature enters the first chamber 16^a, there is release of pressure and evolution of vapour which tends to disrupt the liquid stream so that a mixture of liquid and vapour fills the chamber. As this mixture advances, first as a solid stream and then as an annular stream, through the progressively increasing cross-sectional areas of the chamber it expands and loses pressure. There is also some loss of pressure due to cooling of the mixture, which loss is about the equivalent of the constriction of the annular passage at 27, so that creation of back pressure is avoided. The stream of mixture flows around the base edge of the baffle and through the passage 28 into the baffle, being directed therein by the wall 20. Within the baffle the annular stream reforms with turbulence into a single stream which escapes through the opening 19 into the second chamber, wherein the solid stream is reformed into an annular stream. Owing to the fact that the cross-sectional area of the second chamber at its inlet end is considerably greater than the area of the inlet 19, there is a further and immediate release of pressure with further evolution of vapour and disruption of the liquid stream. The sudden expansion of the fluid stream into the second chamber has a suction effect, tending to draw the fluid in the first chamber through the passages 27 and 28 and the outlet 19. As the fluid flows through the second chamber there is at first a gradual progressive expansion with cooling and tendency to contraction of the stream and repetition of the effects produced in the first chamber. The effects are repeated in as many further chambers as are provided, the final release of pressure as the fluid emerges from the last chamber into the atmosphere providing the aforesaid suction effect drawing fluid through the passages 27 and 28 and the outlet 15. As the fluid enters into each baffle there is opportunity for some slight expansion with suction tendency which facilitates flow through the passages 27 and 28, but the principal suction effect is the result of expansion into the succeeding chamber, or into the atmosphere in the case of the last chamber.

The muffler of this invention is of great advantage in silencing the blowing down of steam

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boilers and other containers for hot liquids under pressure and in avoiding the well-known inconveniences and dangers thereof. The usual roar of escaping steam is entirely eliminated and only a faint rumbling sound is heard. The pressure is reduced gradually in the muffler so that water discharged from the muffler is not projected violently but emerges quietly and at low velocity. The muffler is of particular advantage in connection with locomotive boilers which must be frequently partly blown down while under high pressure so as to eliminate accumulations of mud.

The construction of the muffler providing passages of reduced cross-sectional area where the direction of fluid flow is reversed and where mud would tend to accumulate, i. e., at 27 and 28, ensures sufficient velocity of the fluid at these points to sweep any mud along with the liquid so that clogging of the muffler is avoided.

The muffler is preferably installed in axially vertical position but may be positioned otherwise. The drainage holes 26 prevent water remaining in the annular troughs formed by the body and the walls 20, so that freezing is prevented if the muffler is exposed to cold.

While the various chambers of the muffler are preferably of tapering construction and arranged in axial alignment, it will be understood this is not essential and that an assembly of parallel walled chambers of different sizes, as shown in Figure 4, may be resorted to but has the disadvantage of precluding progressive expansion in each chamber and necessitates reliance on expansion from chamber to chamber. The lengths of the chambers in their axial direction may be all the same or may be progressively increased or decreased. The relative tapers of the baffles and chamber walls may be more or less than illustrated, and the baffles are not necessarily truly or completely conical, so that the term "conical" is to be understood as including truncated conical forms as well as slight departures from true conical forms, such as the paraboloidal or hyperboloidal form suggested by the line 29, in Figure 2. Likewise the taper of the body need not be a straight taper but may be an increasing or decreasing taper and such variations are to be understood as included in the term "conical" or "tapered" as applied to the body.

While the walls 20 and baffles 21 are shown in their preferred relation to the body and the chambers thereof, it will be understood either or both may be inverted with respect to the body and may be regarded as covering the chamber inlets.

While the muffler of this invention is intended primarily for discharging liquids under pressure, it will serve also for discharging gases or vapours.

Having thus described our invention, what we claim is:

1. A muffler for discharging hot liquids under pressure comprising a series of chambers, the volumes of which increase from chamber to chamber of the series, flow openings communicating the chambers and conical baffles covering said flow openings at the inlet sides thereof and having open bases disposed adjacent said openings.

2. A muffler for discharging hot liquids under pressure comprising a series of chambers each having an inlet and an outlet, the cross-sectional area of each said chamber increasing progressively from the inlet to a transverse plane adjacent the outlet, and the outlet of each said chamber being larger than the inlet thereof.

3. A muffler for discharging hot liquids under pressure comprising a series of chambers each increasing in diameter from its inlet end to its outlet end and each having an inlet at its smaller end and an outlet at its larger end, which outlet is larger than the inlet, and a baffle in each chamber covering one of said inlet and said outlet thereof.

4. A muffler for discharging hot liquids under pressure comprising a series of connected chambers each of which is of increasing diameter from its inlet end to its outlet end, an inlet at the smaller end of each chamber, an outlet at the larger end of each chamber, which outlet is larger than the inlet, and a conical baffle in each chamber having an open base larger than and covering the outlet of the chamber.

5. A muffler for discharging hot liquids under pressure comprising a series of connected chambers of progressively greater volumetric capacity, each having an inlet and an outlet larger than the inlet, and a generally conical baffle in each chamber having an open base covering the outlet of the chamber, the baffle being so spaced from the chamber wall as to provide an annular flow passage having an area greater than the inlet of the chamber.

6. A muffler for discharging hot liquids under pressure comprising a series of connected chambers each of increasing diameter from its inlet end to its outlet end, an inlet at the smaller end of each chamber, an outlet at the larger end of each chamber, said outlet being larger than said inlet, and a conical baffle in each chamber arranged with its larger end covering the outlet, relative tapers of the chamber wall and the baffle in each chamber being such that the annular space between the chamber wall and the baffle increases progressively in cross-sectional area through part of the distance from the inlet to the outlet and then decreases to a minimum at the larger end of the baffle, which minimum area is greater than the area of the chamber inlet.

7. A muffler for discharging hot liquids under pressure comprising a plurality of fluid treating sections connected in series and each having an inlet and an outlet larger than the inlet, the volumetric capacity of the sections increasing from section to section from the inlet end of the series to the outlet end thereof, each said section after the first being formed to provide for immediate expansion of fluid to more than twice its volume immediately adjacent the inlet of the section and for further progressive expansion of fluid in transit toward the outlet; the rate of progressive expansion changing from end to end of the section.

8. A muffler for discharging hot liquids under pressure comprising a frusto-conical casing, transverse partitions in said casing having flow openings therein and conical baffles in the casing covering said flow openings and located in the path of fluid flowing to said openings.

9. A muffler for discharging hot liquids under pressure comprising a frusto-conical casing, transverse partitions in said casing dividing the interior thereof into chambers and having flow openings therein, flanges on said partitions surrounding the flow openings and extending toward the smaller end of the casing, and conical baffles in the casing covering said openings and encircling the free edge portions of said flanges, said casing, partitions, flanges and baffles combining to form annular fluid flow passages extending from the inlet to the outlet of each chamber.

10. A muffler for discharging hot liquids under pressure comprising a casing having an inlet and an outlet, said casing being larger at the outlet end than at the inlet end and of intermediate size between its ends, partitions dividing the interior of the casing into chambers, each succeeding chamber being larger than the preceding one, said partitions having fluid flow openings therein, forming inlets and outlets for the chambers, the outlet of each chamber being larger than the inlet thereof, and a hollow, open based conical baffle in each chamber arranged with its base covering one of the inlet and outlet of the chamber and spaced from the chamber wall and the opening covered by it.

11. A muffler for discharging hot liquids under pressure comprising a frusto-conical casing hav-

ing an inlet at its smaller end, partitions dividing the interior of the casing into chambers, each said partition having a central aperture and being formed with a flange around the aperture extending toward the smaller end of the casing, the apertures in the partitions being progressively larger from the inlet end of the casing to the outlet end thereof and all larger than the casing inlet, and a conical baffle in each chamber covering the outlet thereof, said baffles and flanges tapering in the same direction as the casing, the larger ends of said baffles being spaced from the casing, partitions and flanges and the flanges projecting into said baffles.

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