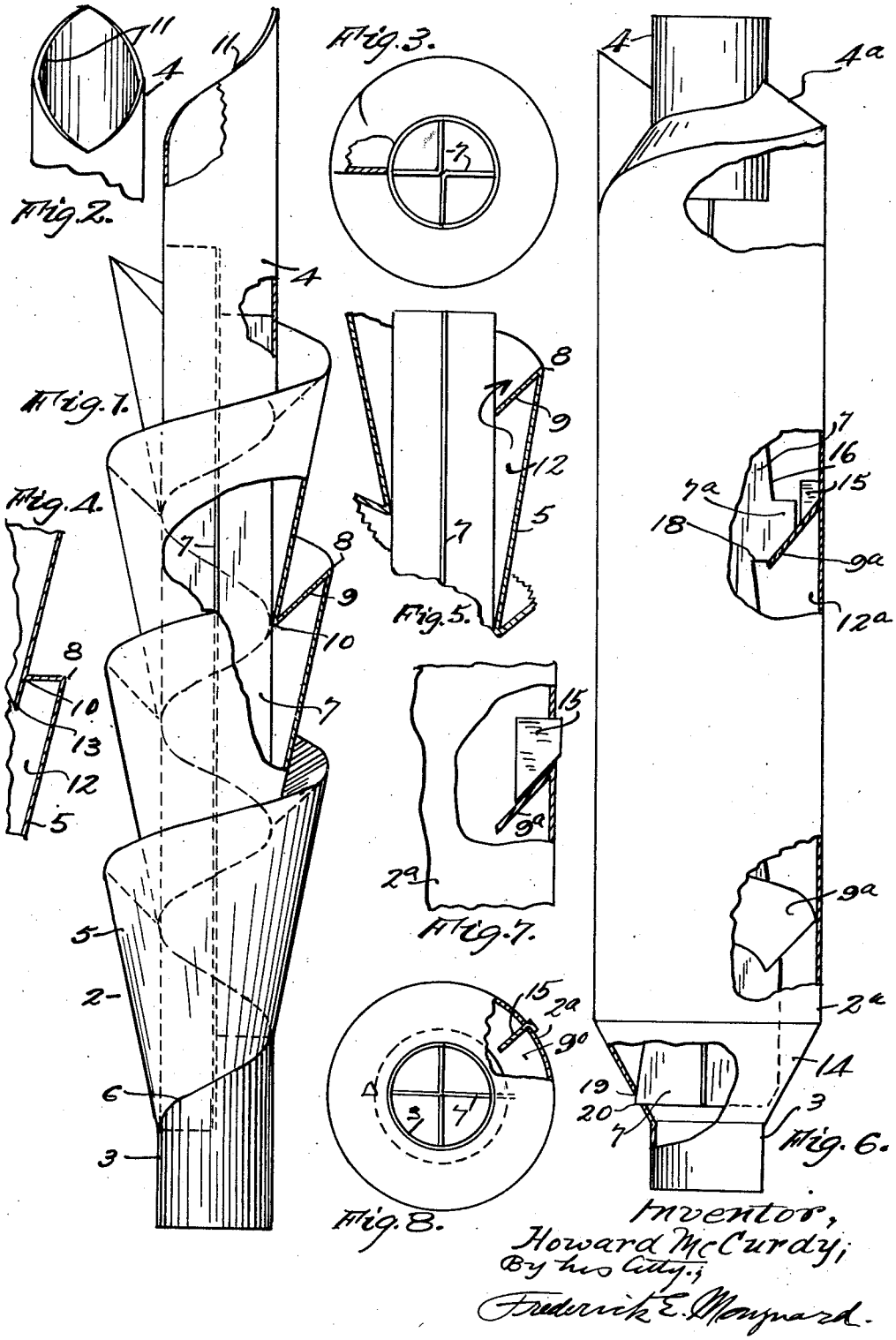
Dec. 24, 1940. H. McCURDY 2,225,650

FLUID MUFFLER

Filed Sept. 2, 1938 3 Sheets-Sheet 1



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FLUID MUFFLER

Filed Sept. 2, 1938 3 Sheets-Sheet 2

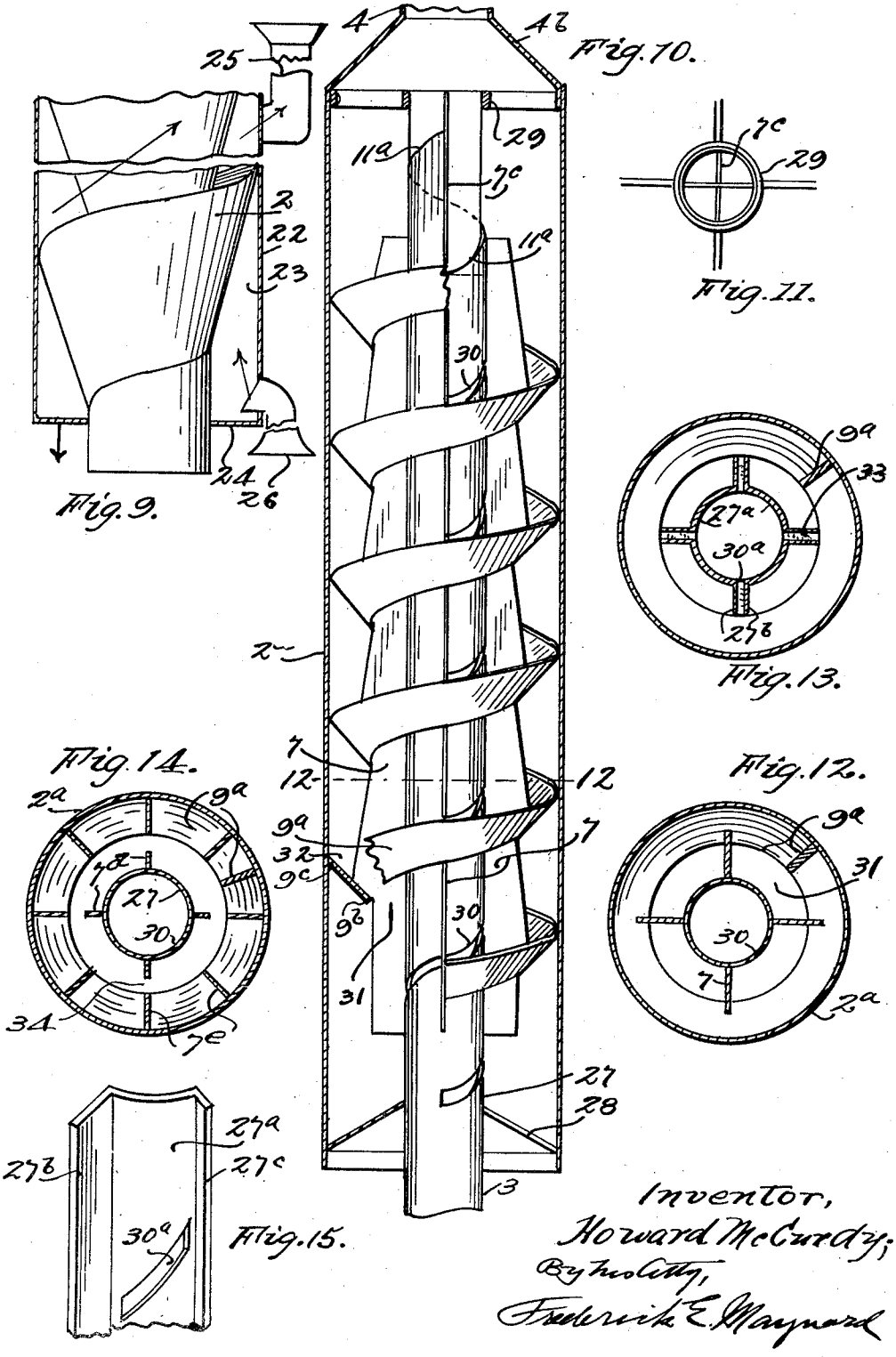


Fig. 9.

Fig. 10.

Fig. 11.

Fig. 13.

Fig. 14.

Fig. 12.

Fig. 15.

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FLUID MUFFLER

Filed Sept. 2, 1938 3 Sheets-Sheet 3

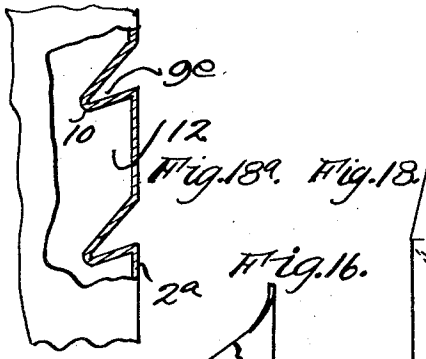


Fig. 18a.

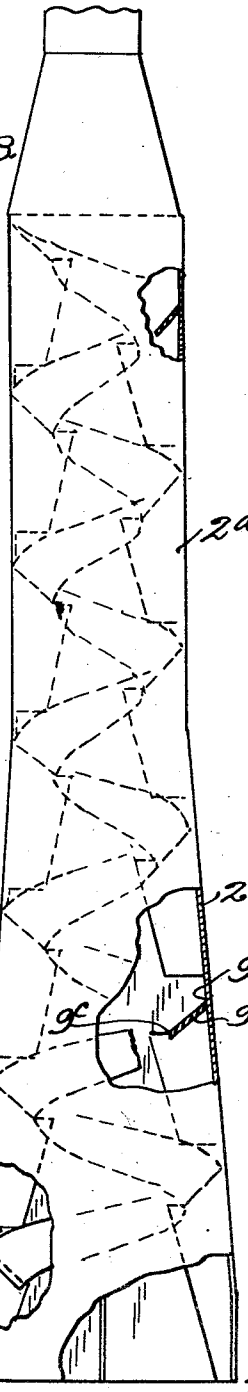


Fig. 18.

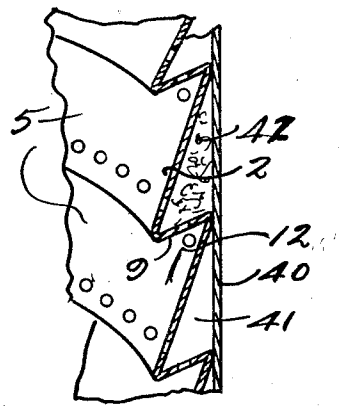
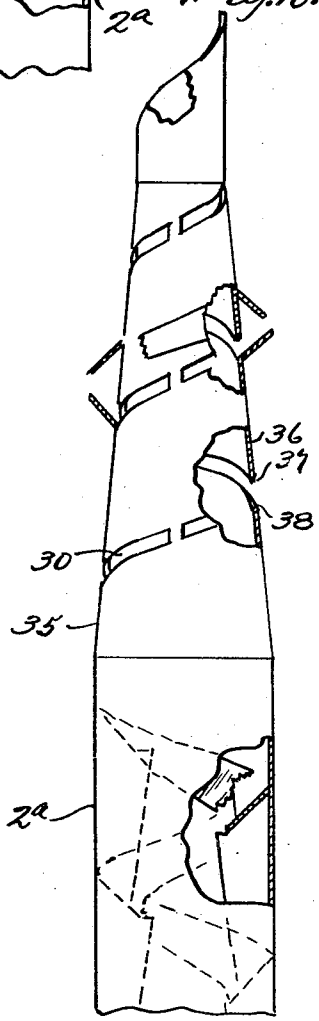


Fig. 17.

Fig. 16.



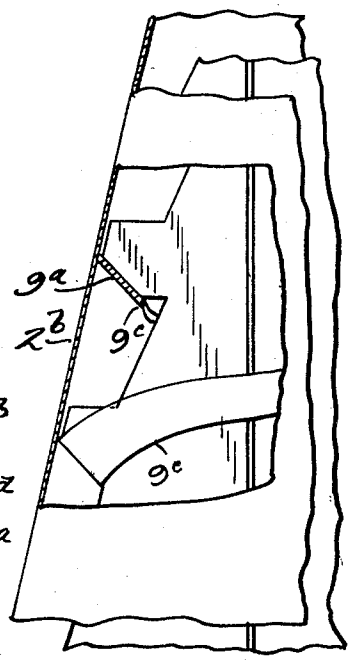


Fig. 19.

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Patented Dec. 24, 1940 2,225,650

UNITED STATES PATENT OFFICE

2,225,650

FLUID MUFFLER

Howard McCurdy, Walnut Park, Calif.

Application September 2, 1938, Serial No. 228,113

20 Claims. (Cl. 181—47)

This invention is a device incorporating a conduit for the passage of a fluid medium and which functions to dissipate both objectionable incidental noise, as for instance in the discharge of burnt fuel gases as exhaust from internal combustion motors, and the sometimes serious air wave pulsations set up by the sudden release of the wave stimulating pressure heads involved in the exhaust discharges of the cylinders of high powered motors of this class; the invention being of use in other mechanical apparatuses where there is a flow of fluid media involving a change in the pressure thereof in the transit.

Reference is made to copending application Ser. No. 218,376, wherein there is shown apparatus involving features of construction characterized by the helical contour of certain parts or the helical contour of edges of certain parts, and this principle of construction is carried forward in and by the present invention for the purpose of further employing, utilizing and increasing the efficiency of the control of flow of moving fluid media in conduits in connection with given types of motors and other apparatuses.

It is, therefore, an object of the present invention to provide means, particularly in the form of an exhaust muffler, incorporating a novel arrangement, construction and combination of features in which the moving fluid is subjected to reaction and control by parts distinguished by helical surfaces or edges of surfaces whereby to cause the gradual expansion of the heads of exhausted gases under various pressures to break down wave stimulation and at the same time to check back and substantially eliminate the incidental noise of discharge of the gases under pressure.

The apparatus and method of this invention consists of certain advancements in this art as will be set forth in the ensuing disclosure and having with the above, additional objects and advantages as hereinafter developed, and whose construction, combinations and details of means and of the method will be made manifest in the descriptions of the herewith illustrative embodiments severally set forth; it being understood that modifications, variations and adaptations may be resorted to within the spirit, scope and principle of the invention as it is more directly claimed hereinbelow.

To facilitate comprehension of the various features of the invention the several figures of the drawings will be described directly in the body of the specification of the embodiments presently depicted.

Fig. 1 is a broken-away side elevation of a helical-shell form of the invention. Fig. 2 is a side elevation, at a right angle to Fig. 1, of the outlet end of the muffler. Fig. 3 is a broken plan of the upper end of the muffler showing radial-plane abutment or reactor means. Fig. 4 is a sectioned fragment to show a slicing feature in the bore of the muffler. Fig. 5 is a section of a fragment of the muffler to show lateral diffusion from the final expansion stage or chamber.

Fig. 6 is a broken side elevation of a form of the invention involving a cylindrical shell and a helical ribbon forming successive expansion chambers along the bore face of the shell. Fig. 7 is a section showing a detail of construction of the ribbon and shell. Fig. 8 is a bottom plan, looking upward, of the muffler of Fig. 7.

Fig. 9 is a broken, sectional elevation showing a jacket applied to the shell of Fig. 1. Fig. 10 is a sectional elevation of a form of muffler including a concentric, inwardly spaced bore conduit element. Fig. 11 is a plan of a reactor or abutment device in the upper end of the muffler of Fig. 10. Fig. 12 is a cross-section on line 12—12 of Fig 10, looking down. Fig. 13 is a cross-section of a sectional-structure, central conduit. Fig. 14 is a cross-section of a modified reactor blade means. Fig. 15 is a perspective of a longitudinal fragment of conduit element.

Fig. 16 is a broken elevation of a muffler having a converging, helical-diffusion shell section.

Fig. 17 is a sectional detail of the shell of Fig. 1 provided with a noise reducer device.

Fig. 18 is a broken side elevation of a form in which the ribbon has its inner edge in gradual convergence as to the bore passageway. Fig. 18*a* is a detail, partial longitudinal section of a shell having inturned bights along its length to form successive expansion chambers. Fig. 19 is a detail section of a converging shell and a converging ribbon along its bore face.

Figure 1 is a broken away, side elevation of an embodiment of the invention, hereinafter referred to, for brevity, as a muffler, including a suitably elongate shell 2 connective by an inlet nipple 3 to a given apparatus from which the fluid media, as exhaust gas from a motor, flows into the shell to be ultimately discharged from the muffler outlet tube 4 substantially without wave power and from which the usual exhaust noises have been absorbed or choked. For the gradual, progressive breaking up of the pressure in the breast of a head of gas suddenly loaded into the nipple 3 of the muffler the shell 2 in its preferred form, Fig. 1, is formed peripherally in the shape of screw or helical surface 5 flaring

outwardly from its root line 6 which is a helix on the surface of the nipple 3 whose inner end terminates in a helix along the root line 6 at the converged surface 5 of the shell.

The nipple 3 and the outlet tube 4 are of about the same bore diameter and a longitudinally extending means is fixed to the tube 4 and forms a core or back-bone for the root edge 10 of the outwardly flared, helical or ribbon like surface 5. This means or back-bone consists of a suitable number of radially extending blades or elongate panels 7 for the length of the helical shell surface 5. It is a purpose of this blade means to form a pressure reaction surface for gases flowing longitudinally of the shell in its bore-like passage presented by the root- edge or line of the flared surface 5, the width of which from the root line to the rim line or edge helix 8 may be varied to suit a given installation or meet a given function. The shell is further made up of a closing or end wall or transverse face element 9 in the form of a narrow ribbon in helical pitch to join with the outer rim or helix 8 of the major shell wall surface 5. This transverse face element 9 may have any desired angle as to the axis of the shell or muffler unit but preferably is inclined inwardly and downwardly, as clearly shown in Fig. 1, to form an acute cutting or slicing edge or angle 10 facing the incoming fluid stream. It will be seen that the upper flared portion of the helical wall surface 5 constitutes a substantially continuous expansion chamber as to the substantially uniform bore defined by the acute, inner corner 10 of the pocket formed by the crowning, inverted-angle ribbon or end wall surface 9 of the helical-contour shell of the muffler. Hence, a ball or breast of fluid pressure will tend at one time to radially expand and axially advance as it enters the first helical pitch of the shell. It will be noticed that instead of the breast of the pressure ball being expanded in all directions in a common plane transverse to the axis of the muffler, the instant wave will bodily flow along the bore and its rim will slue off processionally at successive points axially spaced along the helical line 6 ending the inlet nipple 3. This progressive helical line control action obtains on all gas passing axially of the muffler and is facilitated by the surface of the reaction blades 7 presented continuously between opposite points along the wall surface 5 inwardly of the muffler.

The peculiar shell surfaces 5 and 9 forming the screw-like expansion chamber for the length of the muffler are preferably produced by a method in which a cylindrical tubing of suitable material is rolled, spun or pressed in such a manner that its cylindrical surface is drawn into a shape with the elongate surface 5 defining a helix with a desired flare from the root angle 10 and with the wall surface 9 integral therewith at the rim angle 8.

Figure 2 is a side elevation of the upper end of the outlet tube 4 of the muffler of Fig. 1, which latter shows the tube as ending with a helical line 11, in the view presented while the edge of the tube diametrically opposite to the near edge 11 will be of a left hand pitch to line 11, which is right hand pitch. In this way the finally discharged gas will be prevented from issuing to any noticeable degree in a common plane across the axis of the tube.

Figure 3 is a broken plan of the upper end of the tube 4 and showing the radial blades 7 of the reactor means. It will be seen from this view that rotary motion of the axially moving gases in the muffler bore (formed by cutting edges or angles 10) is prevented by the reaction faces of the blades 7.

As soon as the breast of a wave or pressure head passes a slicing point of the acute angles 10 of the transverse wall surface 9 the expanded or sliced off portion will re-surge back into the bore to follow its parent pressure head before the next incoming stimulating impulse.

It will be seen that each full pitch or coil of the helical shell 2 constitutes a full circle expansion stage and that it is of conoidal form flaring outwardly from the first stage root line 6 at the inner helical end of the inlet nipple 3 and then in succession from the slicing lip or angle 10 defining the perimeter of the axially clear bore of the shell and in which lies the radial reactor blade means 7.

Figure 4 is a detail section showing the junction angle 10 of the conoidal surface 5 of an expansion stage or space 12 as having a slicing flange 13 extended toward the incoming fluid stream.

Figure 5 is a detail section showing a form of muffler outlet omitting the discharge tube 4 and opening directly over the last stage 12 of the shell for lateral diffusion of the gas processionally in successive points along the helical rim 8; the reactor blades 7 presenting radial surfaces for transverse abutment opposite each point along the helical discharge edge of the rim.

Figure 6 is a broken side elevation of a form of the muffler in which the shell 2a is cylindrical and is connected by an expansion collar 14 to its inlet nipple 3; the upper end of the shell converging in a conoidal, helical reducer 4a to its outlet tube 4. In this adaptation the reactor blade device 7 is provided as a back-bone with abutments or supporting parts 7a to which are suitably attached the helical slicing ribbon 9a which is of the desired transverse width and helical pitch and whose outer edge is closely juxtaposed to the inner face of the shell 2a, and preferably the ribbon 9a is fixed to its back-bone 7 to be screwed therewith and thereby in place in the shell; this being provided with means, such as fixed spurs 15 arranged complementally to the pitch of the ribbon. The screw spurs are shown as over-lapping or hooking on the upper surface of the ribbon for the purpose of drawing the ribbon outwardly with the shell 2a as this may expand, and, conversely, contracting the shell with the ribbon as this contracts. It will be seen that the supporting lugs 7a of the blades 7 are set against the upper or back face of the adjacent face part of the ribbon. This not only gives stability to the ribbon against high pressure gas wave or heads which may be released into the muffler but additionally leaves the lower or forward face, toward the incoming stream, of the ribbon 9a circumferentially unobstructed to facilitate the slicing efficiency of the inner, helical edge 9b and provide for free expansion under the length of the ribbon. The outer edge of that part of each blade 7 extending along an expansion stage 12a between successive coils of the ribbon 9a is shown as inclined upwardly and inwardly at 16 and suitably spaced back at 18 from the near, inner edge of the ribbon to facilitate the flow of a wave crest to and then expansively back of the slicing ribbon. The lower end of the risistor 7 may be connected suitably to a near part of the fixed shell structure, and in this illustration the collar 14 is slotted at 19 and

a corner 20 of a blade of the resistor 7 is set in the slot and clinched over or otherwise fixed.

Figure 7 is a detail view of the hooking lug 15.

Figure 8 is a plan or end view of the muffler of Fig. 7; looking upward at its bottom.

Figure 9 is a broken, sectional elevation showing the muffler shell 2 of Fig. 1 enclosed in an exterior jacket 22 so that there is formed between the jacket and the shell 2 a helical passage 23 closed at the entrance end by a head 24 and having at the far end an outlet conduit 25 for air heated by its traverse of the passage. With the muffler installed on a vehicle a bell inlet 26 is fixed to face the direction of forward motion of the vehicle and supplies fresh air to the heater passage 23. This exchange of heat from the helical expansion stages 12 aids in the efficiency of the muffler in reducing the pressure of the hot gas wave.

Figure 10 is an axial, elevational section of a form of the invention in which the cylindrical shell 2a is provided at its intake end with a conical bottom or end head 28 in which there is mounted a concentric conduit 27 to which is attachable an inlet or exhaust nipple 3. The upper end of the conduit 27, which is another form of back-bone, is suitably mounted in a braced ring bearing 29 fixed to the head of the shell; this being contracted by a converged reducer 4b, to outlet tube 4. A feature of this embodiment is that the gas conduit 27 is provided with a helical line outlet or discharge opening 30 for the diffusion of the gas wave or head into the annular space thereabout provided by the spaced, concentric, inner edge 9b of the helical slicing ribbon 9a whose outer edge 9c preferably slidably fits the near face of the shell 2a for compensating temperature influenced motions. Reaction blade means 7 are fixed longitudinally along the exterior surface of the diffusion conduit 27 to act as a tie to the helical wall of the conduit, in such cases where the helical outlet 30 may be continuous and end to end, or nearly so, of the conduit 27; it being understood that the outlet may be helically interrupted, as shown at 30a, in Fig. 15, that is non-continuous. The helical ribbon 9a acts to slice off the rims of pressure heads as these pass into and expand from the conduit 27 and as they tend to move axially in the annular space 31 along the blades 7 and between the inner edge of the ribbon and the surface of the conduit 27. The outer edges of the blades 7 are shown as spaced inwardly at 32 back of the ribbon between the inner surface of the shell to leave the latter unobstructed for advance of the expanding gas in the stages between successive coils of the ribbon.

Figure 11 is a plan of the top bearing ring 29 into which there is slidably extended the upper ends of a set of radial blades 7c forming a reactor in the upper end of the bore forming conduit 27 which preferably terminates in the shell 2a at a distance below the bearing ring 29 and has its terminal edge 11a in sinuous outline as a helix or as in Fig. 1, with half-helices of opposite pitch in directly diametrical opposition as to the axis of the conduit so that any stream of gas discharging from the conduit is diffused in the shell and thence converged to the tube 4.

Figure 12 is a cross-section, of the muffler of Fig. 10, on line 12—12; looking down to show the annular space 31 concentric of the ribbon 9a.

Figure 13 is a cross-section of a form of concentric conduit formed of a set of tube segments 27a with equal-length flanges 27b meeting with the surrounding, inner edge of the helical ribbon 9a, in shell 2a. Contiguous, parallel flanges 27b, which are radial to the conduit axis, or nearly so, are suitably spaced to provide elongate diffusion interstices 30a outwardly from the bore of the longitudinally extending conduit formed by the grouped segments 27a and the flanges are suitably fixed in such spaced relation by any suitable stream slicing members 33. The flanges are reactors.

Figure 14 is a cross-section of a modified form of reactor means in the shell 2a. In this case the helically vented conduit 27 has attached, radial, short-width reactor blades 7d whose long outer edges are spaced inwardly from the near or inner edge of the helical slicing ribbon to form an uninterrupted annular passage 34. Cooperative with this reactor means is an outer set of spaced, longitudinally extending, radially disposed blades 7e edged out against the shell 2a and reaching inwardly toward the inner edge of the fixed helix 9a. The blades 7d form a longitudinal tie for the conduit 27 where this is provided with a continuous slicing or diffusion vent 30.

Figure 15 is a perspective of a longitudinal fragment of a conduit segment 27a, Fig. 13, to show one radially short flange 27c and one wider flange 27b, the latter to reach to the relative coils of the muffler slicing helix 9a. In this case the apposite flanges 27b and 27c, meeting face to face when assembled in a ring of the segments 27a, are suitably fixed together, and diffusion of the wave pressure is had by means of a helical series of vents or ports 30a made through the segment wall.

It is to be understood that the inside venting conduit 27a in any of its forms may be suitably shifted to the most effective relation of its helical vent 30 as to the inwardly presented slicing edge 9b of the cooperative, helical ribbon 9a. It will also be understood that the pitch of the vent 30 and of the slicing ribbon 9a may be similar or dissimilar and either may be single or double.

There may be cases where, due to one factor or another such as cost or of space value, it is desirable to diffuse an exhasting gas, after passing through a primary muffler as of the class above set forth—directly to the free atmosphere.

Figure 16, therefore, is a broken elevation of the upper or discharge end of a muffler shell 2a which outlets into the connected end of an upwardly converging reducer muffler section 35 whose tapering wall or shell 36 has a helical form of vent 30, continuous or interrupted as desired, and which due to the upward convergence of its wall brings the upper lip 37 of its orifice 30 somewhat radially inward of its opposite lower lip 38. From this it will be seen that the pressure wave will, while being contracted by the reducing wall, automatically slue off of the edge 38 and in the slight axial advance toward the facing edge 37 of the orifice 30 the wave will be further sliced off and passed outwardly.

Figure 17 is a sectional detail of a modification of the muffler of the helical, conical stage form of Fig. 1 in which the shell wall itself forms the helical stages 12. Where desired the exterior of the coils of the shell 2 may be encased in a drum 40 to form a helical, exterior pocket 41 which may be filled with a suitable loose packing or absorbent 42 to kill noise and vibration; the wall parts 5 and 9 being perforate for fluid flow.

Figure 18 is a broken, side elevation of a multi-section form of muffler involving an upper shell

2a with inner ribbon means 9a as in Fig. 6 wherein the coils of the helical ribbon are concentrically uniform as to spacing about the axis of the shell; that is, the edge 9b is of constant diameter for its length,—a uniform bore or flow passage is thus provided for the length of the helical blade. This is satisfactory for divers installations, but in given uses and combinations it is desirable to present a gradually converging bore or passage along the inner edge of the slicing ribbon as is shown at 9c, Fig. 18, where the blade 9a is shown as set with its rim 9d against the inner surface of a gradually rearwardly converging or conical shell section 2b. Thus the inner edge 9c of each successive helix coil is offset radially inwardly from the next in advance, that is toward the incoming stream of pressure fluid. This increased presentation of edge surface by the gradual conical contraction of the helical ribbon 9a materially enhances the diffusing reaction of the cutting or slicing ribbon. Such a longitudinally converging or conical-bore edge of ribbon may be sufficient in many cases without the secondary section or shell form 2a.

Figure 18A shows expansion stages 12 between inturned bights 9e.

Figure 19 is a detail section of a portion of a muffler in which the degree of convergence of the shell 2b is such that the full face of each successive helix coil of ribbon 9a will be presented toward the incoming gas stream.

As set forth hereinabove the muffler involves a generally uninterrupted axial bore which is prescribed by the peripheral edge of muffler element such as the inner edge of a ribbon coil or the inner root angle of the helically grooved or corrugated shell wall per se; in either of said cases one coil forming a full circle about the axis of the bore.

The outlet 25 of the muffler of Fig. 9, may, when desired, be utilized to pull cold air into the inlet 26 by provision of a vacuum pulling bell on the outlet instead of delivering heated air by conduit to a remote compartment. Such cool air circulation will facilitate in the muffler function.

The interior and exterior surfaces of the conduit 27 effectively function as lateral re-actor surface, and in the claims the word "re-actor" is intended to include any surface exposed to lateral reaction in opposition to radially opposed bore surface of the muffler shell and in the end discharge tubes 4.

When desired an exterior, supplemental, Venturi form of expansion space may be disposed along the orifice 30, Fig. 16, by the provision of converged, peripheral flanges 35a and 36a leaving a constricted mouth 30b.

What is claimed is:

1. A muffler including a helically corrugated shell of a plurality of pitch coils, and a complementary helical, exterior wall transversely connecting the rim of the coils and the root part of the coils, said coils and said wall each flaring conically rearwardly from said root so that the junction at the root is a cutting edge to a fluid stream flowing toward apexial roots; the roots of the successive turns of the helical wall defining the bore of the muffler, and said bore being longitudinally unobstructed.

2. A muffler including a corrugated shell of a plurality of axially wide, peripheral wall coils, and a narrower, complementary pitch helical, transverse coil-end wall having its outer edge intersecting one end of the coil thereat; the coils including a conical forward end portion converging toward the axis of the coils and intersecting at a root angle with the inner edge of the adjacent transverse wall.

3. A muffler including a cylindric shell which has a helical, oblique, inturned corrugation bight having acutely converging side walls joined by a root angle.

4. A muffler having a helically corrugated shell structure and in which the walls of the corrugations form between themselves expansion spaces axially along the interior of the shell and the roots of the corrugations define the bore, said bore being longitudinally unobstructed for free axial flow of fluid in the bore, and a longitudinally disposed reaction stop means mounted in the bore and having a set of blades radial to the axis and being imperforate and free from lateral projections interfering with axial flow; whereby to prevent transverse reaction of the fluid from one side of the shell to the other.

5. The muffler of claim 4, and the said blades being in cruciform arrangement.

6. The muffler of claim 2, and the shell wall opening from and at the last pitch of the wall (from the inlet thereof) for lateral diffusion across the said end wall.

7. A muffler as in claim 2, and a slicing lip, at the inner or root junction of the corrugation, directed toward the inlet of the muffler.

8. A muffler as in claim 2, and the said end wall meeting the shell wall at an acute angle at each edge of the end wall and converging toward the inlet of the muffler.

9. A muffler including a corrugated shell of a plurality of helical coils peripherally, and a complementary-pitch, transverse coil-end wall having its outer edge intersecting one end of the coil thereat; the coils including a forward, conical portion converging toward the axis of the shell and intersecting at a root angle with the radially inner edge of the adjacent transverse wall.

10. A muffler shell having a screw-thread peripheral wall and in which the roots and the ridges are of V-angle.

11. A muffler as in claim 10, and in which the two side walls of the thread coils both incline toward the axis of the shell in one endwise direction.

12. A muffler shell having an internal helical wall member whose inner edge defines the bore of the shell, and a set of axially elongate, radial partitions fitting the member and spaced inwardly from the shell; said partitions extending radially beyond the bore edge of the said member.

13. A muffler shell having an inwardly directed helical wall of a plurality of turns and whose inner edge defines the bore of the shell and the spaces between the wall turns forming fluid expansion chambers along the axis of the bore, and a longitudinally elongate partition means to stop diametrical or reaction fluid flow in the shell and including a baffle provided with a set of radial blades free of perforations and whose longitudinal edges are spaced in from the shell to provide for angular flow of the expanded fluid.

14. A muffler shell as in claim 13, and in which the blades have portions lapping over and abutting turns of the helical wall.

15. A muffler shell as in claim 13, and in which the blades are connected at their inner parts to a tubular backbone.

16. A muffler having a shell, an internal spaced-coil helix whose outer edge meets the shell and whose inner edge defines the bore of the muffler

and the spaces between the coils of the helix forming expansion chambers, and a concentric conduit in the bore and having a helical diffusion outlet inwardly opposite the spaces forming said chambers.

17. A muffler as in claim 16, and longitudinally extending, radial blades arranged along the exterior of the conduit.

18. A muffler having an inlet and having an internal helical wall whose inner edge defines the muffler bore and which edge gradually converges toward the axis of the helix so that successive margins of the coils of the helix are presented toward the muffler inlet.

19. The muffler of claim 18, and the shell and the helical wall both converging away from the inlet to such a degree that a full face of each coil is exposed at successive coils.

20. A muffler having a shell wall which has a narrow, in-turned, generally V-section bight which inclines uniformly toward one end of the muffler so that the apex of the bight is of slicing effect on oncoming fluid from said muffler end.

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