Silencers for use in conjunction with firearms and as mufflers for internal combustion engines and the like are provided with entry, suppression and resonant chambers arranged coaxially within a tubular housing. A plurality of helical suppressor elements are axially disposed in the suppression chamber and arranged in opposition to each other. The entry and resonant chambers may be provided with baffles. The entry chamber may be provided with an excess pressure relief valve. Orificed resilient plugs may be provided in the vicinity of the discharge end of the silencer particularly for use in conjunction with firearms. At the entry end of the silencer there may be provided a tube with an L-shaped slot permitting ready mounting of the silencer on the barrel of a firearm.

27 Claims, 11 Drawing Figures
In yet another aspect of the invention, there is provided a
mounting means for a silencer which utilizes the front sight on
the barrel of a firearm for retaining the silencer on the firearm.
This feature is particularly useful for use in conjunction with
pistols. More particularly, at the entry end of the silencer is
provided a tubular element of diameter slightly greater than
the diameter of the barrel of the firearm and having a L-
shaped slot. One arm of the L extends parallel to the axis of
the tubular element, opens at the end of the tubular element
which is free when the tubular element is associated with a
silencer and is of a width at least slightly greater than the width
of the front sight of the firearm in a direction perpendicular
both to the axis of the barrel of the firearm and the height of
the sight. At its opposite end this arm of the L-shaped slot
communicates with the other arm of the L-shaped slot. The
other arm is of a width taken on a line parallel to the axis of
the tubular element at least slightly greater than the length of
the front sight.

Hence, the tubular element carrying at its far end the sup-
pressor is slid onto the barrel of the firearm with the front sight
of the firearm being guided in the longitudinal arm of the slot
and when the second arm of the slot is adjacent the front sight
the entire silencer assembly including the tubular element is
rotated in a direction counter to the direction in which the
second arm extends from the front arm whereby the front sight
is received in the second arm and the silencer is thereby
prevented from being slid from the barrel of the firearm.
Preferably, relatively snug fit is provided between the front
sight and the second arm in order that the silencer not inad-
vantly be rotated to a position in which it may slide off the
barrel.

In another feature of the invention, there is provided in
communication with the interior of the silencer an excess
pressure relief valve. This valve communicates preferably with
the entry chamber of the silencer. The valve may be provided
with a spring biased closure or may operate on a principle of
prevention of small or even section tortuous passages for the
evacuating gas whereby provision of moving parts may be
avoided.

The invention will now be further described with reference
to the accompanying drawings in which:
FIG. 1 is a side view of a rifle to the muzzle of which a
silencer constructed according to this invention is affixed;
FIG. 2 is an enlarged cross-sectional view of a silencer con-
stucted according to the invention;
FIG. 3 is an expanded view depicting the internal parts of
the silencer in perspective after their removal from the tubular
outer housing;
FIG. 4 is an enlarged cross-sectional view of one of the sup-
pressor elements depicted in FIGS. 2 and 3;
FIG. 5 is an enlarged cross-sectional view of an axially ap-
verted partition which separates the entry chamber from the
suppression chamber;
FIG. 6 is a cross-sectional view of another silencer con-
structed according to the invention;
FIG. 7 is an isometric view of means according to the invention
mounting a silencer on the barrel of a firearm;
FIG. 8 is a modification of the entry chamber in a silencer
such as of FIG. 2 to incorporate baffles according to the inven-
tion;
FIG. 9 is a modification of a resonance chamber in a
silencer as of FIG. 2 to incorporate baffles according to the inven-
tion; and
FIGS. 10 and 11 are relief valves according to the invention
to be incorporated in a silencer.
In FIG. 1 the numeral 1 designates generally a rifle to which
a silencer generally designated by the numeral 2 is affixed.
Silencer 2 as best shown in FIG. 2 comprises an outer hous-
ing 3 which is internally threaded along a substantial portion
of its inner surface and which therefore is adapted to receive
the inner elements which constitute principal features of the
invention.

SILENCERS FOR FIREARMS, INTERNAL COMBUSTION
ENGINES, OR THE LIKE
This invention relates to silencers for use in conjunction
with firearms and as a muffler for internal combustion engines
and, more generally, in any instance in which it is desired to
decrease the level of noise carried by a fluid. The silencers of
the present invention are particularly adapted to decreasing
the sound level resulting from the sudden expansion of a gas.
A silencer constructed according to one embodiment of this
invention may comprise a plurality of helical suppressor ele-
ments which chamber functions as a pressure reducing chamber
for supplying gaseous material to the suppression chamber fol-
lowing expulsion from the muzzle of the gun barrel.
According to another aspect of the invention, the entry and/or
the resonance chamber there may be positioned at least one and preferably a plurality of baffles each comprising a
plate having an aperture therethrough surrounded by a wall
which acutely flares outwardly to define increasing diameters
of the aperture. When such a baffle is positioned in the entry chamber, it is an axial path way together with a plu-
arity of radially disposed ports arranged to establish commun-
ication from the passageway to the suppressor elements so
that out-of-phase vibrations are supplied from the axial passageway to the suppressor units in such manner as substan-
tially to neutralize each other. A suppression chamber is
dimensioned adjacent to and in axial alignment with the suppres-
sion chamber and is provided with end walls having concave
inwardly dished inner surfaces and an inwardly protruding
throat portion is formed on the inner surface of the outer end
wall, the resonant chamber being effective to damp and sub-
stantially to silence any unneutered frequencies which escape from the suppression chamber. An entry chamber, dis-
posed within the tubular outer housing and between the
muzzle of the associated gun barrel and the entry end of the suppressor chamber functions as a pressure reducing chamber
for supplying gaseous material to the suppression chamber fol-
lowing expulsion from the muzzle of the gun barrel.
A further feature of the present invention is directed to
greatly decreasing or eliminating the popping sound charac-
teristic of a bullet discharging from a bore in alignment with the
firing chamber of the firearm. To this end there is provided
near the discharge of the silencer a plug of a resilient material,
such as a rubber or a polyurethane or other resilient plastic.
Through the plug is provided an apature for passage of the
bullet. The aperture is of diameter smaller than the bullet. The
resilience of the material of the plug permits passage of the bullet through the aperture. In a preferred embodiment, the
plug is provided with at least one radial cut communicat-
ing with the orifice, the cut together with the radius of the orifice
being at least equal to the radius of the bullet whereby the cut
 aids the passage of the bullet through the aperture and in-
creases the useful life of the plug. Preferably, there is provided
at least one diametrically opposed pair of such radial cuts.
Moreover, against the discharge side of this first plug may be
provided a second plug of a resilient material, the second plug
having an orifice of greater diameter than the bullet. The
second plug acts as a backup for the first plug. Specifically, the
passage of the bullet through the orifice of the first plug causes
the plug to protrude into the orifice in the second plug.
The support provided by the second plug helps decrease any
tendency of the first plug to shear during passage of the bullet.
There may be provided two or more abutting pairs of these
plugs.
3,667,570

3. At the entry end of tubular outer housing element 3, an entry chamber 4 is defined by flanged end wall element 5 which is externally threaded as indicated at 8 for cooperation with the internal threads of tubular outer housing 3. End wall 5 is internally threaded as indicated at 6 for receiving external threads formed on the exterior surface of the muzzle of the barrel of gun 1. A flange 7 forms an abutment ledge for engagement with the end of tubular outer housing 3.

At the opposite end of the entry chamber 4, an axially apertured partition 9 is disposed. Partition 9 is provided with external threads 10 which cooperate with the inner threads of tubular outer housing 3. The axial aperture 11 formed in partition 9 is of progressively diminishing diameter and is of stepped configuration as indicated at 12.

The apertured projectile passes through the entry chamber in the direction indicated by the arrow A, relatively high pressure gas is admitted to the entry chamber as the projectile clears the muzzle of the gun barrel. Similarly, when the device is employed as a muzzle for an internal combustion engine, relatively high pressure gas is allowed to pass into the entry chamber through a passage or nozzle therein. This high pressure gas is allowed quickly to expand and then pass through the aperture 11, in the case of use with a firearm as the projectile completes its passage through partition 9.

The suppression chamber constructed according to this invention is defined at its ends by partition 9 and by partition 14. Partition 14 is externally threaded as designated at 15 and hence may be adjustably mounted with the tubular outer housing 10 in any desired axial position by simply rotating the partition 14 and thus causing axial movement thereof.

In order to provide for the application of out-of-phase vibrations to the oppositely disposed reversely wound helical suppressor elements 16-20 inclusive, a plurality of radial ports disposed therein by the numerals 21-30 are spaced along passageway 13 so that these ports are progressively uncovered. Fluid is thus admitted first through radial port 30 and subsequently through radial port 20 and so on as the fluid proceeds from right to left as viewed in FIG. 2. Frequencies which are characteristic of the fluid adjacent to helical suppressor 20 must necessarily be out-of-phase with subsequently supplied vibrations adjacent the helical suppressor 19. Since suppressor elements 16 and 20 are reversely wound, the oppositely disposed elements tend to neutralize each other. Furthermore, this neutralizing action may, if desired, be emphasized by the use of more than a pair of suppressor elements such as 19 and 20, additional suppressor elements 16, 17, and 18 being depicted in the drawing. Of course, it will be understood that more than five suppressor units may be used if desired although satisfactory results may be achieved with only two such oppositely wound units particularly if the number of helical windings is sufficiently great of the order of six or eight, for example.

Any unsuppressed vibrations which pass through the aperture 31 formed axially in partition 14 are admitted to the resonant chamber defined by partition 14 and outer configuration as indicated by the numeral 33 about its aperture 31. Similarly, the inner surface of end wall 32 is disposed as indicated at 34, and a throat portion 35 is formed on the inner surface of end wall 32. The throat portion 35 defines a part of the passageway 30 formed between end wall 32 and apertured end wall 5.

A sound deadening action is achieved by variations in the thickness of the tubular outer housing 3. Furthermore, these portions of different thicknesses are of varying lengths axially of the outer surface of tubular housing 3. For example, thick knurled portion 37 is of less axial length than thick knurled portion 38 as best shown for example in FIG. 3. Furthermore, thin unknurled portion 39 is of longer axial length than thin unknurled portion 40. These random variations have been found to be particularly effective as sound dampening means.

A suppressor 2' in FIG. 6 is a variant from suppressor 2 of FIGS. 2 and 3. End wall element 5 is divided with external threads which engage internal threads in the housing 3'. Partition 34' is provided with external threads which engage interior threads in the housing 2'. A slot 45' is provided in the partition 34' to permit its being threaded into the housing 3' by means of a tool such as a screw driver. A portion 9' is slidingly received in the housing 3' and is separated from the end wall 8 by an entry chamber 4' by means of a spacer element 45. Between partition 9' and partition 14' are retained oppositely wound helical suppressors 10' and 20'.

Provided at the discharge end of the suppressor 2' is an assembly 46 which defines both at the least the greatest part of the resonance chamber, all of which lies between partition 14' and end wall 32' and a means for eliminating the otherwise occurring "popping" sound of a bullet exiting from the silencer.

Assembly 46 consists of apertured end wall defining elements 32' and 50, a sleeve 51 and apertured plugs 52, 53, 54, and 55 of a resilient material such as a polyurethane. Sleeve 51 is press fit on end wall 50 and end wall 32' is press fit into sleeve 51. The assembly 46 is retained in the housing 3' by means of external threads provided on the end wall 32' which engage internal threads provided in the housing 3'.

The apertures in the plugs 52 and 53 of smaller diameter than the bullet. However, each of these plugs is provided with diametrically opposed radial cuts which communicate with the aperture and which together with the aperture define a diameter at least equal to and preferably exceeding the diameter of the bullet. These radial cuts are designated 52' and 53' relative to plugs 52 and 53, respectively. Passage of the bullet through the aperture in the plug 52 causes the plug 52 to protrude into the aperture through the plug 54 and the plug 54 acts as a back-up to help prevent shearing of the plug 52. The plugs 53 and 55 likewise cooperate together. In some instances, it may preferably to provide that the plugs 54 and 55 be of a softer material than plugs 52 and 53.

When the plugs have worn out, the assembly 46 may simply be unthreaded from the housing and a new assembly threaded into the housing.

In FIG. 7 is illustrated a device which may be incorporated with a suppressor, such as that of FIGS. 2 and 3 or FIG. 6, to permit mounting of the suppressor on the barrel of a firearm, particularly a pistol, by means of the sight, in the form of, for example, an ear, conventionally provided on the end of the barrel. The mounting device 60 is in the configuration of a tube 61 provided with a L-shaped slot 62 and an apertured and externally threaded extension 63. The device 60 may be mounted on the suppressor of FIGS. 2 and 3 or that of FIG. 6 by means of the external threads on the extension 63 engaging the internal threads in the end wall 5. The internal diameter of the tube 61 is greater, preferably only slightly greater, than the external diameter of the barrel of the firearm. The longitudinal arm of the slot 62 which is parallel to the axis of the tube 61 is of a width at least slightly greater than the width of the sight at the muzzle of the barrel. The portion of the slot 62 which is at right angles to the longitudinal arm, is of a dimension parallel to the axis of the tube 61 greater than the length of the sight and preferably only slightly greater. Hence, mounting of the suppressor is effected simply by sliding the tube 60 onto the barrel with the longitudinal arm of the slot 62 in alignment with and thereby receiving the front sight. Then, when the front sight reaches the other arm of the slot 62, the suppressor is rotated to position the sight in the other arm of the slot. It is provided that the fit between the sight and the other arm of the slot be relatively snug, the suppressor will not inadvertently rotate from the position from which it is locked onto the barrel to the position in which it may be slid off the barrel.

In FIGS. 8 and 9 are illustrated the entry and resonance chambers, respectively, of a silencer according to the invention modified by incorporation therein of baffles according to an alternative embodiment of the invention.

In FIG. 8, the entry chamber 4' is defined between the end wall 5 having external threads engaging internal threads in the housing 3' and the partition 9' slidingly received in the housing 3'. The spacer element 45 defines an interior portion of the chamber 4' which is adjacent to the external bore.
Not only does a silencer of this invention function effectively as a silencer, but when used with a firearm it also functions as a flash inhibitor so as effectively to render the flames of the associated powder burning action invisible.

While particular embodiments of the invention have been shown and described, the invention is not limited thereto and it is intended in the appended claims to cover such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A firearms silencer adapted to be mounted on a firearm in alignment with the firing chamber of the firearm to receive a bullet discharged from the firing chamber and comprising means defining a passage for the discharged bullet, the improvement comprising positioned in the passage a plug of a resilient material having therethrough in axial alignment with the passage a circular orifice of smaller diameter than the bullet and at least one radial cut communicating with the orifice, the radial cut together with the radius of the orifice being at least equal to the radius of the bullet and having therethrough in axial alignment with the orifice permitting the discharged bullet to pass through the orifice.

2. In the firearms silencer improvement according to claim 1, a second radial cut communicating with the orifice, said second radial cut being of length at least equal to that of the first radial cut and in diametrical opposition to the first radial cut.

3. In a firearms silencer adapted to be mounted on a firearm in alignment with the firing chamber of the firearm to receive a bullet discharged from the firing chamber and comprising means defining a passage for the discharged bullet, the improvement comprising positioned in the passage a first plug of a resilient material having therethrough in axial alignment with the passage and an orifice on the orifice of said material and the radial cut permitting the discharged bullet to pass through the orifice, and a second plug of a resilient material abutting against the bullet exit side of the first plug and having therethrough in axial alignment with the orifice through the first plug an orifice of larger diameter than the bullet.

4. In a firearms silencer improvement according to claim 3, a third plug of a resilient material having therethrough in axial alignment with the orifice through the second plug an orifice of smaller diameter than the bullet, the resiliency of the material of the third plug permitting the bullet to pass through the orifice of the third plug, and a fourth plug of a resilient material abutting against the bullet exit side of the third plug and having therethrough in axial alignment with the orifice of the third plug an orifice of larger diameter than the bullet.

5. In a firearms silencer improvement according to claim 3, in which the first plug is provided with at least one radial cut communicating with the orifice of the first plug, the radial cut together with the radius of the orifice being at least equal to the radius of the bullet, the radial cut assisting in the permitting of the discharged bullet to pass through the orifice of the first plug.

6. In a firearms silencer improvement according to claim 5, in which the first plug is provided with a second radial cut communicating with the orifice, said second radial cut being of length at least equal to that of the first radial cut and in diametrical opposition to the first radial cut.

7. In a firearms silencer improvement according to claim 4, in which the third plug is provided with at least one radial cut communicating with the orifice of the third plug, the radial cut together with the radius of the orifice being at least equal to the radius of the bullet, the radial cut assisting in the permitting of the discharged bullet to pass through the orifice of the third plug.

8. In a firearms silencer improvement according to claim 7, in which the third plug is provided with a second radial cut communicating with the orifice, said second radial cut being of length at least equal to that of the first radial cut and in diametrical opposition to the first radial cut.
9. A silencer comprising aligned entry and suppression chambers, the suppression chamber containing helical suppression elements and the entry chamber being upstream from the suppression chamber, in the entry chamber at least one baffle comprising a plate having an aperture therethrough surrounded by a wall which accurately defines outwardly to define increasingly greater diameters of the aperture at the distance from the baffle to the suppression chamber increases.

10. A silencer comprising aligned suppression and resonance chambers, the resonance chamber being positioned downstream from the suppression chamber, a plurality of helical suppression elements aligned coaxially in the suppression chamber with adjacent helical elements arranged in opposition to each other, means defining an axial passageway through said helical elements and a plurality of radial ports by which communication is established between said passageway and said helical elements, said ports being spaced axially along said passageway whereby gaseous material in said passageway is supplied sequentially to said helical elements through said ports so that self-neutralizing opposed vibrations are produced, at least one baffle positioned in the resonance chamber, the baffle comprising a plate having an aperture therethrough surrounded by a wall which accurately defines outwardly to define increasingly greater diameters of the aperture at the distance from the baffle to the suppression chamber increases.

11. A silencer according to claim 9, in which a plurality of said baffles are positioned in the entry chamber.

12. A silencer according to claim 10, in which a plurality of said baffles are positioned in the resonance chamber.

13. A silencer comprising aligned entry, suppression and resonance chambers, the suppression chamber containing helical suppression elements, the entry chamber being upstream from the suppression chamber and the resonance chamber being downstream from the suppression chamber, a plurality of baffles positioned in each of the entry chamber and resonance chamber, each of the baffles comprising a plate having an aperture therethrough surrounded by a wall which accurately defines outwardly to define increasingly greater diameters of the aperture, the baffles in the entry chamber being so positioned that the diameter of the aperture of a respective baffle increases as the distance from the baffle to the suppression chamber increases.

14. A silencer according to claim 13, further comprising a plurality of helical suppression elements disposed coaxially in the suppression chamber with adjacent helical elements arranged in opposition to each other, means defining an axial passageway through said helical elements and a plurality of radial ports by which communication is established between said passageway and said helical elements, said ports being spaced axially along said passageway whereby gaseous material in said passageway is supplied sequentially to said helical elements through said ports so that self-neutralizing opposed vibrations are produced.

15. A silencer according to claim 14, further comprising a tubular outer housing defining the outer wall of the aligned chambers and wherein the thickness of the housing irregularly varies along its length.

16. A silencer according to claim 14 further comprising a relief valve communicating between the interior of the entry chamber and the exterior of the suppression chamber.

17. A silencer according to claim 14, further comprising a mounting means in the form of a hollow element defining the entry end of the silencer and in axial alignment with the entry chamber, said hollow element being provided with a L-shaped slot having a longitudinal arm parallel to the axis of the element and opening at the free end of the element and a second arm communicating with the longitudinal arm and being oriented at right angles to the longitudinal arm.

18. A firearms silencer according to claim 14, further comprising positioned in the resonance chamber a plug of resilient material having therethrough in axial alignment with the passage an orifice of smaller diameter than the bullet to be discharged from the firearm, the resilient material permitting the discharged bullet to pass through the orifice, and a second plug of resilient material abutting against the bullet exit side of the first plug and having therethrough in axial alignment with the orifice of the second plug an orifice of larger diameter than the bullet.

19. A firearms silencer according to claim 18, in which the plug is provided with a second radial cut of length at least equal to that of the first radial cut and in diametrical opposition to the first radial cut.

20. A firearms silencer according to claim 17, further comprising positioned in the resonance chamber a first plug of resilient material having therethrough in axial alignment with the orifice of the second plug an orifice of smaller diameter than the bullet, the resilient material of the third plug permitting the bullet to pass through the orifice of the third plug, and a fourth plug of resilient material abutting against the bullet exit side of the third plug and having therethrough in axial alignment with the orifice of the third plug an orifice of larger diameter than the bullet.

21. A firearms silencer according to claim 20, further comprising in the resonance chamber a third plug of resilient material having therethrough in axial alignment with the orifice of the respective plug, the radial cut together with the radius of the orifice of the respective plug being at least equal to the radius of the bullet, the radial cut assisting in the permitting of the discharged bullet to pass through the orifice of the respective plug.

22. In a silencer comprising a housing having an entry end and containing helical suppression elements and a discharge end, the improvement comprising non-uniform variations of the thickness of the housing.

23. In a silencer comprising aligned entry and suppression chambers, the suppression chamber being downstream from the entry chamber and containing helical suppression elements, the improvement comprising a relief valve communicating between the interior of the entry chamber and the exterior of the silencer.

24. In a silencer comprising aligned entry and suppression chambers, the suppression chamber being downstream from the entry chamber and containing helical suppression elements, the improvement comprising a relief valve communicating between the interior of the entry chamber and the exterior of the silencer.

25. In a silencer improvement according to claim 24, in which the relief valve comprises means defining a conduit communicating between the interior and the exterior of the silencer, closure means for the conduit mounted for reversible movement from a closed position to an open position and spring means biasing the closure in a closed position toward the interior of the entry chamber.

26. In a silencer improvement according to claim 25, in which the closure comprises a wall.

27. In a silencer improvement according to claim 24, in which the relief valve comprises means defining a tortuous and constricted path between the interior of the entry chamber and the exterior of the silencer.

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