Jan. 13, 1953 C. P. CAULKINS 2,625,235

DISCHARGE SILENCER AND RECOIL COMPENSATOR

Filed July 14, 1949 2 SHEETS—SHEET 1

FIG.1.

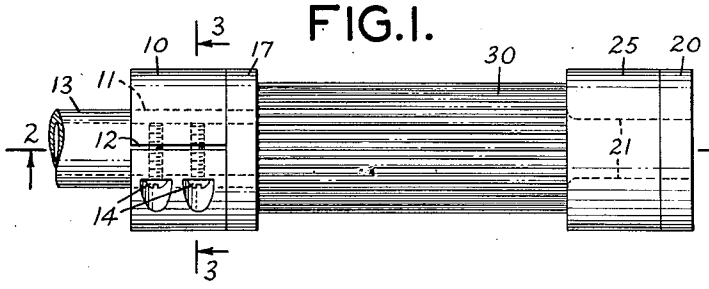


FIG.3.

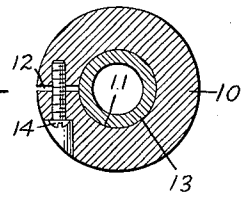


FIG.2.

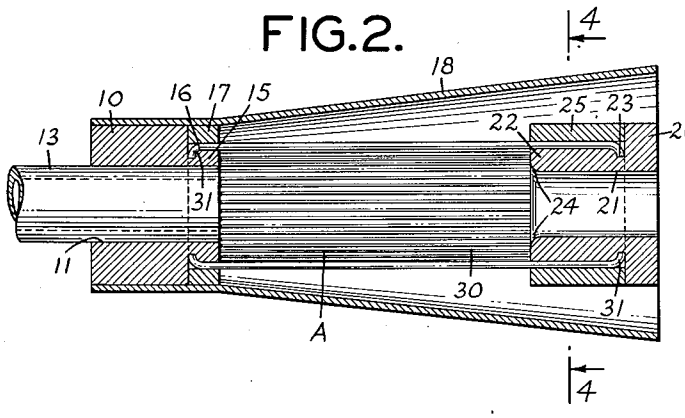


FIG.4.

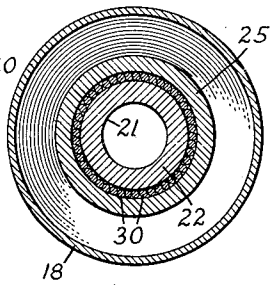


FIG.5.

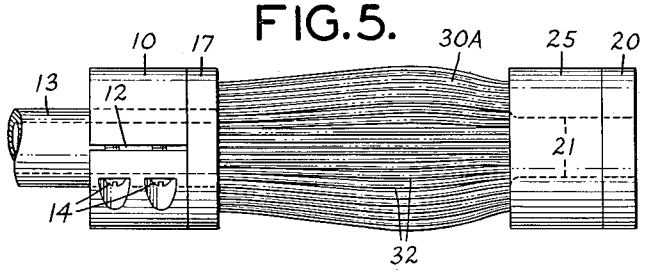


FIG.12.

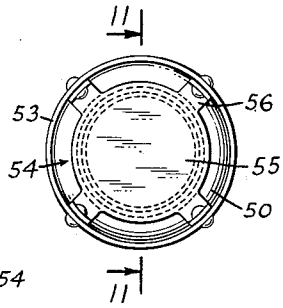
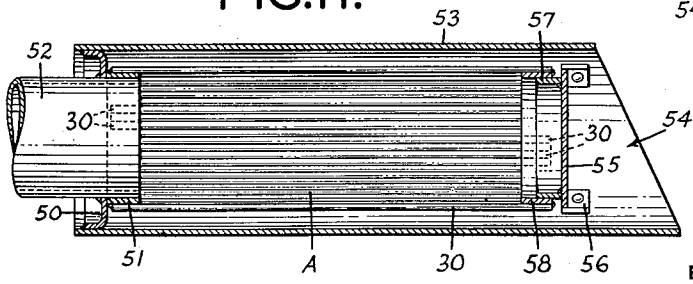


FIG.11.



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FIG.6.

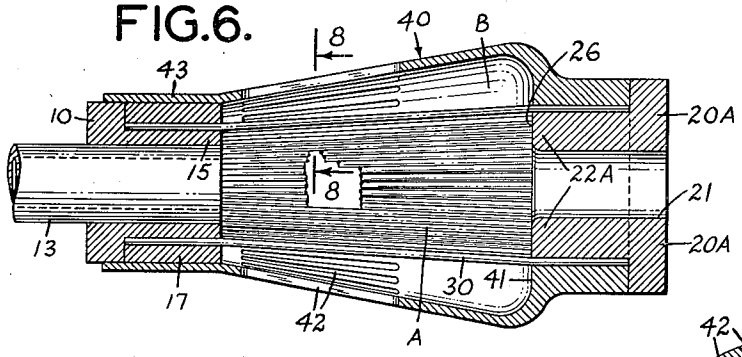


FIG.8.

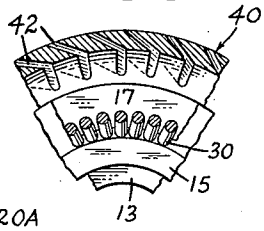


FIG.7.

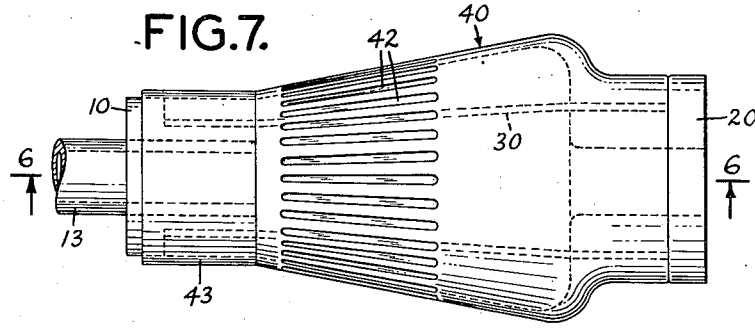


FIG.9.

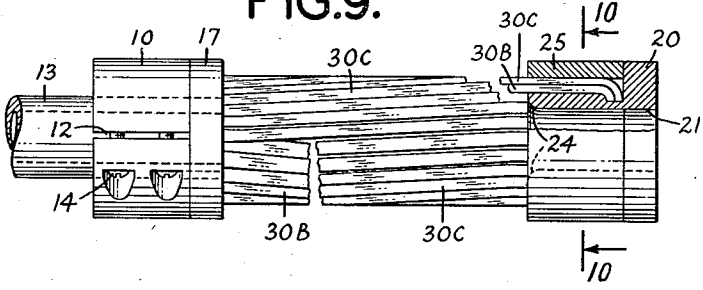


FIG.10.

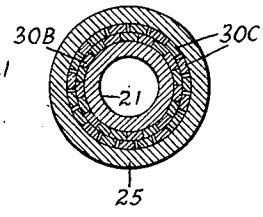
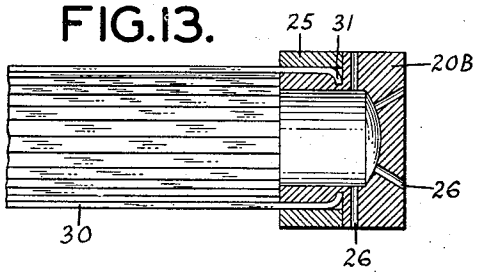


FIG.13.



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DISCHARGE SILENCER AND RECOIL COMPENSATOR

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Application July 14, 1949, Serial No. 104,667

21 Claims. (Cl. 181—46)

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This invention relates to a discharge silencer and recoil compensator for muffling the sound and reducing the recoil such as that caused by the discharge of a firearm or silencing the exhaust of an internal combustion engine, and for other uses.

Its object is to provide a device of simple, sturdy construction and of light weight which shall have the advantages which are specifically described herein over formerly available devices.

This application is a continuation-in-part of an application I filed October 5, 1948, as Serial No. 52,889, now abandoned.

I will describe certain embodiments of the invention in the following specification and point out its novel features in claims.

Referring to the drawings—

Fig. 1 is a side elevation of a silencer and recoil compensator which is made according to and embodies this invention. It is shown affixed to the end of a gun barrel.

Fig. 2 is a sectional side elevation of the parts shown in Fig. 1, with the addition of a shroud—the section of the parts shown in Fig. 1 being taken on the line 2—2 thereof.

Fig. 3 is a sectional end elevation taken on the line 3—3 of Fig. 1.

Fig. 4 is a sectional end elevation taken on the line 4—4 of Fig. 2.

Fig. 5 is a side elevation corresponding to Fig. 1, showing the parts in different relative positions to illustrate the operation of the device.

Fig. 6 is a sectional side elevation of a device of modified construction.

Fig. 7 is a side elevation of the device shown in Fig. 6.

Fig. 8 is a partial sectional end elevation on an enlarged scale of the device shown in Figs. 6 and 7. The section in this figure is taken on the line 8—8 of Fig. 6.

Fig. 9 is a side elevation, partly in section, of a device of modified construction, which also embodies this invention.

Fig. 10 is a sectional end elevation of the device shown in Fig. 9, the section being taken on the line 10—10 of the latter figure.

Fig. 11 is a sectional side elevation of another modification which is especially designed for use as a muffler for the exhaust of internal combustion engines and the like.

Fig. 12 is an end elevation of the device shown in Fig. 11. The section in Fig. 11 is taken on the line 11—11 of Fig. 12; and

Fig. 13 is a sectional side elevation of one end of a muffler of modified construction.

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10 designates an inner head having a bore 11. It is split longitudinally, as shown at 12, so that it may be attached to a gun barrel 13 by means of screws 14. The forward portion 15 of the head 10 is cylindrical and of smaller outer diameter than the outer dimension of the part of the head back of it. 16 is an annular groove formed in this forward portion 15.

20 is an outer movable head having a bore 21. The inner portion 22 of this head is cylindrical and of an outer diameter corresponding to the outer diameter of the part 15 of the head 10. 23 is an annular groove formed in the part 22. The bore 21 is of a diameter somewhat larger than the caliber of the gun barrel 13, and its inner corners are rounded, as shown at 24.

The heads 10 and 20 are interconnected by a plurality of like parallel resilient members 30, which, in all of the figures except Figs. 5, 9, 10 and 13, are shown as straight metallic wires of cylindrical cross section and of equal length. Their ends may be bent inwardly, as at 31, and inserted in the grooves 16 and 23 and secured to the heads by collars 17 and 25, which have a drive fit over the wires in the construction shown in Figs. 1–5. The wires 30 lie in close proximity to one another or abut one another, and when not expanded in a manner which will be described hereinafter, form a chamber A (Fig. 2) between the heads 10 and 20 of a diameter somewhat greater than that of the bore 11.

Before specifically describing the modifications shown in the remaining figures, I will point out the operation of the device as illustrated in Figs. 1–5. When the head 10 is affixed to the gun barrel 13, the wires 30 hold the head 20 in axial alinement with the bore of the barrel. When the gun is fired, the projectile passes, with no retardation, through the bore 21 in the head 20 followed by some of the gases of the explosive charge. The greater part of these gases enter the chamber A and expand therein, and their pressure bows the wires outwardly, as shown at 30A in Fig. 5. This forms longitudinal openings 32 between the wires if they are in abutment, or enlarges the openings if the wires are spaced, through which the gases escape. The bowing of the wires draws the head 20 back toward the head 10 without disturbing its alinement with the gun barrel. This movement of the head 20 is resisted by the pressure of the gases on the head 20, and this opposes the recoil of the gun materially. The resiliency of the members 30 returns the head 20 immediately to its initial position.

In addition to muffling the sound of the dis-

charge, nearly all of its flash is retained in the chamber A, the wall of which, when the wires are bowed, act on the principle of a Davy lamp.

If desired, a shroud 18 extending around and over the wires 30, may be affixed to the head 10. The movement of the head 20 produces a vibration of the wires which prevents the accumulation of carbon on them.

In the device illustrated in Figs. 6–8, the head 10 is similar to that shown in the preceding figures, but the outer diameters of the head 20A are larger. Consequently, the wires 30 at the outlet end of the device are farther apart than they are at the inlet end. As the area of the rear end 26 of the movable head is larger than that of the forward end 15 of the head 10, the effect of the pressure of the gases in the chamber formed within the wires is greater against the head 20A than it is against the head 10, and thus enhances the desired opposition to the recoil of the gun.

In this embodiment of the invention a shroud 40 is affixed to the movable head 20A and its other end is supported on the head 10 and is longitudinally slidable thereon. Its outer end is diametrically enlarged to add an annular area 41 to that of the inner end 26 of the head 20A, against which the gases within the device exert an outward pressure which further dampens the recoil of the gun.

The shroud forms an outer chamber B surrounding the chamber A formed by the wires 30. A series of angularly spaced substantially longitudinally disposed slots 42 provide a means of egress for the gases in the chamber B. These slots are positioned toward the intake end of the device. They are also cut at an angle to axial planes through them, as shown in Fig. 8.

The operation of this, which I now consider the preferred form of my device when used as a gun recoil compensator or brake, is as follows:

The greater part of the gases formed by a discharge of a gun, which flow into and expand in the chamber A, escape therefrom into chamber B near the forward part of the device where the spaces between the wires 30 is greatest. In doing this, the muffling effect and the flame-damping effect are like that previously described. The general direction of the flow of the gases in chamber B is reversed as they move toward the slots 42. This reversal of flow further augments the recoil compensation. Although there is but little or no glow from the gases in chamber B, it cannot be seen from the outside because of the nonradial or slanting position of the slots.

It is not necessary to dispose the resilient members in parallelism with the axis of the gun barrel, nor to form them of wire of cylindrical cross section. In Figs. 9 and 10 the resilient members 30B are in the form of longitudinal solid strips having a substantially rectangular cross section disposed cylindrically about the axis of the gun barrel but angularly disposed in relation to said axis. They are, however, of equal length and parallel with one another, and the opposite ends of each of them are affixed to the heads 10 and 20. In these figures another set of similar resilient members 30C is shown outside of the members 30B at an angularity opposite that of the inner members 30B. In this outer series the resilient strips are slightly spaced apart, as shown in Fig. 10.

In Figs. 11 and 12 I have shown an embodiment of the invention which has gone into successful use as a muffler for the exhaust of internal combustion engines. In this construction a head 50 and a ring 51 are welded onto an exhaust pipe 52. 53 is an outer cylindrical shroud welded onto the head 50. The head 50 closes one end of the shroud and holds the shroud in axial alinement with the pipe 52. The outer end 54 of the shroud is open.

An imperforate circular disk 55 of smaller diameter than the inner diameter of the shroud is affixed to the shroud near its open end by radially extending arms 56, which position it centrally. 57 is a cylindrical collar affixed to the disk 55. A ring 58 is supported by and is longitudinally slidable on the collar 57. The wires 30 are welded onto the rings 51 and 58.

The explosive discharges of the engine enter and expand in the chamber A surrounded by the wires 30. This bows the wires outwardly so that the gases flow through the plurality of longitudinal spaces between them into the shroud with but little back pressure and escape through the spaces between the disk 55 and the shroud and between the arms 56 and out of the open end 54 of the shroud. As the wires are bowed by the pressure of the exhaust gases, the ring 58 slides inwardly on the collar 57. Immediately after an explosive discharge has bowed the wires outwardly, they tend to return, because of their resiliency, to their initial positions. This alternate flexing of the wires materially reduces and practically eliminates back pressure on the pipe 52. The repeated explosions in the engine cylinder cause a continuous vibration of the members 30. Not only is the sound of the explosions deadened, but any flame which may come out of the engine with the exhaust gases is extinguished. The vibration of the wires prevents the accumulation of carbon thereon.

Instead of an imperforate movable head, one like that shown at 20B in Fig. 13 may be used in a muffler. This is provided with perforations 26, through which some of the exhaust gases may pass.

I have shown this device as applied to a silencer and recoil brake for guns and as a muffler for the exhausts of internal combustion engines. It is also applicable for use as a pressure relief valve. It is admirably suited for this purpose, because when the pressure in the line slightly exceeds a desired amount, the wires will be bowed slightly to permit the escape of a small amount of the gaseous fluid under pressure, but when an excessive pressure arises the wires will be bowed to a larger extent to allow a great amount of the gaseous fluid to escape. It is also well adapted to use as a snubber for door spring checks. It may be used also to advantage for other purposes.

Various modifications in construction, mode of operation, method and use of an invention may and do occur to others, especially after benefiting from knowledge of such a disclosure as that herein presented of the principles involved, but the invention itself is not confined to the present showing.

I claim:

1. A device comprising a pair of longitudinally spaced relatively movable transverse rigid heads, one of said heads being provided with an intake opening, and a gas chamber between the heads of larger internal dimension than that of the opening, having a wall formed by a plurality of closely assembled longitudinally disposed resilient members with their ends affixed to the heads.

2. The combination defined in claim 1 in which

the resilient members are wires of circular cross section.

3. A device comprising a pair of longitudinally spaced relatively movable transverse rigid heads, one of said heads being provided with an intake opening, and a gas chamber between the heads of larger internal dimension than that of the opening, having a wall formed by a plurality of closely assembled longitudinally disposed resilient members with their ends affixed to the heads, in which the resilient elements are of equal length and are spaced at equal radii from an axis through the center of the heads.

4. The combination defined in claim 3 in which the resilient members are of heat resistant material.

5. A device comprising a pair of longitudinally spaced relatively movable transverse rigid heads, one of said heads being provided with an intake opening, a gas chamber between the heads of larger internal dimension than that of the opening, having a wall formed by a plurality of closely assembled resilient vibratile members extending longitudinally from head to head, means for attaching one end of each of the members to one of the heads and means for attaching the opposite end of each of the members to the other head.

6. A device comprising a pair of longitudinally spaced relatively movable transverse rigid heads, one of said heads being provided with an intake opening and a gas chamber between the heads of larger internal dimension than that of the opening, having a wall formed by a plurality of closely assembled longitudinally disposed resilient members with their ends affixed to the heads with at least parts of proximate members abutting one another.

7. A device comprising a pair of longitudinally spaced relatively movable transverse rigid heads, one of said heads being provided with an intake opening, the other head being provided with a vent, and a gas chamber between the heads of larger internal dimension than that of the opening, having a wall formed by a plurality of closely assembled longitudinally disposed resilient members with their ends affixed to the heads.

8. A device comprising a plurality of longitudinally spaced relatively movable transverse rigid heads, one of said heads being provided with an intake opening, and a gas chamber between the heads of larger internal dimension than that of said opening, having a wall formed by a plurality of closely assembled resilient members extending longitudinally from head to head with the ends of each member affixed to the heads, said members being spaced at equal radii from a longitudinal axis through the center of the heads and disposed at an angle to said axis.

9. A device comprising a plurality of longitudinally spaced relatively movable transverse rigid heads, one of said heads being provided with an intake opening, a gas chamber between the heads of larger internal dimension than that of said opening, having a wall formed by a plurality of closely assembled resilient members extending longitudinally from head to head with the ends of each member affixed to the heads, said members being spaced at equal radii from a longitudinal axis through the center of the heads and disposed at an angle to said axis and an outer layer of resilient members surrounding the chamber-forming members disposed at an opposite angle to said axis with their ends affixed to the heads.

10. A device comprising a pair of longitudinally spaced relatively movable transverse rigid heads, one of said heads being provided with an intake opening, a gas chamber between the heads of larger internal dimension than that of the opening, having a wall formed by a plurality of closely assembled longitudinally disposed resilient members with their ends affixed to the heads and a shroud affixed to one of the heads surrounding but laterally spaced from the resilient members.

11. The combination defined in claim 10 in which the shroud extends over the other head.

12. A device comprising a pair of axially alined longitudinally spaced relatively movable transverse rigid heads, each having a circular portion, one of said heads being provided with an intake opening, a gas chamber between the heads of larger internal diameter than that of the opening, having a wall formed by a plurality of closely assembled longitudinally disposed resilient members with their ends affixed to the circular portions of the heads and a perforate shroud affixed to one of the heads surrounding but spaced from the resilient members.

13. The combination defined in claim 12 in which the shroud extends over the other head and is slidably supported thereby.

14. A device comprising a pair of axially alined longitudinally spaced, relatively movable transverse rigid heads, each having a circular portion, one of said heads being provided with an intake opening, a gas chamber between the heads of larger internal dimension than that of the opening, having a wall formed by a plurality of closely assembled longitudinally disposed resilient vibratile members with their ends affixed to the circular portions of the heads, and a shroud affixed to one of the heads surrounding but laterally spaced from the resilient members and extending over the other head, said shroud being constructed with a plurality of angularly spaced substantially longitudinal slots cut at an angle to radial planes passing through them.

15. A device comprising a pair of longitudinally spaced relatively movable transverse rigid heads provided with axially alined bores therethrough and a gas chamber between the heads, having a wall formed by a plurality of closely assembled longitudinally disposed resilient members with their ends affixed to the heads.

16. A device comprising a fixed rigid head, a longitudinally spaced relatively movable rigid head longitudinally spaced from the fixed head, axially alined bores through said heads, a gas chamber between the heads of larger internal diameter than those of the bores, having a wall formed of a plurality of closely assembled longitudinally disposed resilient members with their ends affixed to the heads, and a shroud affixed to one of the heads, surrounding but spaced from the resilient members and extending over the other head.

17. In combination with a gun barrel, a device comprising a transverse rigid head affixed to said gun barrel, a longitudinally spaced relatively movable rigid head having a bore therethrough of larger diameter than the caliber of the gun barrel in axial alinement with the gun barrel, and a gas chamber between the heads of larger internal diameter than that of the bore, having a wall formed by a plurality of closely assembled longitudinally disposed resilient members with their ends affixed to the heads.

18. In combination with a gun barrel, a device comprising a transverse rigid head affixed to said

gun barrel, a longitudinally spaced relatively movable rigid head having a bore therethrough of larger diameter than the caliber of the gun barrel in axial alinement with the gun barrel and a gas chamber between the heads of larger internal diameter than that of the bore, having a wall formed by a plurality of closely assembled longitudinally disposed resilient members, said fixed head having a circular portion of larger outer diameter than that of the gun barrel, the movable head having a circular portion of larger outer diameter than that of said circular portion of the fixed head, with the ends of the resilient members affixed to said circular portions of the heads.

19. In combination with a gun barrel, a device comprising a transverse rigid head affixed to said gun barrel, a longitudinally spaced relatively movable rigid head having a bore therethrough of larger diameter than the caliber of the gun barrel in axial alinement with the gun barrel, a gas chamber between the heads of larger internal diameter than that of the bore, having a wall formed by a plurality of closely assembled longitudinally disposed resilient members with their ends affixed to the heads and a perforate shroud surrounding but spaced from the resilient members affixed to one of the heads and slidably supported on the other head.

20. The combination as defined in claim 19 in which the shroud is supported on the movable head, has a closed portion near the movable head and has a vented portion near the fixed head.

21. In combination with an exhaust pipe, a device comprising a rigid head affixed to and extending transversely from said pipe, a shroud affixed to said head extending longitudinally therefrom, a supporting member of smaller external dimension than the internal dimension of the shroud, longitudinally spaced from said head on the exhaust pipe and affixed to the shroud, a second rigid head mounted slidably on said supporting member and a gas chamber between the heads, having a wall formed by a plurality of closely assembled resilient members extending from the head on the exhaust pipe to said second head, with one end of each member affixed to the head on the exhaust pipe and its opposite end affixed to said second head.

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