

United States Patent Spies

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[54] MODEL AIRPLANE MUFFLER CONSTRUCTIONS.

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181/61

[51] Int. Cl. F01n 1/08, F01n 1/14, F01n 7/10

[58] **Field of Search**.....181/40, 43, 51, 72, 61-63,
181/47, 57, 60

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[57] **ABSTRACT**

A lightweight sheet metal model airplane muffler in the form of a hollow shell having symmetrical airfoil characteristics and defining an internal expansion chamber for exhaust gases. Outlet ports are provided in the camber regions of the shell where they communicate with the vacuum pockets which are established by the slipstream during flight and the low pressure air in such pockets assists in evacuating the chamber.

14 Claims, 15 Drawing Figures

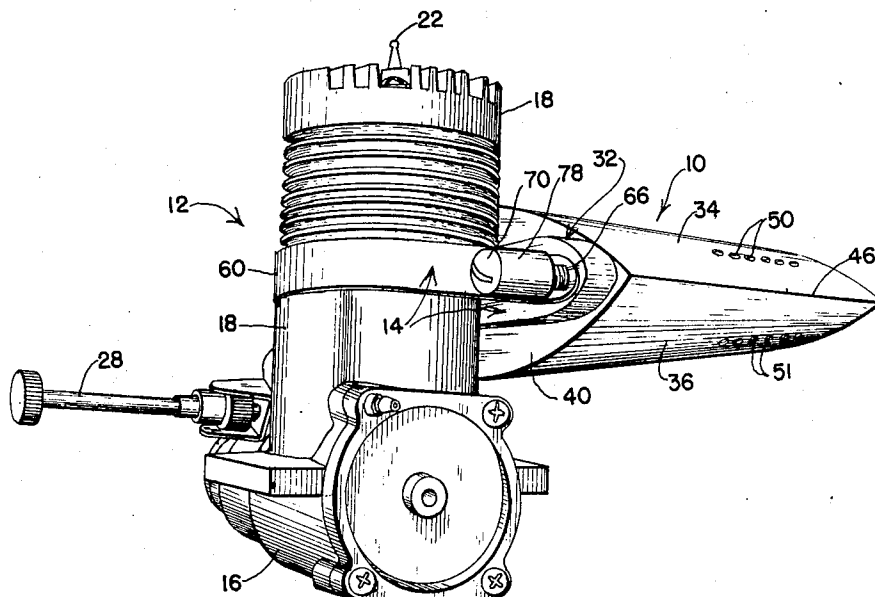


FIG. 1

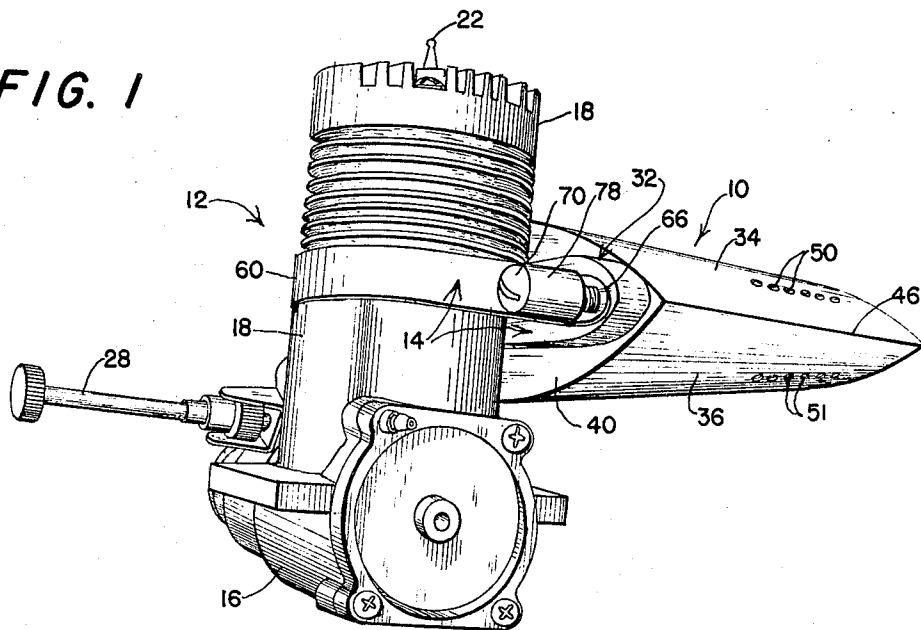


FIG. 2

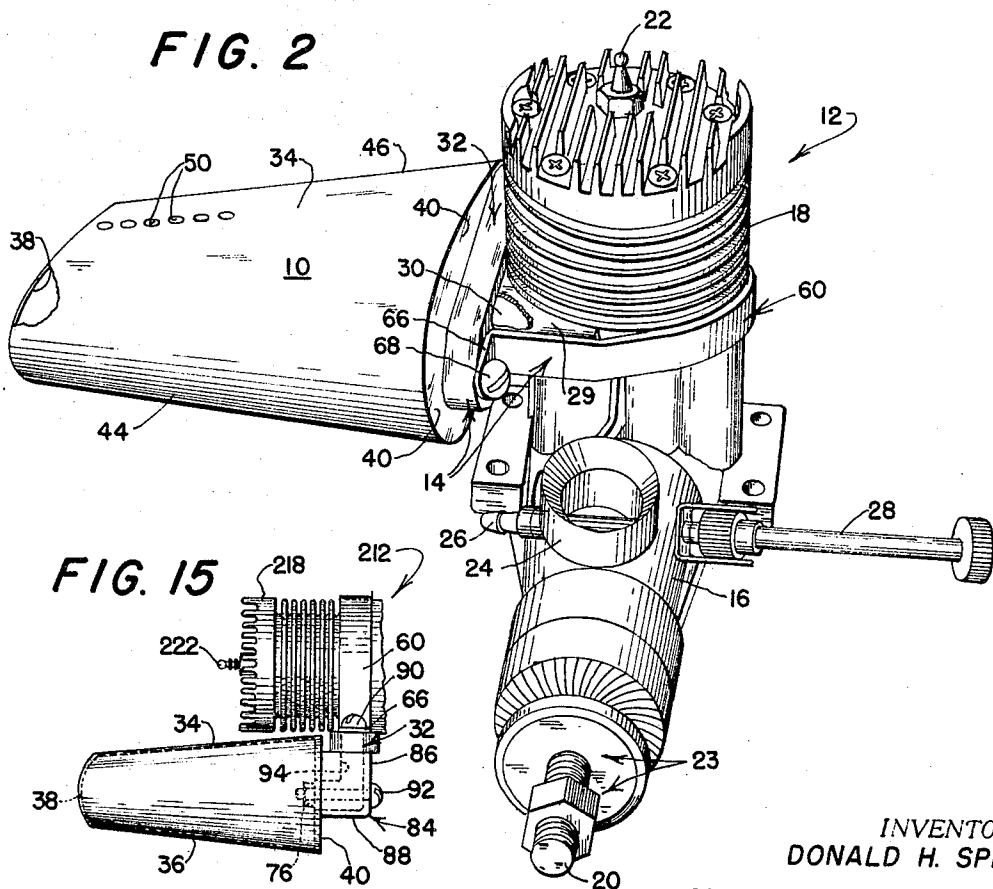
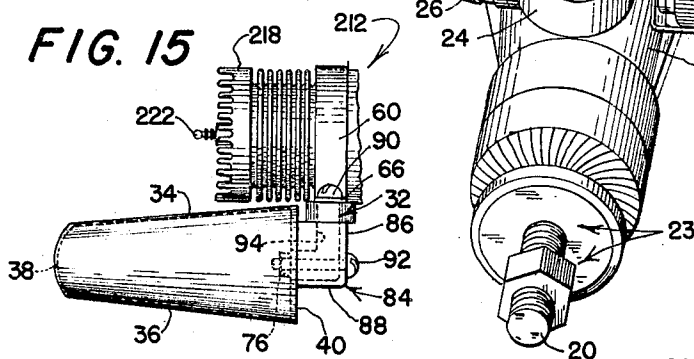


FIG. 15



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FIG. 5

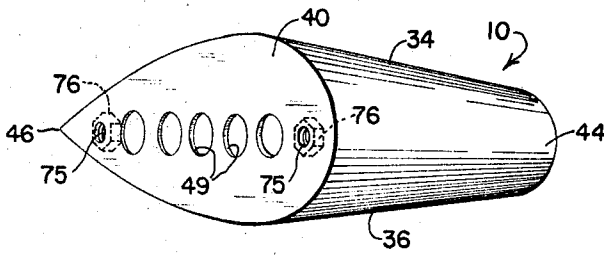


FIG. 6

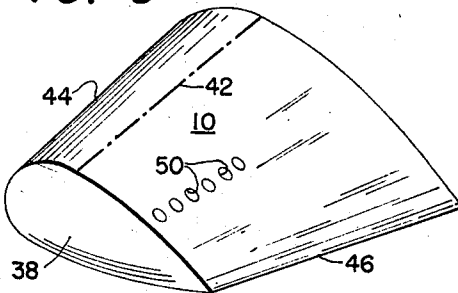


FIG. 8

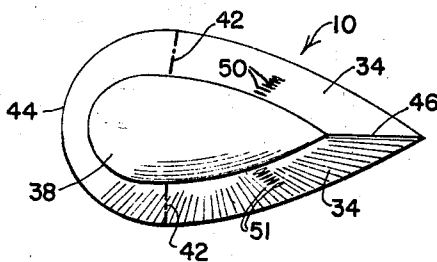


FIG. 10

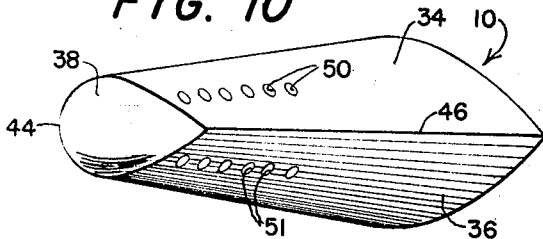


FIG. 4

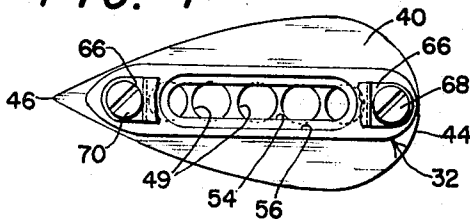


FIG. 7

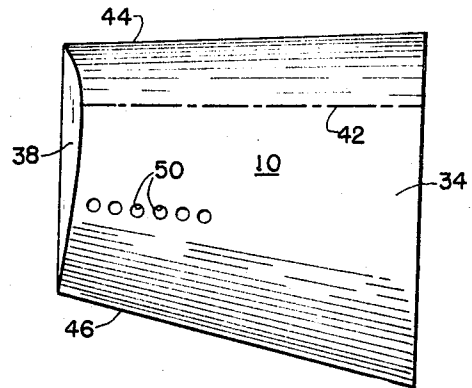


FIG. 9

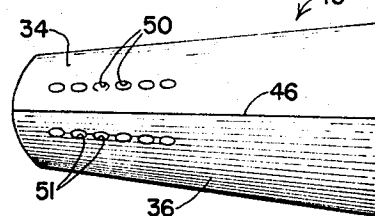
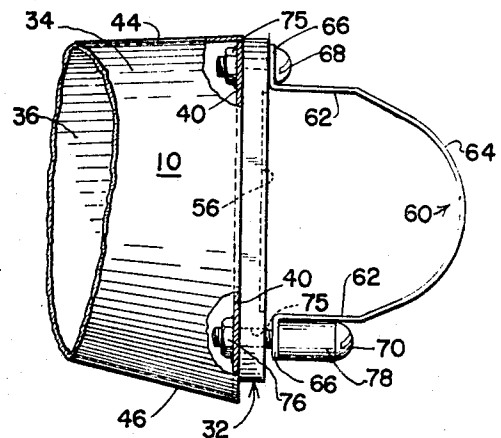


FIG. 3



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MODEL AIRPLANE MUFFLER CONSTRUCTIONS

The present invention relates to muffler constructions and has particular reference to a muffler which is specifically designed for use in connection with the internal combustion engine of a model airplane, especially competition type model airplanes which are radio controlled from the ground. Still more specifically, the invention is concerned with an expansion type muffler or exhaust silencer which, when operatively installed on a model airplane engine and the airplane is in flight, is disposed directly in the slipstream of the airplane propeller and depends upon well known phenomena associated with airfoil design for its successful operation.

It has long been recognized that when the upper surface of an airplane wing is arched in the transverse direction of the wing, maximum aerodynamic advantage is obtained. This advantage resides principally in the fact that as the wing moves forwardly through the slipstream, the air is deflected upwardly by the leading side of the arch, thereby creating a vacuum above the wing in the trailing camber region. The vacuum thus produced creates unbalanced forces on opposite sides of the wing, such forces being relied upon largely for wing lift and the phenomena involved is generally known as the airfoil principle.

According to the present invention, the improved model airplane muffler is of symmetrical airfoil design, which is to say that both the upper and lower sides thereof are arched in airfoil fashion and, in effect, constitute a tubular structure which is of tear drop design in transverse cross section. This tubular structure is closed at its opposite ends by means of tear drop shaped end walls, thus defining an internal, maximum volume, full length, full height and full width expansion chamber. The muffler is so designed and installed on a model airplane engine that it projects radially outwardly from the engine cylinder and the exhaust gases leaving the engine cylinder enter the expansion chamber through the inner end wall and are expanded in the chamber. These expanded gases leave the expansion chamber through a series of outlet ports which are formed in the camber regions of the muffler at locations where they are in direct register with the vacuum areas above and below the muffler. These vacuum areas, acting through the outlet ports assist in drawing the expanded gases from the chamber and, in so doing, they not only decrease the noise level involved due to gas evacuation, but also reduce the back pressure on the engine to a large degree. While the exact causes of such reduction in noise level may not at the present time be thoroughly understood, it is believed that the reduction takes place at the precise moment when the expanded pulsating gases emerge from the outlet openings and enter a region of high vacuum where sound waves are devoid of a strong carrier medium or, stated otherwise, a sound source will not yield as high a decibel factor in rarefied air as it will in air at atmospheric pressure.

It is not the aim of the present invention to produce a muffler having a noise reduction factor which is so great that the sound of the emerging gases is nearly inaudible, as is the case with ordinary automobile mufflers. In such an instance the muffler would be practically valueless for model airplane use where it is necessary for the ground operator to memorize the sound of his own particular craft and identify it when the craft is in flight so that he may estimate its location at all times and being it back to home ground. Thousands of model aircraft have been lost after straying out of earshot. However it is the aim of the present invention to afford some reduction in noise level and particularly to yield a noise emission that is well within the decibel range of non-objectionable audibility and will not be subject to neighborhood complaint. Moreover, the invention aims to produce a sound emission which is of a pleasing quality in that it is devoid of any objectionable trumpet action as is the case with many conventional model airplane mufflers.

The provision of a novel model airplane muffler of the character briefly outlined above constitutes the principal object of the present invention. An additional object of the invention is to provide a muffler which is extremely light in

weight, consisting as it does of three light gauge stainless steel sheet metal pieces cut to shape and silver soldered together along certain meeting edges.

A further and important object of the invention is to provide a muffler which is possessed of a high heat-dissipating factor, such object being attained by the use of the aforementioned stainless steel material for the muffler walls. With such high heat-dissipating qualities for the muffler as a whole, a cool running engine will be the obvious result.

Yet another object is to provide a novel muffler mounting including an angular muffler manifold by means of which the muffler proper may be cause to assume an out-of-the-way position when it is applied to a side mounted engine.

The provision of a model airplane muffler which is extremely simple in its construction, consisting as it does largely of sheet metal stampings and which therefore may be manufactured at a low cost; one which is rugged and durable and which therefore will withstand rough usage; one which is possessed of no moving parts, internal or external and which therefore is unlikely to get out of order; one which is of compact design and therefore consumes but little space, either on the shelf or when packaged for shipping; one which offers no appreciable wind resistance when the aircraft with which it is used is in flight; one which is easily applicable to and removable from a wide variety of different engine designs; one which is attractive in its appearance and pleasing in its design; and one which, otherwise, is well adapted to perform the services required of it, are further desirable features which have been borne in mind in the production and development of the present invention.

Other objects and advantages of the invention, not at this time enumerated, will readily suggest themselves as the nature of the invention is better understood.

In the accompanying drawings forming a part of this specification, several illustrative embodiments of the invention have been shown.

In these drawings:

FIG. 1 is a rear perspective view of a model airplane muffler embodying the principles of the present invention and showing the same operatively installed on a model airplane engine;

FIG. 2 is a front perspective view of the structure shown in FIG. 1;

FIG. 3 is a fragmentary top plan view of the inner portion of the muffler and its adapter and clamping assembly;

FIG. 4 is an end elevational view of the structure shown in FIG. 3, the adapter strap being broken away in the interests of clarity;

FIG. 5 is a front inside mid-plane perspective view of the muffler per se;

FIG. 6 is a rear outside top perspective view of the muffler;

FIG. 7 is a top plan view of the muffler;

FIG. 8 is an outside end elevational view of the muffler;

FIG. 9 is a front mid-plane elevational view of the muffler;

FIG. 10 is an outside rear mid-plane perspective view of the muffler;

FIG. 11 is an exploded perspective view of the muffler and its associated adapter plate and clamping assembly;

FIG. 12 is a sectional view, entirely schematic in its representation, illustrating certain aerodynamic principles which are involved in connection with the operation of the present muffler;

FIG. 13 is an inside, slightly above mid-plane, rear perspective view of a slightly modified form of muffler;

FIG. 14 is a top plan view of the muffler shown in FIG. 13; and

FIG. 15 is a fragmentary front elevational view of a portion of an airplane engine of the side mount type, showing the muffler of FIGS. 1 to 10 inclusive operatively installed thereon by means of a novel 90° manifold.

Referring now to the drawings in detail, and in particular to FIGS. 1 and 2, a preferred form of model airplane muffler embodying the principles of the present invention is designated in its entirety by the reference numeral 10 and it is shown as

being operatively applied to a conventional model airplane engine 12 of the internal combustion type, the muffler mounting being effected by means of an adapter plate and clamping assembly 14 the details of which are further disclosed in FIG. 11.

The combustion engine 12 is of conventional construction and no claim is made herein to any novelty associated with the same, the present muffler being readily applicable to a wide variety of engine constructions. The engine selected for environmental purposes herein embodies the usual crankcase 16 from which there projects vertically upwardly a cylinder 18. A crankshaft 20 which is rotatable in the crankcase 16 is associated with the usual connecting rod and piston (not shown), the latter being reciprocable in the cylinder 18. The forward end of the crankshaft threadedly receives thereon a clamping nut and hub assembly 23 by means of which a propeller (not shown) may be fixedly secured to the crankshaft. Other conventional engine components are a cylinder glow plug 22 at the top of the cylinder 18, a carburetor 24 which receives fuel from a fuel line 26, a throttle or fuel adjustment rod 28, and other combustion engine components the details of which have not been disclosed herein.

A tubular extension 29 projects laterally from one side of the cylinder 18 in the medial region of the latter and defines an elongated slot-like exhaust port 30 for the combustion gases issuing from the engine. This exhaust port 30 communicates through an adapter block or plate 32 (see also FIGS. 3 and 11) with the muffler 10 in a manner and for a purpose that will be set forth in detail presently.

Considering now the specific character of the muffler 10, this muffler is in the form of a lightweight hollow stainless steel member of tapered tubular construction and which is closed at its ends. The muffler involves in its general organization a top wall 34, a bottom wall 36, an outer end wall 38 (FIGS. 6, 7, 8 and 10), and an inner end wall 40 (FIGS. 4, 5 and 11). Both the top wall 34 and the bottom wall 36 are of airfoil shape or design, the top wall 36 being arched upwardly with the extreme crest of the arch lying forwardly of the central longitudinal axis of the tubular muffler as indicated by the broken line 42 in FIGS. 6, 7 and 8. The bottom wall 36 is similarly arched downwardly. The muffler 10 is tapered on a small slant angle.

Because of the dual or symmetrical airfoil shape of the muffler as described above, the leading side thereof is curved as indicated at 44 in FIGS. 2, 5 and 8 with fairly large increments of curvature prevailing, while the trailing side of the muffler presents a relatively sharp and linearly straight knife edge 46.

As previously stated, the tubular muffler is of tapered design and, therefore, the inner end wall 40 is appreciably larger than the outer end wall 38, both walls being generally of tear drop configuration in outline. The inner end wall 40 is flat or planar while the outer end wall 38 is preferably, but not necessarily, curved so that it bulges outwardly as clearly shown in FIGS. 6 and 7, the shading of this wall in FIG. 6 representing the bulge. It is however within the purview of the present invention to construct the muffler so that the outer end wall 38 is planar and generally parallel to the wall 40, in which case the muffler will assume the form of a tapered frustum.

As best seen in FIGS. 4, 5 and 11, the inner end wall 40 is formed with a linearly straight row of muffler inlet ports 49, five such ports being shown herein although a greater or a lesser number of such ports may be employed if desired. These ports 49 lie on the major axis of the tear drop shaped end wall 40 and they are designed for register with the exhaust port 30 (FIG. 2) of the cylinder 18 when the muffler 10 is installed on the engine 12. The outer end wall 38 is imperforate.

As clearly shown in FIGS. 1, 2 and 6 to 10 inclusive, the top wall 34 of the muffler 10 is formed with a row of relatively small outlet ports 50, the row extending in the longitudinal direction of the muffler and being disposed an appreciable distance rearwardly of the aforementioned crest 42 of the arched portion of the top wall 34 so that the ports lie well within the chamber area of the airfoil shaped wall. Although six such outlet ports 50 have been disclosed herein, it will be

understood that a greater or a lesser number of such ports may be provided if desired. Preferably this row of ports is disposed in the outer region of the muffler remote from the inlet ports 49. A similar row of outlet ports 51 is provided in the bottom wall 36 and they are similarly positioned.

Installation of the muffler 10 on an engine such as the engine 12 is effected by means of the aforementioned adapter plate 32, together with a clamping strap or band (FIG. 11) the nature of which will be described presently. The adapter plate 32 may be in the form of either a casting or a machined part and it is in the form of an elongated narrow strip of metal, preferably aluminum of approximately square cross section and having a centrally disposed slot 54 extending transversely therethrough. One side of the adapter plate 32 fits flat against the inner end wall 40 of the muffler 10 when the adapter plate is installed thereon with the slot 54 embracing all of the muffler inlet ports 49 in the end wall 40. The opposite side of the adapter plate 32 is recessed at the rim region of the slot, thus providing a shallow seating or pilot socket into which the outer rim region of the tubular extension 29 projects so that the exhaust port 30 registers with the slot 54, and consequently with the ports 49 in the muffler end wall 40.

In order to removably clamp the muffler 10 in its operative position on the engine 14, a U-shaped clamping strap or band 60 (FIGS. 1, 2 and 11) having parallel side legs 62 and a connecting bight portion 64 is provided. The outer ends of the side legs 62 are turned laterally outwardly away from each other to provide a pair of attachment ears 66. A pair of clamping screws 68 and 70 project through a pair of holes 72 which are provided in the attachment ears 66, through a pair of bores 74 formed in the end regions of the adapter plate 32, and also through similar holes 75 which are provided in the end wall 40, these screws being threadedly received by nuts 76 (FIG. 3) which are welded to the inside face of the muffler wall 40. The clamping screw 70 also passes through an alignment collar or sleeve 78 which is welded to one of the ears 66. The curvature of the bight portion 64 of the clamping strap 60 is conformable to that of the cylinder 18 of the engine 12 and the strap partially encircles the cylinder at approximately the level of the tubular extension 29 when the strap is in position on the cylinder so that upon tightening of the clamping screws 68 and 70, the muffler 10 is drawn hard against the rim of the tubular extension 29 and the exhaust port 30 communicates with the interior of the muffler through the adapter plate and in sealing relationship. In this position of the muffler 10, the longitudinal axis of the latter extends horizontally and projects radially outwardly from one side of the cylinder 18.

Structurally, the muffler 10 is of extremely lightweight construction, it being constructed in the main of relatively thin stainless steel sheet stock having a thickness on the order of 0.015 inches. The muffler lends itself to ease of manufacture in that the top wall 34 and bottom wall 36 are of unitary one-piece construction and are formed from a single blank of the stainless steel sheet metal. The blank is folded, so to speak, so as to bring the opposite ends thereof together to form the sharp trailing edge 46, after which they may be silver soldered together. Thereafter, the tear drop shaped end walls 38 and 40 are soldered in position to close the ends of the thus formed tubular symmetrical airfoil structure. The outer end wall 38 is formed of stainless steel sheet material similar to that which forms the top and bottom walls 36 and 38, while the inner end wall 40 is formed of somewhat thicker stainless steel material which may be on the order of 0.035 inches in thickness. It will be understood of course that the various openings 49, 50, 51 and 75 are punched or otherwise formed in the sheet metal stock prior to assembly of the three constituent parts of the muffler.

The thus assembled muffler 10, which is comprised of three sheet metal stampings, produces a symmetrical airfoil shape which defines an internal expansion chamber 90 of maximum volume.

It is to be noted at this point that, as shown in FIGS. 1 and 2, the muffler 10 projects radially and horizontally from the

cylinder 18 of the engine 12 and has its inner end disposed in close proximity to the latter so that the entire muffler lies well within the slipstream of the propeller of the airplane. Thus, as the airplane moves forwardly, the muffler in its entirety is subjected to substantially the same well known phenomena of airfoil behavior which is present in connection with a symmetrical airfoil wing but with the airfoil effect being enhanced by reason of the position of the muffler bodily within the slipstream. This airfoil effect is schematically illustrated in FIG. 12 wherein it will be observed that as the muffler moves forwardly with the airplane, the air which strikes the leading edge region 44 is deflected upwardly and downwardly over and below the crest regions 44 of the top and bottom walls 34 and 36 respectively, thus creating vacuum pockets 82 above and below the muffler in the camber regions thereof. The subatmospheric pressure values of these pockets will, of course, be a function of the speed at which the model airplane is traveling.

As schematically shown in FIG. 12, the various outlet ports 50 and 51 are located in the top and bottom walls 34 and 36 so that they communicate with the vacuum pockets 82 and, therefore, as the air slipstream moves past the muffler, the exhaust gases within the muffler expansion chamber 80 are drawn outwardly as indicated by the arrows through the outlet ports 50 and 51 under the influence of the subatmospheric air pressure which obtains within these pockets. This expansion chamber 80 is completely devoid of baffles or other internal instrumentalities so that free and unhindered expansion of the high pressure gases issuing from the outlet port 30 of the cylinder 18 may take place rapidly, thereby very materially reducing such pressure to such an extent that the subatmospheric pressure within the vacuum pockets 82 is effective in assisting evacuation of the chamber 80, especially at high engine speeds and consequent high airplane velocity. Power losses due to exhaust back pressure at the engine is thus reduced to a minimum. Due to the lightweight construction of the muffler as a whole incident to the use of extremely thin stainless steel sheet metal, unusually high heat-dissipating factors are present at any engine speed. It has been found that stainless steel sheet metal on the order of 0.015 inches is suitable for use in constructing the top and bottom walls, as well as the outer end wall 38, while similar sheet metal on the order of 0.035 inches is suitable for constructing the inner end wall.

For a proper understanding of the principle involved in connection with the operation of the present muffler, it should be borne in mind that exhaust gas evacuation takes place as a result of the airfoil principle involving the pressure differential which is present between the gases in the expansion chamber 80 and the air within the vacuum pockets 82, as distinguished from conventional model airplane mufflers which function on the Venturi principle of forced air rushing past the exhaust port through a restriction which is purposely created to attain such Venturi effect.

In FIGS. 13 and 14 a slightly different muffler design has been illustrated, the muffler in these two views functioning on precisely the same airfoil principle as that which has previously been described herein. Due to the similarity between the muffler 10 of FIGS. 13 and 14 on the one hand, and the muffler of FIGS. 5 and 7 on the other hand, and in order to avoid needless repetition of description, similar reference numerals but of a higher order have been applied to the corresponding parts as between the disclosures of these two groups of views. It is to be noted that the muffler 110 is appreciably shorter than the muffler 10, that the outer end wall 138 is slanted toward the inner end wall 140, and that the outlet ports 150 in the top wall 134 are positioned further along the top wall camber and are thus closer to the trailing edge 146 of the muffler. It will be understood that the outlet ports in the bottom wall 136 are similarly positioned. Otherwise the details of the muffler 110 remain substantially the same as those of the muffler 10. The difference between the mufflers 10 and 110 is largely a matter of design, the latter muffler giving a more or less rakish appearance which may be favored in connection with its use on certain designs of model aircraft.

In FIG. 15 the muffler 10 is shown as being applied to an airplane engine 212 which is mounted on the model airplane in such a manner that the cylinder 218 thereof extends horizontally. The engine 212 is similar to the engine 12 except for such modifications as necessary to accommodate its side mounting. Again, in order to avoid needless repetition of description, similar reference numerals of a still higher order have been applied to the corresponding parts of the engine as between the disclosures of FIGS. 1 and 15.

According to the present invention, it is contemplated that the muffler 10 may underlie the outer end region of the engine cylinder 218 in close proximity thereto and in a horizontal position. Accordingly, to accommodate such horizontal positioning of the muffler, a manifold 84 of L-shape construction is provided with a vertical leg 86 and a horizontal leg 88. The leg 86 is secured endwise by means of clamping screws 90 to the ears 66 of the clamping strap 60, as well as to the adapter plate 32. The horizontal leg 88 is secured by means of clamping screws 92 directly to the end wall 40 of the muffler 10. An L-shaped manifold passage 94 establishes communication between the slot 54 (see FIG. 11) in the adapter plate 32 and the muffler inlet ports 49 (FIG. 5). This horizontal mounting of the muffler 10 is highly desirable inasmuch as with conventional side mounted the mufflers which currently are in use project vertically downwardly an appreciable distance below the engine and are frequently damaged by impact with the ground.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit of the invention. For example, whereas the muffler 10 and its adapter plate 32 have been illustrated herein as being operatively installed upon the engines 12 and 112 by means of a clamping strap such as the strap 60, other attachment means for the muffler and its adapter plate are contemplated. Some commercial model airplane engines are supplied with mounting holes which are threaded for reception of clamping screws and, in such an instance, if desired, the clamping strap may be omitted and the installation made by utilizing clamping screws which effect clamping of the adapter plate between the engine and the muffler. Additionally, although plural inlet openings have been shown in the camber areas of the top and bottom walls 34 and 36 respectively, it is contemplated that single openings of appropriate gas flow capacity may be provided if desired. Furthermore, where plural openings are used, their placement in a linearly straight row as described herein is not essential to proper operation of the muffler. Finally, although the illustrated mufflers are stated to be formed of sheet metal, it is within the scope of the present invention to form such mufflers by a suitable molding or casting process. Therefore, only insofar as the invention has particularly been pointed out in the accompanying claims is the same to be limited.

Having thus described the invention, what I claim and desire to secure by Letters Patent is:

1. An airfoil muffler for a single cylinder model airplane engine having a lateral exhaust port, the muffler being of elongated design, having a leading and a trailing edge and being adapted for edgewise movement forwardly through the slipstream of the airplane when the latter is in flight, said muffler comprising a single hollow tubular shell defining an internal expansion chamber for exhaust gases and having a top wall which is arched upwardly in airfoil fashion, a bottom wall, and inner and outer end walls substantially closing the opposite ends of the tubular shell, there being at least one outlet opening in said top wall for the expanded gases in said chamber, said outlet opening being disposed rearwardly and entirely below the crest of the airfoil arch in said top wall to the end that it will communicate directly with the vacuum pocket which is created by such airfoil arch incident to passage of the muffler edgewise through said slipstream.

2. An airfoil muffler as set forth in claim 1, wherein said bottom wall is arched downwardly in airfoil fashion and is provided with at least one outlet opening which is disposed rearwardly and entirely above the crest of the latter airfoil arch.

3. A muffler as set forth in claim 2, wherein said shell is of three-piece sheet metal construction in that said top and bottom walls are formed from a single sheet metal blank, folded upon itself in the longitudinal direction of the muffler and heat sealed along the trailing edge of the muffler, and the inner and outer end walls are separately formed and heat sealed around their peripheral edges to the top and bottom walls.

4. An airfoil muffler as set forth in claim 3, wherein said top, bottom and outer walls are formed of stainless steel sheet metal on the order of 0.015 inches in thickness and the inner end wall is formed of sheet metal on the order of 0.035 inches in thickness.

5. An airfoil muffler as set forth in claim 4, wherein the trailing edges of the top and bottom walls are heat sealed together so as to subtend a small included angle which defines a sharp knifelike trailing muffler edge.

6. An airfoil muffler as set forth in claim 2, wherein said top and bottom walls are each provided with plural outlet openings which are arranged in linearly straight rows that extend generally in the longitudinal direction of the muffler.

7. An airfoil muffler as set forth in claim 2, wherein said muffler is tapered on a small slant angle so that said top and bottom walls define a frustum the large base of which is substantially closed by said said inner end wall.

8. An airfoil muffler as set forth in claim 7, wherein said inner end wall is planar and the outer end wall is generally arcuate in vertical cross section.

9. An airfoil muffler as set forth in claim 8, wherein the crest line of said arcuate end wall is substantially parallel to the plane of said inner end wall.

10. The combination with a model airplane having an engine provided with a cylinder from which there projects radially a tubular extension defining an exhaust port of elongated design and which produces a high sound level by pressure pulses of shock wave severity, of an airfoil muffler for reducing the severity of said shock waves and consequently the sound level, said muffler being of elongated design, having a leading and a trailing edge, and being adapted for edgewise movement forwardly through the slipstream of the airplane when the latter is in flight, said muffler comprising a single hollow longitudinally tapered tubular metal shell of symmetrical airfoil configuration, defining an internal expansion chamber for exhaust gases and having a top wall which is arched upwardly in airfoil fashion, a bottom wall which is arched downwardly in airfoil fashion, and inner and outer end walls of tear drop outline substantially closing the opposite ends of the tubular shell, there being an inlet opening in said inner end wall and a series of outlet openings in each of said top and bottom walls, an adapter plate having a slot extending transversely therethrough, means releasably securing said muffler and adapter plate to the cylinder with the tubular muffler shell projecting radially from the cylinder and the adapter plate in-

terposed between said inner end wall and the cylinder so that said slot establishes sealed communication between said exhaust port and the inlet openings said outlet openings being disposed in the trailing airfoil regions of their respective arched walls and entirely inwardly of the arch crests to the end that they will communicate directly with the vacuum pockets which are created by the airfoil arches incident to forward movement of the airplane and consequent passage of the muffler edgewise through the slipstream of air generated by such forward movement.

11. The combination set forth in claim 10, wherein the rim region of said elongated slot in the adapter plate is recessed to provide a pilot socket into which the outer end of said tubular extension of the cylinder projects and within which it seats, and the side of the adapter plate which opposes the muffler is planar and fits flush against said end wall in face-to-face sealing relationship.

12. The combination with a model airplane having an engine provided with a horizontally disposed cylinder form which there projects downwardly and radially a tubular extension defining an exhaust port of elongated design and which produces a high sound level by pressure pulses of shock wave severity, of an airfoil muffler for reducing the severity of said shock waves and consequently the sound level, said muffler comprising a single, hollow, longitudinally tapered tubular metal shell of symmetrical airfoil configuration, defining an internal expansion chamber for exhaust gases and having a top wall which is arched upwardly in airfoil fashion, a bottom wall which is arched downwardly in airfoil fashion, and inner and outer end walls of tear drop outline substantially closing the opposite ends of the tubular shell, there being at least one outlet opening in each of said top and bottom walls, the inner end region of said muffler closely underlying said cylinder with the longitudinal axes of the muffler and cylinder extending in parallelism and the outer end region of the muffler projecting longitudinally beyond the cylinder, and an L-shaped manifold having a vertical leg secured to the cylinder and a horizontal leg secured to the end wall of the muffler and provided with an internal passage which establishes communication between said exhaust port and the inlet opening in said inner end wall of the muffler.

13. The combination set forth in claim 12, including additionally an adapter plate interposed between the vertical leg of said manifold and said tubular extension on the cylinder, said adapter plate being provided with an elongated slot which extends transversely therethrough, the upper side of said adapter plate being provided with a shallow recess which extends around the rim region of said slot and into which the outer end of the tubular extension projects in seated relationship.

14. The combination set forth in claim 13 wherein the internal passage in the adapter plate is of L-shape configuration.

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