Aug. 15, 1967 T. R. KELLEY 3,335,813

INSERT MUFFLER

Filed June 2, 1966

Fig. 1

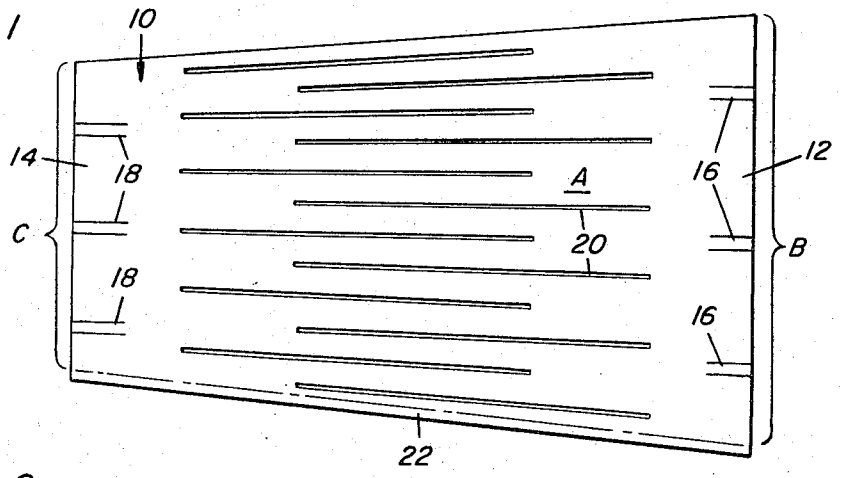


Fig. 2

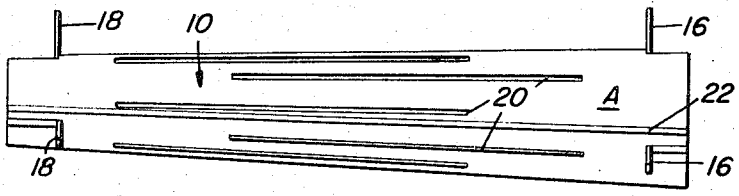
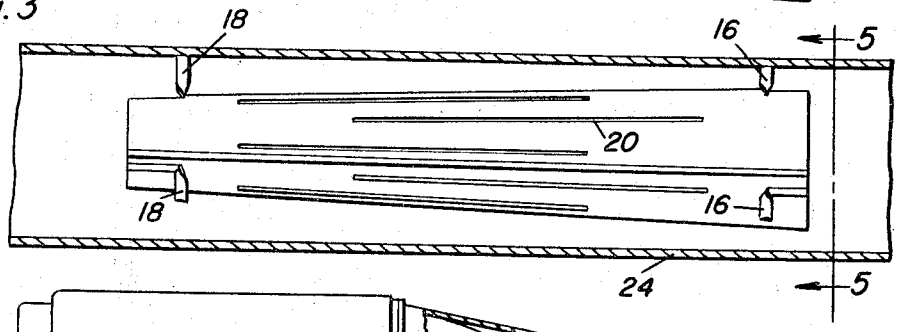


Fig. 3



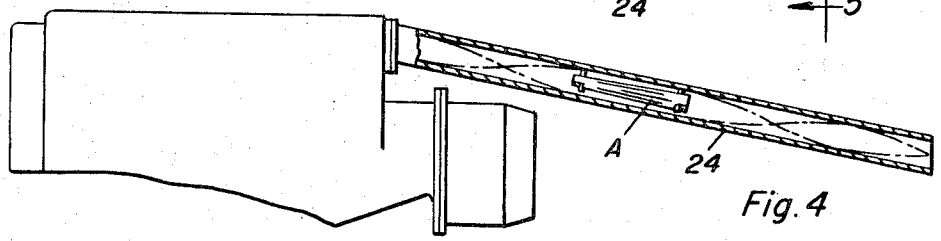
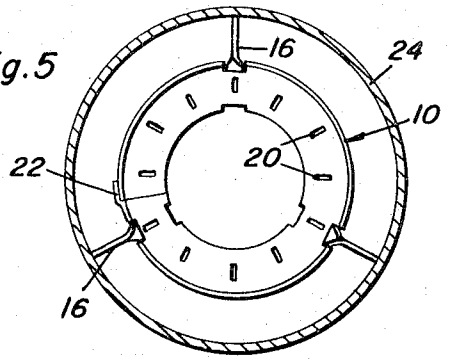


Fig. 4

Fig. 5



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3,335,813

INSERT MUFFLER

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The invention disclosed herein relates to a muffler for reduction of the noise caused by the operation of an internal combustion engine, and more particularly, to a muffler which is entirely receivable within the exhaust or tail pipe, and may be installed by merely inserting it into the pipe whereupon it becomes self-locking in position.

So far as applicant is aware, a muffler of this type has not heretofore been available. Because of this, it has been common practice, particularly in marine installations or small craft where the tail pipe is from two to four inches in diameter, to omit mufflers. When the muffler is omitted, sound reduction is accomplished, to some extent, by the discharge of cold water through the exhaust or tail pipe. The cold water contracts the exhaust gases by absorbing the heat, thereby reducing the volume and the resultant noise. Although mufflers have been used, there is a reluctance to do so because of the increase of back pressure on the engine. Additionally, the type of mufflers presently available have required special and costly installation, and present an added space and weight requirement.

The muffler disclosed herein overcomes the objections set forth above, in that it is entirely receivable within the tail pipe, thus eliminating the space problem; it is self-locking in position, thus eliminating the provision of any securing means and avoiding the necessity of cutting or otherwise changing the tail pipe; it is extremely light in weight and inasmuch as securing means are avoided the weight problem is reduced to a minimum; and it is so constructed and designed that a substantially straight flow of the fluids through the tail pipe, whether they be gases or water, or a combination of both, is permitted with a minimum of turbulence and thus any appreciable increase in the back pressure is eliminated. Inasmuch as the muffler is installed by merely inserting it through the open end of the exhaust pipe, it may be readily moved forward or aft as necessary to obtain the best noise reduction.

In addition to the above advantages, the muffler may be fabricated in flat, sheet form, and shipped in this form, and readily rolled into final shape at the point of installation. The resultant reduction in shipping costs, storage space, and handling, makes it possible to market the muffler at a relatively low cost.

The foregoing and other objects and advantages will become apparent from the description of the muffler herein, when read in view of the accompanying drawings wherein:

FIGURE 1 is a view of the muffler, in what may be termed its blank form, and as fabricated from sheet material;

FIGURE 2 is a view of the muffler blank of FIGURE 1, rolled into frustoconical shape and ready for installation in a tail pipe;

FIGURES 3 and 4 show the muffler as installed in a tail pipe; and

FIGURE 5 is a view taken on the line 5—5 of FIGURE 3.

Referring to the drawings, wherein like parts are given like numbers, the muffler A is a blank of light gauge sheet material **10**, preferably of stainless steel. The blank **10** is in the form of an isosceles trapezoid having a base **12** the length of which is designated by B and a smaller base **14** the length of which is designated by C. At the base **12** a plurality of positioning and locking tabs or

fingers **16** are provided, by simply slitting the material to the desired depth. At the base **14** a plurality of positioning tabs or fingers **18** are formed by slitting the material to the desired depth. As seen in FIGS. 2 and 3, the tabs **16** and **18** are bent outwardly at substantially 90° to the blank **10** and then twisted so that their outer ends are at approximately right angles to the base lines of the blank **10**. The tabs **16** and **18** are so positioned that when the blank is rolled into frustoconical form as shown in FIGS. 2 and 3, the fingers are equiangularly apart circumferentially of the muffler. In the embodiment disclosed, they are 120° apart, it having been found in smaller size mufflers that three fingers are sufficient to position and lock the muffler in position, although in some larger size mufflers, four or more fingers may be required.

It should be noted that the length of the spring fingers **16** and **18** when extended is different. The length of the fingers at the respective ends is such that two finger lengths plus the diameter of the muffler at the point of bend lie within an imaginary circumscribed circle substantially equal to the inner diameter of the tail pipe in which the muffler is to be installed. The foregoing can readily be seen with reference to the spring fingers **16** in FIG. 5.

The blank **10** is further provided with a plurality of longitudinally extending slits **20** equally spaced transversely of the blank. The total area of the slits must be approximately not less than the cross-sectional area of the exhaust pipe in which the muffler is to be received; that is, the area of the circle drawn to include the extended spring fingers **16, 18**. It is also necessary that the height of the trapezoid be such that sufficient metal is between the slits to prevent a vibration as the gases flow therethrough. It is likewise desirable that the muffler be of sufficient length so that it may be readily positioned and extend for a substantial length in the anti-node area of sound pulsation, as hereinafter explained. To accomplish the foregoing and to obtain the most desired results, it has been found that the length of the muffler should be approximately four times the diameter of the tube into which it is to be inserted.

From the foregoing it will be seen that when the muffler is rolled into the frustoconical shape in which it is inserted into the tail pipe, and as seen in FIGS. 2, 3 and 5, the muffler has its axial center positioned along the axial center of the tail pipe and the slits **20** also extend axially, and are also equiangularly spaced around the axial center. When so positioned, it will be seen that the axial flow of the fluids through the tail pipe continues along and through the muffler. The spring fingers **16** and **18** so position the muffler as to allow an uninterrupted flow path equivalent to the spacing between the large end of the muffler and the tail pipe, a substantially uninterrupted flow equal to the path defined by the smaller diameter of the muffler, and the laminar flow of the gases along the surface passes over the slits, permitting a flow therethrough. As the area of the slits is substantially not less than the cross-sectional area of the pipe, the muffler offers substantially no resistance to the flow of the fluid or fluids, and an increase in back pressure of any appreciable amount is avoided.

As previously described, one base for the circumference of the muffler is defined by B and the other by C, and it will be seen in FIG. 1 that there is added an overlap **22** to close off the slit which might otherwise exist if the exact circumference were used. Also, as stated, the muffler is preferably made of stainless steel sheet having a light gauge and which, when rolled, will have an inherent spring-back tending to unroll. With the construction shown it will be apparent that the blank **10** may be rolled to the shape shown in FIG. 2 where, because of the convolute winding, the spring fingers will define a lesser diameter than that of the pipe into which it is to be inserted. It may then be secured in this position by

clamps on the end of any type of tool having releasable clamp ends and a sufficiently long handle to insert the muffler into the tail pipe to the position best desired. When so positioned, the convolute winding may be released by releasing the clamps whereupon the metal will spring back and the spring fingers engage the interior surface of the tail pipe and position and spring lock the muffler in place. Adjustment fore and aft can readily be obtained because the metal will permit sufficient movement of the spring fingers to allow it. Literature on the subject indicates that the sound pattern in the tail or exhaust pipe is that indicated by the sinusoidal bent lines shown in FIG. 4. The intersecting points are the regions of minimum pressure changes or nodes, and the maximum divergents thereof are the areas of maximum pressure changes or anti-nodes. The maximum pressure changes or anti-nodes occur at the engine gas entrance to the tail pipe and approximately two-fifths and four-fifths of the length of the pipe from the gas entrance end. A muffler is most effective when located at an anti-node, and preferably, as close to the source of exhaust as possible. For this reason, the best position should be at two-fifths of the length of the pipe, and as previously stated, the muffler should be of sufficient length to span the area of maximum pressure. If desired, two or more mufflers may be used, and one of the advantages of the present muffler is that it has been found that it is immaterial as to whether the large or small open end is placed nearer the engine; in other words, the muffler may be turned end-for-end, and thus error of installation is avoided.

As a specific example, if the muffler is to be installed in a two inch tail pipe, it would preferably be fabricated from stainless sheet having a gauge of from .02 to .025. The dimension B would be 4.71 inches thus providing a diameter at the larger end which is approximately 75% of the diameter of the two inch tail pipe. The dimension C would be 3.141 inches thus providing a diameter at the small end of the muffler of approximately 50% of the diameter of the two inch tail pipe. The overlap **22** should be approximately 10% of the larger diameter.

As previously stated, the area of the slits should equal the cross-sectional area of the exhaust pipe which, for the two inch pipe, would be 3.1416 inches. As best results are obtained with extremely narrow slits, the slits are made one-sixteenth of an inch wide. Thus to obtain the area, a single slit would be of necessity 60 inches long, which readily permits the provision of twelve slits each 5 inches long, as shown, or there could be ten slits 6 inches long, it again being desirable that the slits either extend substantially the full length of the muffler or be of such length that the inner end of each slit extends beyond the inner end of an adjacent slit, so that the muffler body does not have a closed circumferential section, similar to a closed conduit, except adjacent the ends thereof.

As the diameter of the tail pipe increases, the width of the slits may be increased 1/16 of an inch for each such increase in diameter up to 1/8 of an inch for a four inch circumference. Beyond this, it is preferable to provide more slits, rather than increase their width, as there is sufficient body material to prevent vibration. The gauge of the blank may also be increased .005 for each inch increase in diameter up to four inches.

It is thus seen that in the preferred embodiment the larger end diameter approximates 75% of the diameter of the tail pipe, and the smaller end diameter 50% of the diameter of the tail pipe, and with the ends of all the positioning fingers circumscribing an imaginary circle approximating the circumference or the diameter of the tail pipe in which the muffler is to be installed. The length of the muffler should be about four times the diameter of the tail pipe, and the narrow slits have an area approximating the cross-sectional area of the tail pipe. The slits should be equiangularly spaced with relation to the axial center of the muffler and preferably not more than 40° apart.

The figures given are for the preferred embodiment and may be varied, within the limits of back pressure and sound increase.

The muffler blanks **10** may be shipped flat and then formed at the point of installation. Shipping costs and storage space are thus reduced to a minimum. Additionally, spare mufflers may readily be carried aboard. It is also apparent that at the point of installation the overlap could be removed and the body welded along the seam. If this be done, it is only necessary for spring fingers to be radially bent in one direction to have an edge just frictionally engaging the inner surface of the tail pipe, whereupon little resistance is offered to longitudinal movement but when inserted to proper position, rotation in the direction of the bend will cause the fingers to resist the rotation and move to locking position.

The invention having been described, the claims hereof define the patentable and equivalent subject matter.

I claim:

1. A muffler having a frustoconical body, a plurality of positioning fingers extending radially outwardly from each end of the body, the outer ends of the fingers at both ends all lying within an imaginary circle having a like diameter circumscribed around the ends of the fingers, the diameter of the circle being greater than the larger diameter of the body, said body having a plurality of narrow slits extending longitudinally thereof and equiangularly spaced around the body relative to the axial center thereof, the area of the slits approximating the cross-sectional area of the imaginary circle.

2. A muffler as defined in claim **1** wherein the frustoconical body is a convolutely wound isosceles trapezoid blank of sheet metal and said positioning fingers are integral with the body and bent radially therefrom.

3. A muffler as defined in claim **2** wherein longitudinal edges of the body overlap and the sheet metal has an inherent spring-back characteristic.

4. A muffler as defined in claim **2** wherein the diameter of the larger end of the body is 75% of the diameter of the imaginary circle and the diameter of the smaller end of the body is 50% of the diameter of the imaginary circle.

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