Dec. 7, 1965 F. L. KLEINIG 3,221,836

MUFFLER ARTICLE AND METHOD OF CASTING SAME

Filed March 4, 1964 2 Sheets-Sheet 1

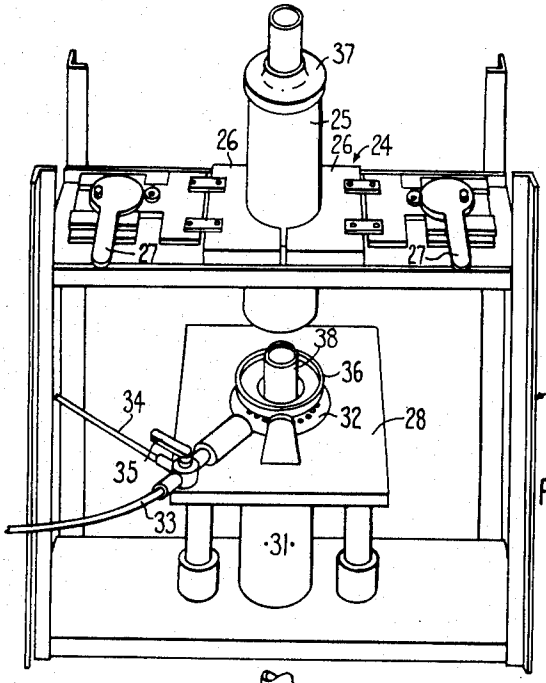

FIG. 1

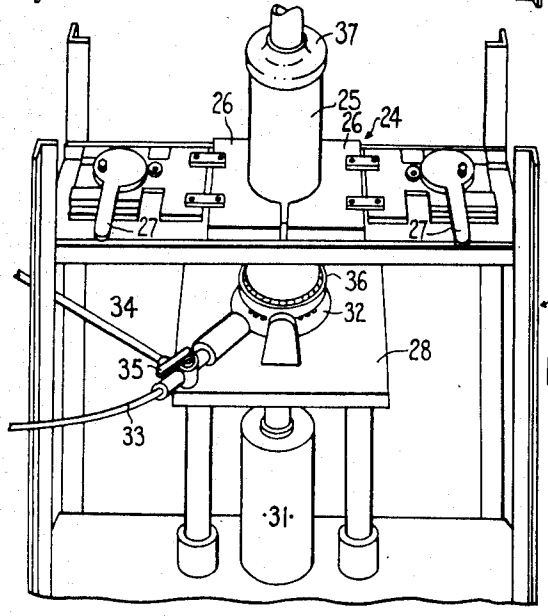

FIG. 2

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MUFFLER ARTICLE AND METHOD OF CASTING SAME

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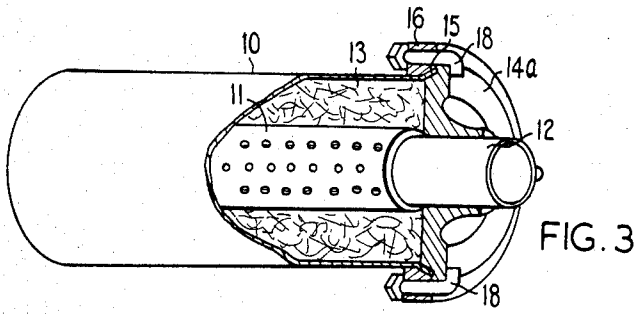

FIG. 3

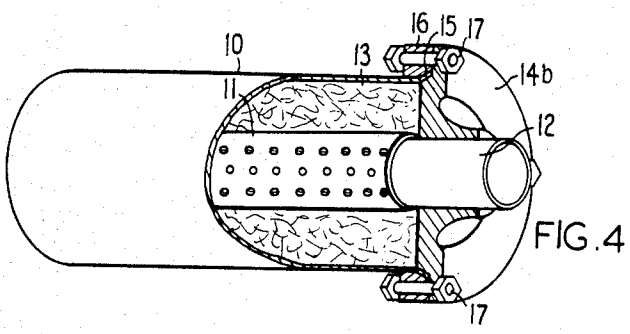

FIG. 4

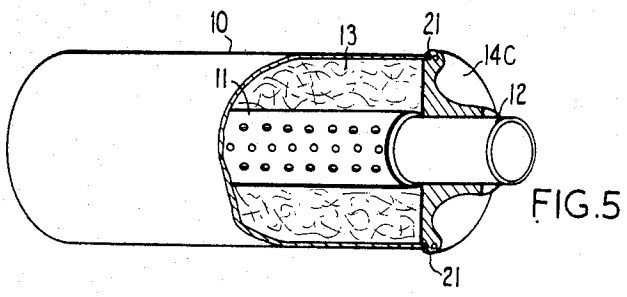

FIG. 5

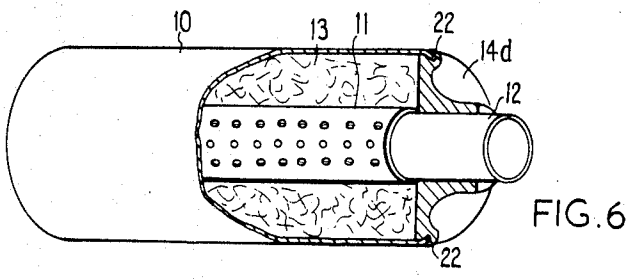

FIG. 6

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MUFFLER ARTICLE AND METHOD OF CASTING SAME

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7 Claims. (Cl. 181—61)

The present invention relates to silencers for motor vehicles and to a method of making silencers.

The object of the invention is to provide a silencer which is particularly durable and effective in use and a method by which certain forms of the invention can be manufactured easily and economically.

At the present time all silencers in normal commercial use are made from mild steel sheet material, the sheet being rolled into cylindrical form and end covers attached to the cylinder so formed. While such silencers are effective, their life is short owing to the fairly rapid deterioration of mild steel by rusting. The use of other materials such as aluminium or stainless steel presents certain economic and manufacturing difficulties one of which is the provision of a cheap and effective means for forming and attaching end covers to a silencer.

The present invention provides a construction and a method of manufacture for silencers which assists in overcoming this particular difficulty.

The invention consists in a silencer for a motor vehicle having a tubular body of corrosion resistant sheet metal such as aluminium or stainless steel and end covers made by casting from aluminium, each end cover being secured to one end of the tubular body and having set in it an end pipe, the end pipe having been set in position during the casting of the end cover or having been pressed into it after casting.

The end covers may be secured to the body by means of bolts arranged around the periphery of the cover and passing through a ring surrounding the end of the body, the end portion of the body being clamped between the end cover and the ring. In an alternative arrangement the end cover may be secured to the body by casting it around the end of the body. The term "casting" is to be taken to include the process defined in the next succeeding paragraph.

The invention also consists in a method of making a silencer including the steps of forming an inwardly flared flange or a plurality of radial holes at one end of a tubular body for a silencer or otherwise treating the end to form a key with an end cover, melting aluminium in an open mould corresponding in shape to the end cover after setting an end tube in the mould so that it projects on either side thereof, holding the body in a vertical position over the mould, offering the mould up to the body to immerse the end of the body in the molten aluminium and thereafter cooling the mould to cause the aluminium to solidify.

In order that the invention may be better understood and put into practice, preferred forms thereof are hereinafter described, by way of example, with reference to the accompanying drawings in which:

FIGS. 1 and 2 are perspective views illustrating the method of making silencers according to the invention and

FIGS. 3 to 6 are part-sectional perspective views of the end portions of silencers showing different ways in which an end cover may be attached to a silencer.

Considering FIGURES 3 to 6 firstly, in each figure **10** denotes the cylindrical body of the silencer which

is formed preferably from aluminium sheet, although other corrosion resistant materials such as stainless steel may be used.

Down the centre of the aluminium tube **10** extends a tube **11** the wall of which is perforated with a considerable number of holes. This perforated tube **11** is aligned with and connected to the short length of end tube **12** at each end of the silencer so that the exhaust gases pass straight through the silencer. The space **13** between the inner perforated tube **11** and the outer aluminium tube **10** is packed with a fibre glass which is preferably in the form of a batt or strip which is applied around the inner perforated tube. As is well known, the arrangement described has a silencing effect by the absorption of sound waves in the fibre glass through the holes in the inner perforated tube.

In FIG. 4 to the end of the tube **10** there is attached an end cover **14*b*** in the form of an aluminium casting around the circumference of which are formed a number of bolt holes. The end cover **14*b*** is formed with a spigot having an external frusto conical face which just fits within a flared portion **15** on the end of the aluminium tube **10**. It is secured to the tube by means of a ring **16** of similar material having an internal annular frusto conical face which corresponds to the external surface of the flared portion **15** at the end of the tube **10**. This ring **16** is also provided with holes around its periphery corresponding to those in the end cover, bolts **17** are passed through those holes and the ring and the end cover are bolted together to grip the flared end of the aluminium tube **10** between them.

In FIG. 3 the construction is very much the same as that shown in FIG. 4 except that the end cover **14*a*** is held in position by hook bolts **18** in place of the bolts **17**.

In the centre of each end cover **14*a*** or **14*b*** is formed a hole into which is pressed a short length of steel end tube **12** which is arranged to project to a sufficient distance from the outer face of the end cover to enable the exhaust pipe from the engine of the vehicle, or the tail pipe of the exhaust system as the case may be, to be attached to the silencer in a conventional manner. The relative diameters of the end tube and the hole in the end cover are chosen so that when the silencer reaches its normal operating temperature the tube is still a tight fit in the hole of the end cover. The end tube **12** may be set in position in the mould during the casting of the end cover so that on cooling the end tube is set firmly in place.

While the constructions shown in FIGS. 3 and 4 provide a satisfactory means of attaching the end covers and while these constructions have the advantage that the end covers may be removed from the silencer, the constructions shown in FIGS. 5 and 6 are to be preferred on the grounds of low cost, ease of manufacture and neatness of appearance. In practice a silencer may be constructed having one fixed end such as is shown in FIGS. 5 and 6 and one removable end as is shown in FIGS. 3 and 4. This enables the silencer to be repacked from time to time.

In FIGS. 5 and 6 end covers **14*c*** and **14*d*** are attached to the end of the aluminium tube **10** by the method described below with reference to FIGS. 1 and 2. The only difference between the two constructions is that whereas in FIG. 5 a plurality of radial holes **21** are formed in the end of the tube **10** to provide a key for the material of the end cover **14*c*** in FIG. 6 the end **22** of the tube **10** is flared inwardly for the same purpose. It will be appreciated that the end of the tube **10** may be treated in a number of other ways to form a key with the end cover.

In each of FIGS. 3 to 6 the end of the silencer not shown may be of the same construction as the end shown or of any of the constructions shown in the other figures.

Silencers made as described above are very simple to make and by the use of an external aluminium tube are very durable as aluminium does not rust in the same way as steel.

These constructions may be varied in a number of ways. For example the silencing properties may be improved by omitting a portion of the fibre glass packing **13** from the central portion of the silencer and also by surrounding the outer aluminium tube by a corrugated sleeve of aluminium which tends to damp out resonances which might otherwise occur at certain speeds.

Where it is necessary to use an outer aluminium tube of relatively large diameter, it may be found convenient for purposes of installation to manipulate the central portion of the tube to convert it from a circular to an oval cross-section. It is also possible to form the whole tube so that it is of oval cross-section, the end covers in the case of FIGS. 3 and 4 being turned or ground on a suitable lathe so as to provide oval surfaces corresponding to the frusto conical surfaces formed on the circular end covers.

Where the aluminium tube is of oval cross-section, the construction of the silencer may be modified by forming the hole in each end piece off-centre, the hole at each end being on either side of the axis of the silencer. A perforated tube is attached to each end of the silencer and is led to a central compartment at the middle of the silencer. In such an arrangement the gases cannot flow straight through the silencer but must move laterally within the compartment from one perforated tube to the other.

A variety of other modifications of the details of construction are possible, for example the perforated tube **11** may be formed by rolling a sheet of perforated material to form a scroll so that in effect a tube having a number of layers is formed and this is found to give improved silencing qualities to the silencer. Other modifications will occur readily to those skilled in the art.

The method of making silencers having end covers attached in the manner shown in FIGS. 5 and 6 is illustrated in FIGS. 1 and 2. In these figures a framework **23** is used to support a clamp **24** by means of which the body **25** of a silencer may be held in a vertical position. The clamp **24** consists of a pair of jaws **26** shaped to fit around the body **25** of a silencer and which may be moved laterally by levers **27** into and out of a clamping position. It will be obvious that any conventional clamping means may be used for the purpose and it is therefore not proposed to describe it in further detail.

The framework **23** also supports a platform **28** which may be lowered by a hydraulic ram **31**. It is shown lowered in FIG. 1 and raised in FIG. 2.

A gas ring **32** rests on the platform **28** and this may be connected by pipe **33** to a gas supply or by pipe **34** to a supply of compressed air by means of the cock **35**.

A mould or die **36**, the internal shape of which corresponds with the external shape of the end cover **37** is supported above the gas ring **32**. The mould **36** has a central hole into which an end pipe **38** is a push fit.

The apparatus is used in the following manner. The tubular body **25** of a silencer is treated at each end in a manner such as is described in connection with FIGS. 5 and 6 to form a key with an end cover. It is preferably packed with fibre glass and fitted with a central perforated tube before an end cover is fitted although one end cover may be fitted before this is done. The body **25** is then set in the clamp **24** in the position shown in FIG. 1. An end tube **38** is then passed through the central hole in the mould to project on either side of the mould. It will be seen that the end tube in effect forms a part of the mould.

The mould **36** is then heated by means of a gas flame from the gas ring **32** and the mould is filled with molten aluminium which is maintained in this condition by heat from the gas flame. The platform **28** is then raised by means of the hydraulic jack **31** to offer the mould **36** up to the end of the silencer body **25**. When the end of the body is immersed to the correct depth, movement of the platform is stopped, the cock **35** is used to cut off the supply of gas to the gas ring and to substitute for it a blast of compressed air which quickly cools the mould **36** and causes the aluminium to solidify. The silencer body **25** with the end cover **37** and end tube **38** attached may then be removed from the apparatus. After one end cover has been affixed the other may then be attached by simply reversing the position of the body in the clamp **24** and repeating the operation.

When the mould is offered up to the silencer body **25** the end tube **38** fits within the inner perforated tube (reference **11** in FIGS. 3 to 6) and if desired the length of this latter tube may be such that it projects into the mould **36** and is then also cast into the end cover.

The method described above provides a very simple and inexpensive means of applying end covers to the body of a silencer having an aluminium tubular body or a tubular body of other corrosion resistant material.

Whenever in FIGS. 1 and 2 the mould **36** is shown as being circular the method is equally well applicable to silencers of oval cross-section, it being only necessary to make a mould of suitable shape.

What I claim is:

1. A method of making a silencer for a motor vehicle having a tubular body, an end cover and an end tube extending through said cover including the steps of forming a tubular sheet metal body; deforming an end portion thereof in a substantially transverse direction to form a key for subsequent connection to the end cover; supporting said tubular body vertically with the deformed end downwardly over but spaced from the cavity of an open mold corresponding in shape to the end cover and having a substantially vertical opening extending therethrough; supporting an end tube substantially vertically in the opening of the mold so as to extend at least partially into the cavity thereof; heating a batch of metal in the cavity of the open mold around the end tube supported therein so as to melt the batch of metal forming a stagnant bath of molten metal surrounding the end tube; changing the vertical distance between the deformed end of the tubular body and the mold so as to immerse the deformed end in the molten metal surrounding the end tube; and cooling the molten metal to solidfy the same into binding engagement with the end tube and the deformed end portion of the tubular body.

2. A method as set forth in claim **1** wherein said step of deforming the end portion of the tubular body includes flaring the end portion so that at least a part thereof extends substantially transversely to said tubular body.

3. A method as set forth in claim **1** wherein said step of deforming includes the step of forming the end portion with holes extending transversely therethrough.

4. A method as set forth in claim **1** wherein said step of cooling the molten metal comprises directing blasts of compressed air against the exterior of the mold.

5. A method as set forth in claim **1** including the steps of fixedly supporting the tubular body and moving the mold containing the molten metal together with the end tube supported therein upwardly toward the tubular body until the deformed end of the latter is immersed in the molten metal.

6. A method of making a silencer for a motor vehicle having a tubular body, an end cover and an end tube extending through said cover including the steps of forming a tubular body with a flared flange at one end to form a key with the end cover; supporting an end tube vertically in an open mold having a mold cavity corresponding

in shape to the end cover in such a manner that the end tube projects at least partially into the mold cavity; melting aluminum in the cavity of the open mold; supporting the tubular body in a vertical position over the molten aluminum; changing the relative vertical position between the mold and the tubular body so as to immerse the end portion of the tubular body in the molten aluminum; and thereafter cooling the molten aluminum to cause the same to solidify and tightly adhere both to the portion of the end tube located within the mold cavity and to the end portion of the tubular body surrounding the same.

7. A silencer for a motor vehicle comprising a tubular body of corrosion resistant sheet metal; an end tube extending substantially axially into the interior of said tubular body and spaced from the wall thereof, said tubular body having an end portion surrounding at least a part of said end tube and including an interior and an exterior surface portion; and an aluminum end cover cast around said end tube and into binding engagement with both said interior and said exterior surface portions of said end portion of said tubular body so that said end tube is fixed relative to said tubular body and provides a passage through said end cover.

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