June 11, 1963 E. E. HOWE 3,093,208

COMPOSITE COATED MUFFLER AND METHOD OF MAKING THE SAME

Filed Nov. 17, 1960 2 Sheets-Sheet 1

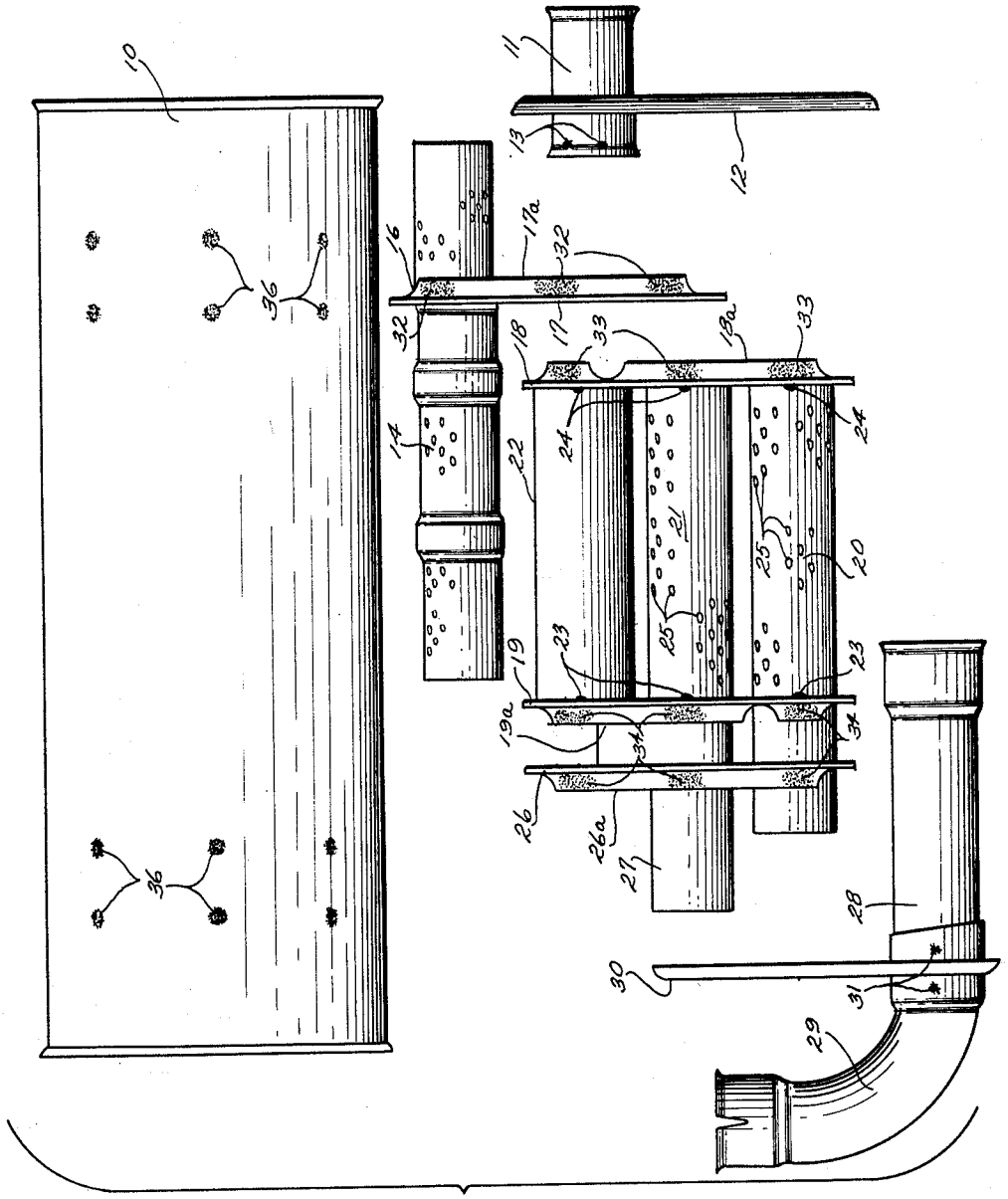

FIG. 1

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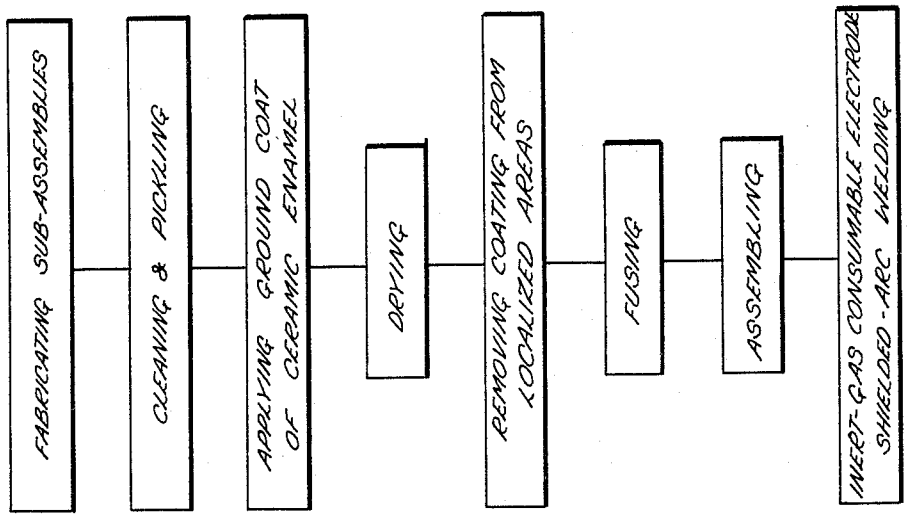

FIG. 2

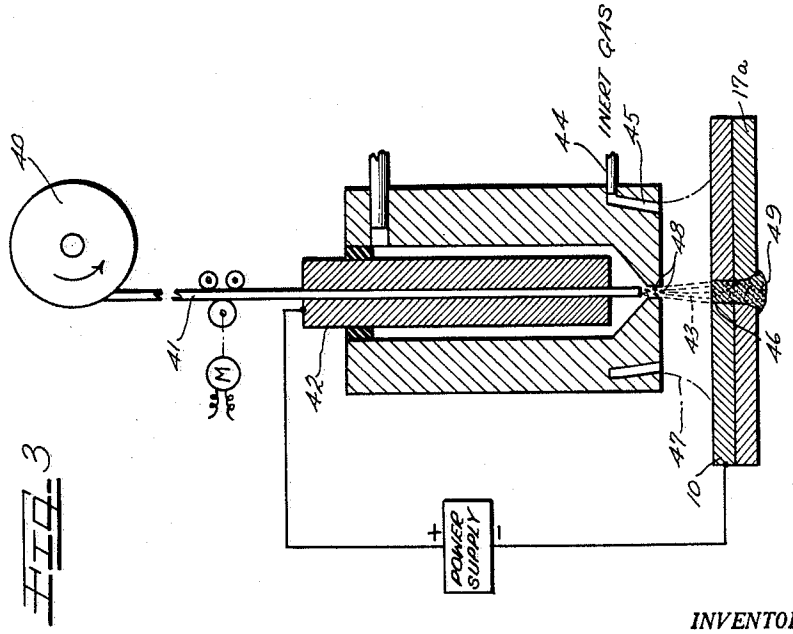

FIG. 3

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COMPOSITE COATED MUFFLER AND METHOD OF MAKING THE SAME

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This invention relates generally to a composite coated article and a method of making the same and more particularly to a porcelainized fabricated composite assembly such as an exhaust muffler for an internal combustion engine.

Exhaust mufflers are usually modifications of an elementary low-pass acoustical filter comprising a through tube to which closed cavities are coupled through small holes at intervals along the tube.

To be efficient as a sound silencer, an exhaust muffler must decrease the exhaust gas velocity and must also absorb the sound waves or cancel the sound waves by interference with other waves from the same source. For example, a sound wave may be broken into two parts which follow different paths and meet again out of phase before leaving the muffler.

Contemporary muffler constructions usually comprise a shell or can housing in which is contained a baffle means forming a plurality of closed cavities and through which extends a tubular multiple path passage. The shell or can housing preferably has a volume six to eight times the piston displacement of the internal combustion engine with which the muffler may be associated. Either the baffle or the tubular elements, or both, may be provided with holes.

Because of condensation which occurs within the interior of the muffler assembly, the combustion products of the exhaust gases frequently go into solution with such condensation and form acids which have a highly destructive effect on the muffler construction. For that reason, mufflers have heretofore been considered an expandable article of manufacture, particularly in the automotive industry where it has not been uncommon for a muffler to be replaced at frequent recurring intervals.

In order to avoid the trouble and expense of replacing mufflers, it has been proposed to provide a ceramic enamel coating for the muffler construction. As is well known, porcelain enamel is a ceramic enamel constituting a thin layer of glass fused to a metal. Such coating is particularly useful in the prevention of corrosion and has been widely in the appliance industry for enhancing the attractiveness and appearance of fabricated articles. The hard glossy surface of porcelain enamel resists solution, corrosion and scratching. Moreover, the metal backing of a porcelainized article provides strength and resistance to damage.

In attempting to apply the art of porcelain enameling to muffler constructions, attempts have been made to coat the completely fabricated muffler apparatus. One particularly troublesome problem is the avoidance of blind spots since the effectiveness of the coating is directly related to the continuity of the coating surface on all surfaces of the muffler which are exposed to the corrosive gases and fluids.

Furthermore, the ceramic coating of a fabricated muffler assembly is complicated by the necessity of draining from the various compartments within the muffler either the solution used for cleaning and pickling the assembly or the suspension constituting the ground coat of frit with clay in water.

Some of the specific problems which are presented in connection with the porcelainizing of a muffler construction involve the plugging of the holes formed in the baffles or the tubular components within the interior of the muffler shell. It is also desirable to avoid the formation of concentrated globs of material.

In attempting to meet such problems, additional drainage holes have been employed and it has also been proposed to use additional drainage tubes which are subsequently plugged before the muffler constitutes a completed article.

It is also particularly difficult to properly fuse the coating on the muffler components because of the uneven heating which occurs within the muffler construction upon subjecting the same to a temperature sufficiently high to accomplish fusion.

It is an object of the present invention, therefore, to provide a porcelainized fabricated composite assembly which overcomes all of the deficiencies of the prior art.

Another object of the present invention is to provide an improved porcelainized muffler construction.

Yet another object of the present invention is to provide an improved process of ceramic coating a composite coated article.

Still another object of the present invention is to combine a porcelainizing procedure with a welding procedure and thereby effect a novel method of fabricating composite coated articles.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings in which a preferred structural embodiment of an exhaust muffler is illustrated and in which an exemplary form of inert-gas consumable-electrode, shielded-arc welding technique is illustrated and by means of which the advantages of the present invention may be obtained.

On the drawings:

FIGURE 1 is an exploded view of an exhaust muffler for an internal combustion engine embodying the principles of the present invention;

FIGURE 2 is a flow chart identifying the principal steps involved in the fabrication method of the present invention, and

FIGURE 3 is a somewhat schematic view illustrating the structures and principles involved in the use of an inert-gas consumable-electrode, shielded-arc welding technique.

As shown on the drawings:

The principles of the present invention are generally applicable to the fabrication of any composite coated article and the method of making the same; however, the principles of the present invention find a particularly useful application in connection with the manufacture of exhaust mufflers for internal combustion engines.

As shown in FIGURE 1, the muffler construction of the present invention may conveniently comprise a can housing or shell shown generally at **10**, in which the various baffles and tubular members may be assembled to form the completed muffler assembly. Thus, there is provided an outlet neck **11** which is assembled to a rear head **12** and is retained in firm assembly therewith by a plurality of circumferentially spaced spot welds as at **13**.

A second subassembly is constituted by an outlet tube **14**. The outlet tube **14** is spot welded as at **16** to a small cartridge head **17** flanged as at **17*a***.

Yet another subassembly is formed by a baffle **18** and a baffle **19** spaced longitudinally and firmly assembled into an assembly unit with an inlet tube **20**, a return tube **21** and a tube **22**. The baffles are flanged as at **18*a*** and **19*a***. When assembled into the shell of a muffler, the baffles partition the interior of the shell into separate compartments or cavities to which the tubes are coupled

by small holes **25** formed at intervals along the length thereof.

The various tubes and baffles **18–22** are assembled together by spot welds on the respective ends of the subassembly as shown at **23** and **24**.

Another subassembly which is associated with the subassembly **18–24** is provided by a baffle **26** flanged as at **26***a* to which is connected a tuning tube **27**.

Finally, there is provided an inlet tube **28**, a bent inlet neck **29** and a front head **30** all of which are connected with one another by spot welding as at **31**.

In accordance with the principles of the present invention, each of the five subassemblies (which of course are exemplary insofar as muffler constructions are concerned) are individually prefabricated, for example, from sheet metal stock, as is the shell **10**. After prefabricating, each respective subassembly is coated with a ceramic enamel.

The process of porcelain enameling is well known since it has developed from an early art to a full scale industry. As commonly practiced in the United States, articles fabricated from sheet metal are subjected to a cleaning and pickling process which prepares the surface for enameling. Thereafter a ground coat may be applied by so-called wet process which involves the application of the ground coat through dipping or sprinkling of a suspension of frit with clay in water. The ground coat may contain a small percentage of cobalt to give it improved adherence. The coated article is then dried and is subsequently fused by firing, for example, in a furnace at about 830° C. An additional coat, or coats, may be applied by repeating the process.

Such a process of porcelain enameling can be separately practiced with each of the subassemblies and the muffler shell as described in connection with FIGURE 1. For example, each part or subassembly is separately dipped into a cleaning and pickling bath. Thereafter, a ground coat of ceramic enamel is applied by separately dipping each part or subassembly into a suspension containing frit. The coated article or subassembly is then dried and is subsequently fired, for example, in a furnace at about 830° C.

In accordance with the principles of the present invention, there is practiced a special step between the drying and fusing steps, namely, the removal of the ground coat from a plurality of assembly related localized bonding or joint areas. For example, note that on the cartridge head **17** there is shown a plurality of coating free areas **32** on the flange **17***a*. Likewise, on the baffle **18** there is provided a plurality of coating-free areas **33** at the flange **18***a*. On the baffles **19** and **26** the coating-free areas are shown at **34** on the flanges **19***a* and **26***a*.

On the external peripheral surface of the shell **10**, a corresponding plurality of areas are freed of coating as at **36**. The entire inner surface of the shell **10** remains undisturbed and likewise, the inner surfaces of the cartridge head **17** and the baffles **18**, **19** and **26** remain undisturbed.

In order to remove the ground coat, a simple brushing operation may be utilized at the localized areas thereby to remove the dried ground coat at the places specified. Since each part or subassembly is separately fused, good heat distribution is effected and the fusing operation is greatly simplified. There are thus formed precoated parts and subassemblies. Furthermore, each individual part or subassembly may be separately inspected prior to assembly. If a bad part is detected, for example, a part which is improperly coated, it is immediately detected and a new part can be furnished, thereby precluding loss of an entire muffler.

Note also that the tubular parts such as the parts **20**, **21** and **14** which are made foraminous or are provided with apertures such as the holes **25** are uniformly coated without plugging the holes or apertures **25**. Where a completely assembled muffler is subjected to a dipping operation, the holes or apertures may sometimes be closed by bridging, however, the practice of the present invention insures continuity of coating surface without filling of the holes or apertures **25** by bridging or by concentrations of coating material.

The precoated prefabricated parts or subassemblies of the muffler of the present invention may also be conveniently characterized by the formation of baffle flanges **17***a*, **18***a*, **19***a* and **26***a* extending in a common direction to facilitate insertion assembly within the shell. In the exemplary construction herein described, the flanges **19***a* and **26***a* of the baffles **19** and **26** are aligned interiorly adjacent the localized areas **36** of the shell **10** while the flanges **17***a* and **18***a* of the cartridge head **17** and the baffle **18** are aligned with the coating-free areas **36** spaced longitudinally therefrom. Thus, each of the coating-free areas **32**, **33** and **34** is aligned with respect to the coating free-areas **36**. The components are bonded in firm assembly with one another by spot welding.

Although the internal components of the muffler assembly have coating-free areas **32**, **33** and **34** and the external shell of the muffler assembly has coating-free areas **36**, yet the internal surface of the shell **10** remains coated as do the internal surfaces of the flanges on the cartridge head **17** and the baffles **18**, **19** and **26**. Accordingly, the coated areas constitute dielectric material which precludes the use of spot welding according to a conventional resistance welding technique. It is thus contemplated by the present invention that the muffler assembly components be placed in firm assembly with one another by an inert-gas consumable-electrode, shielded-arc welding technique which is exemplified by the schematic arrangement of FIGURE 3. In FIGURE 3 there is shown a reel **40** containing a wire electrode **41** which is mechanically fed through a torch head **42** to a welding arc **43** formed between the electrode **41** and the work.

The torch head **42** has an annular recess **45** connected by means of a conduit **44** to a supply of an inert gas. Accordingly, the arc **43** which is struck between the work (exemplified by the shell **10** and a flange **17***a*) and the electrode **41** forms a weld puddle **46** which is shielded by a stream **47** containing inert gas.

The inert gas shielded-arc welded method is characterized by the projection of small discrete metal droplets **48** axially from the end of the consumable wire electrode **41** into the weld puddle **46**. It may be noted that the projection of the metal droplets **48** is with sufficient force to accelerate to a finite velocity. There is thus formed an integral welded bond or joint **49** which places adjoining layers of metal including the shell **10** and the adjoining flange of either the cartridge head **17** or the baffles **18**, **19** or **26** in firm assembly. The bond or joint **49** is characterized by a button on both sides of the work since there is good heat penetration and added material from the consumable electrode is fed into the weld puddle. Moreover, because of the remaining coating on the surface confronting the coating-free areas, the welded bonds **49** are effectively insulated and the continuity of the coating surface is preserved.

The finished article thus provided permits a muffler construction to be porcelain enameled without changing the functional design to accommodate coating. Thus, by following the principles of the present invention, it is unnecessary to provide for the addition of holes for drainage or to make any other structural revision which might possibly change the acoustics of the muffler construction. Moreover, no subsequent closure of temporary access openings is required, complete inspection of every part is possible prior to assembly and improved quality control is insured.

Although minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. An exhaust muffler comprising, baffle means forming closed cavities having a through-tubular-multiple-path passage extending therethrough with small holes in said passage at intervals, thereby to break sound waves which follow different paths and meet again out of phase before leaving the muffler, a shell forming a housing to enclose said baffle means, each of said baffle means and said shell having a thin layer of glass fused to the surface thereof except for a plurality of spaced points on an external surface of said baffle means and a corresponding plurality of points on the external surface of said shell, and a welded joint at each said set of points bonding said baffle means in firm assembly with said shell.

2. An exhaust muffler of the type comprising a shell housing and insertable baffle and tube components together forming closed cavities and a multiple path through tube passage having holes at intervals, thereby to break sound waves which follow different paths and meet again before leaving the muffler, said housing and said components each having a thin layer of glass fused to the inner and outer surfaces thereof prior to assembly, said shell and said baffle components having spaced confronting support portions, the outer surface of each said supporting portion being initially free of said layer of glass and a welded joint extending through said support portions to assemble the components in firm assembly with one another without adversely affecting the layer of glass.

3. The use of porcelain enameling in the fabrication of an exhaust muffler which includes the steps of fabricating the baffle, tube and shell housing components as individual sub-assemblies out of sheet metal, cleaning and pickling each of said components, applying a ground coat of a suspension including frit to each of said components, drying said individual components, removing said ground coat from localized spots on assembly-related portions of said components, firing each respective component to fuse the ground coat at the coated areas, assembling the components to align the localized spots on the assembly-related components, drawing an electrical arc between a consumable wire electrode and each set of localized aligned spots to form a weld puddle, shielding the weld puddle by a stream containing inert gas, and projecting small discrete metal droplets axially from said electrode to fill the weld puddle, whereby the pre-porcelainized components are welded in firm assembly with one another.

4. A porcelainized fabricated muffler assembly comprising, a plurality of sheet form elements each formed and shaped into a separate fabricated baffle, tube and shell housing sub-assembly, a coating on each said sheet form element comprising a fused porcelain enamel extending continuously over substantially all of the respective surfaces of said sheet form elements, each of said elements having a plurality of coating-free localized areas at assembly-related joint areas aligned in adjoining register with one another when the sub-assemblies are arranged in assembled relation, and a metal bond extending through each of said assembly-related joint areas to place said components in firm assembly with one another at said localized areas.

5. The use of an inert-gas consumable-electrode shielded-arc welding method in the fabrication of an exhaust muffler which includes the steps of applying a ground coat of ceramic enamel to an exhaust muffler sub-assembly, drying the sub-assembly, removing the ground coat at a localized area on the sub-assembly, heat fusing the ground coat to the coated areas of the sub-assembly, repeating the foregoing steps on an assembly-related component of the exhaust muffler, assembling the related components to align the localized areas in operative registry, and applying a metal bond to said localized areas via the inert-gas consumable-electrode shielded-arc welding technique to place the porcelainized components in firm assembly with one another.

6. The use of an inert-gas consumable-electrode shielded-arc welding method in the fabrication of an exhaust muffler which includes the steps of applying ceramic enamel to the exposed surfaces of exhaust muffler sub-assemblies except for assembly-related localized bonding areas, assembling the sub-assemblies, and forming integral metal bonds at said bonding areas by projecting small discrete metal droplets axially from the end of a consumable wire electrode into a weld puddle formed by drawing an arc between the electrode and an adjoining localized bonding area of the assembled together sub-assemblies.

7. The use of porcelain enameling in the fabrication of an exhaust muffler which includes the steps of fabricating the baffle, tube and shell housing components of an exhaust muffler as individual sub-assemblies, applying a ground coat of ceramic enamel to each respective sub-assembly, drying each said coated sub-assembly, removing the coating from assembly-related localized bonding areas of each sub-assembly, fusing the coating to the sub-assemblies, assembling the components with the localized bonding areas in operative registry, and welding the localized bonding areas.

8. The use of porcelain enameling in the fabrication of an exhaust muffler which includes the steps of fabricating the baffle, tube and shell housing components of an exhaust muffler as individual sub-assemblies, applying a ground coat of ceramic enamel to each respective sub-assembly, drying each said coated sub-assembly, removing the coating from assembly-related localized bonding areas of each sub-assembly, fusing the coating to the sub-assemblies, assembling the components with the localized bonding areas in operative registry, and forming integral metal bonds at said bonding areas by projecting weld metal thereinto via an inert-gas consumable-electrode shielded-arc welding technique.

9. The use of porcelain enameling in the fabrication of a composite coated muffler which includes the steps of individually prefabricating baffle, tube and shell housing sub-assemblies of a composite article, applying a ground coat of ceramic enamel to each respective sub-assembly, removing the coating from assembly-related localized joint areas of each sub-assembly, heat fusing the coating to the sub-assemblies, assembling the components with the localized joint areas in operative registry, and welding the localized joint areas.

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