Feb. 9, 1926. 1,572,428

C. P. GRIMES

METHOD OF ATTACHING COPPER FINS TO CAST IRON CYLINDERS

Filed April 4, 1924

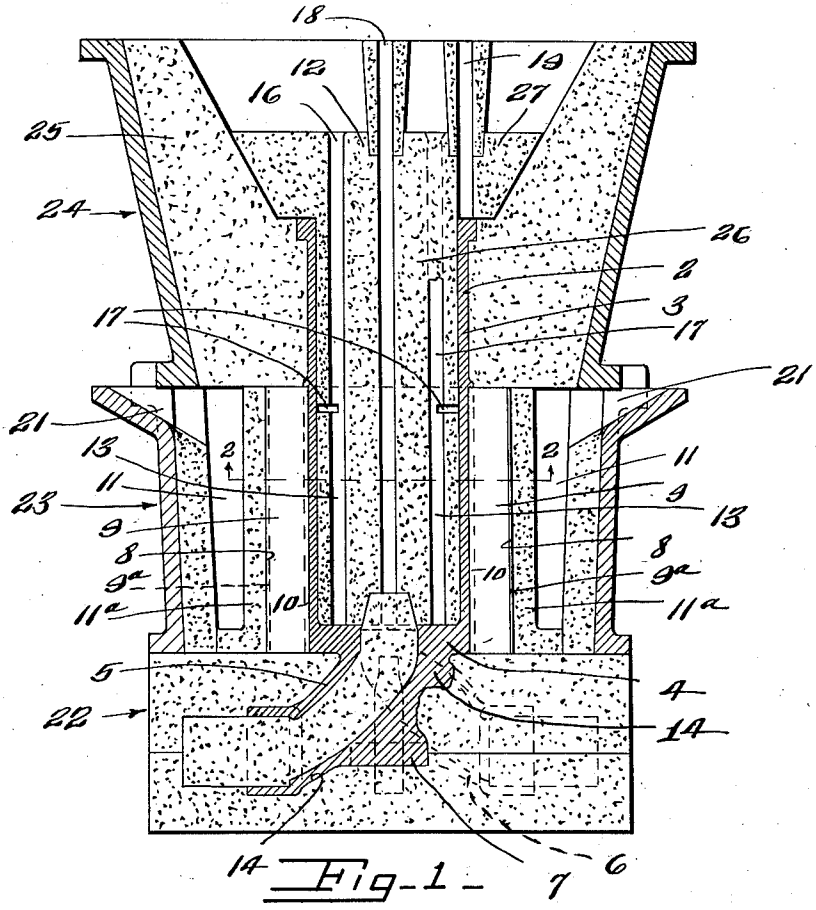


Fig-1-

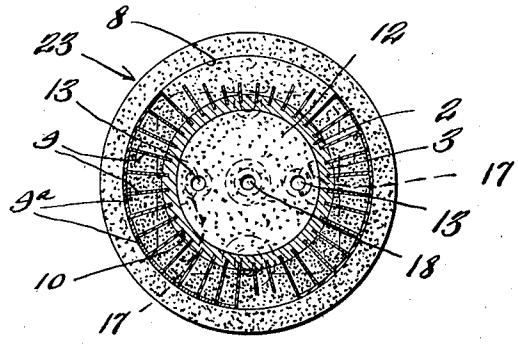


Fig-2-

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Patented Feb. 9, 1926. 1,572,428

UNITED STATES PATENT OFFICE.

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METHOD OF ATTACHING COPPER FINS TO CAST-IRON CYLINDERS.

Application filed April 4, 1924. Serial No. 704,140.

To all whom it may concern:

Be it known that I, CHARLES P. GRIMES, a citizen of the United States, and a resident of Syracuse, in the county of Onondaga and State of New York, have invented a certain new and useful Method of Attaching Copper Fins to Cast-Iron Cylinders, of which the following is a specification.

This invention relates primarily to attaching to a metal part a projection or projections as fins of metal having a different coefficient of expansion or a different coefficient of heat conductivity than the metal of said part, and has for its object a method or process of accomplishing such results and particularly a method of attaching to iron cylinders to be embodied in internal combustion engines copper heat radiating fins or heat radiating fins of a metal having a different coefficient of expansion than iron, or a method of forming a secure and efficient heat conducting joint between the cylinder and the heat radiating fins or projections.

The invention consists in the steps and in the order of the steps hereinafter set forth and claimed.

In describing this invention reference is had to the accompanying drawings in which like characters designate corresponding parts in all the views.

Figure 1 is a vertical sectional view of a mold or apparatus for carrying out my method.

Figure 2 is a sectional view taken on line 2—2, Fig. 1.

This method of attaching to metal parts, as cast iron engine cylinders, heat radiating fins of a metal having a different or greater coefficient of expansion or heat conductivity than iron, as copper fins, comprises pouring the molten metal or cast iron into a mold cavity into which the portions as the margins of the fins extend or are exposed, while the fins are comparatively cool, heating the fins by means of a suitable heating medium, as molten iron, to a temperature approximating or greater than that of the casting at the time the heating medium is applied, and permitting the casting and the heating medium to cool gradually at substantially the same rate.

Preferably the metal of the cylinder is poured into the mold cavity so that it flows from the bottom of the mold cavity upwardly along the margins of the fins and also downwardly in the mold cavity from the upper ends of the fins toward the lower ends, this being done preferably while the fins are comparatively cool, to prevent undue fusing of the margins of the fins and consequent weakening of the fins at the periphery of the cylinder in the finished product. The gases formed in the mold during the casting are removed or allowed to escape through suitable vents as soon as possible after the gases are formed and thereafter after the metal is poured into a second cavity up around the outer edges of the fins and out of contact with the fins, the metal in this second mold cavity heating the fins to approximately the temperature of the molten metal of the casting, and the heating metal in the second cavity heats the fins and keeps them heated, so that, the fins cannot cool more rapidly than the casting, and hence firm joints are formed between the fins and the casting which will not become loose and which also will rapidly conduct from the cylinder to the fins the heat generated in the cylinder when the cylinder is embodied in an internal combustion engine.

Also the fact that the metal of the casting is poured while the fins are comparatively cool contributes to the forming of a firm secure joint and to the forming of the joint having substantially the same texture as that of the remaining part of the cylinder. In other words, the texture of the iron of the cylinder wall is substantially homogeneous throughout. The fins are formed with angular flanges at their outer edges, these flanges extending in a circumferential direction around the cylinder and forming a jacket around the cylinder through which the cooling current of air is passed when the engine embodying the cylinders having such fins is in use. These angular flanges, in so far as this process is concerned, tend to efficiently conduct the heat from the heating medium or molten metal to the fins.

The apparatus or mold for carrying out this method or process comprises a casing or box in which the molding sand and cores are arranged to form a cylindrical mold cavity 2 shaped to form the cylindrical walls 3 of a cylinder, the head 4, and also usually the intake and exhaust ports and the pipe connections 5, 6 by which connection is made

to the intake and exhaust manifolds of the engine and also the bosses 7 in which the valve stems are guided. The mold is also formed with an annular cavity 8 in which the heat radiating fins 9 preferably having angular, circumferentially extending flanges 9ª at their outer margins are arranged with the margins 10 extending into the cavity 2, the fins being surrounded by sand or other material to hold them in place. Usually, so-called green sand is packed between the fins.

The mold is further formed with an annular cavity 11 around the annular fin cavity 8 and spaced therefrom by a wall or core 11ª of sand or other suitable material. The mold or the core 12 thereof is also formed with inlet passages 13, for the molten metal, these passages opening into the lower part of the mold cavity so that the metal, when first poured, first enters the bottom end of the cylindrical cavity 2 and flows into the cavities 14 which form the intake and exhaust pipe connections 5, 6 and into the lower end of the cylindrical cavity to form the head of the cylinder and upwardly along the margins of the fins from the lower toward the upper end of the fins. By the time the lower portion of the mold cavity, that is, that portion forming pipe connections 5, 6 and the head 4 of the cylinder, is filled up, the passages 13 are also filled and also the entrance 16 for such passages, so that the molten metal will also flow through laterally extending passages 17 from the passages 13 into the cylindrical mold cavity 2 and, as these lateral passages 17 are located near the upper ends of the fins 9, the molten metal starts to flow downwardly along the margins of the fins from their upper ends toward their lower ends at about the same time that the metal starts to flow from the lower ends of the fins toward their upper ends. Such pouring of the metal, so that it flows along the margins of the fins from the lower ends toward the upper end and from the upper end toward the lower prevents the burning off or weakening of the fins and causes them to be united equally throughout their length to the casting. Also the fact that the fins are cold prevents undue burning, fusion, weakening or destruction of the margins 10.

The mold is also provided with vent passages or gas outlets 18 and 19, the passage 18 extending to the lower end of the cylindrical cavity 2, so as to permit the immediate escape of the gases formed from the casting and cores within the lower end of the mold, that is, within the part of the mold forming the pipe connections 5, 6 and the head of the cylinder; and the passages 19 leading from the upper end of the cylindrical cavity 2. Thus all the gases formed during the casting operation are free to escape immediately and not remain in the mold cavities.

After the casting is poured, the heating metal is then poured in the annular cavity 11 through suitable inlets 21 and the heat therefrom raises the temperature of the fins to approximately or above the temperature of the casting. The casting and the heating metal in the cavity 11 are then allowed to cool gradually and at substantially the same rate.

Owing to the fact that the gases have been allowed to escape, as soon as formed, explosion of such gases, which would otherwise occur if the metal were poured into the cavity 11 before such gases had escaped or before or during the casting of the metal into the mold cavity 2, is avoided, and further owing to the fact that the heating metal is poured into the cavity 11 after the metal is poured into the cavity 2 against the margins of the cool fins 8, firm, integral, homogeneous joints are formed between the fins and the cast iron and the cast iron is substantially homogeneous throughout.

As here shown, the mold casing consists of a lower or base section 22 in which the cavities 14 are formed for forming the pipe connections 5, 6 and associated parts, an intermediate section 23 in which is located the portion of the mold cavity 2 forming that part of the cylinder to which the fins are attached and also in which the annular chamber 11 for the heating medium is located, and an upper section 24 mounted on the section 23 and shaped to receive the sand or core 25 which forms the portion of the cylinder not provided with heat radiating fins.

The annular wall or core 11ª is placed within the section 23 around the outer ends of the fins. A cylindrical core 26 is placed within the sections 23, 24 to form the cylindrical mold cavity 2 and this core is formed with the pouring passages 13 and with the gas outlets 18, 19. The cylindrical core has a head 27 at its upper end within the entrance cavity 16.

Many methods have been tried and patented for attaching copper fins to cast iron cylinders but such methods have proven failures or at the most partial successes, due to the fact that the joint between the fins and the cylinder is not firm or to the fact that the fins chill and harden the metal of the casting and the resulting joints are not good heat conductors and such hardened joints change the texture of the metal to such extent that the cylinders cannot be satisfactorily machined.

By my process, owing to the fact that the cast iron is first brought around the comparatively cold fins, undue fusing or burning of the margins of the fins with which the metal comes in contact is avoided and, owing to the after heating of the fins, undue chilling of the metal of the cylinder

is avoided and equal cooling of the metal of the cylinder and of the fins is brought about, so that firm, secure joints are formed which are rapid conductors of heat and the texture of the cast iron is homogeneous.

Furthermore, owing to the fact that the gases formed in the cores and in the mold during the casting operation are permitted to escape immediately, fin heating means of high temperature can be used without liability of exploding the gases, especially when the heating means for the fins is used after the metal has been poured into the mold cavity to form the cylinder. The pouring of this heating metal, after the cylinder has been cast but while the metal of the cylinder is in molten condition, effects three main results:

A. It permits the metal of the cylinder to be first cast around comparatively cool fins.

B. It avoids explosion of the gases liberated during the casting of the cylinder.

C. It contributes to forming of firm, heat conducting joints between the cylinder and the fins.

What I claim is:

1. The method of attaching to a metal part, fins of a metal having a greater co-efficient of expansion than said metal part, comprising supporting the fins with margins thereof projecting into a mold cavity which forms the metal part to which the fins are to be attached, pouring the metal into such mold cavity, whereby it flows around the margins of the fins, while the fins are comparatively cool, and then after the pouring of said metal, heating the fins to a temperature approximating that of the molten metal of said part, and permitting the molten metal and the heating means to cool gradually.

2. The process of attaching to a metal part, fins of a metal having a different co-efficient of expansion than said metal part, consisting in pouring molten metal to form said part around and in contact margins of the fins, heating the fins after the pouring of the metal to a temperature approximately that of the molten metal and permitting the molten metal and the heating means to cool gradually at substantially the same rate.

3. The method of attaching to a metal part, fins of a metal having a greater co-efficient of expansion, than the metal of said part consisting in supporting the fins with margins thereof projecting into a mold cavity, pouring the molten metal which is to form the part to which the fins are to be attached, into the mold cavity to flow from the bottom of the mold cavity upwardly along the margins of the fins, and also to flow downwardly in the mold cavity along the margins of the fins from the upper ends thereof toward the lower.

4. The method of attaching to a metal part, fins of a metal having a greater co-efficient of expansion, consisting in supporting the fins with margins thereof projecting into a mold cavity, pouring the molten metal which is to form the part to which the fins are to be attached into the mold cavity to flow from the bottom of the mold cavity upwardly along the margins of the fins, and also to flow downwardly in the mold cavity along the margins of the fins from the upper ends thereof toward the lower, thereafter heating the fins to a temperature approximating the temperature of the molten metal and allowing the molten metal and the heating means to cool gradually at substantially the same rate.

5. The process of attaching cast iron cylinders, heat radiating fins, of a metal having greater co-efficient of expansion than cast iron, comprising pouring cast iron into a mold cavity into which the margins of the fins project, while the fins are comparatively cool, and thereafter heating the fins by a heating medium to a temperature approximating that of the molten metal in the mold cavity, and permitting the metal of the casting and the heating means to cool gradually at substantially the same rate.

6. The method of attaching to cast iron cylinders, fins of a metal having a greater co-efficient of expansion than cast iron, comprising pouring the iron into a mold cavity in which the margins of the fins are exposed, and causing the metal to flow from along the margins of the fins from the lower ends of the fins toward the upper ends thereof, and from the upper ends of the fins toward the lower ends thereof.

7. The method of attaching to cast iron cylinders, fins of a metal having a greater co-efficient of expansion than cast iron, comprising pouring the iron into a mold cavity in which the margins of the fins are exposed while such fins are comparatively cool, causing the metal to flow along the margins of the fins from the lower ends of the fins toward the upper ends thereof, and from the upper ends of the fins toward the lower ends thereof, heating the fins to approximately the temperature of the molten metal by a heating medium, and allowing the casting and the heating medium to cool gradually at substantially the same rate.

8. The method of attaching to cast iron cylinders, heat radiating fins of a metal having greater co-efficient of expansion than iron consisting in supporting the fins with margins thereof projecting into the mold cavity for forming the cylinder, pouring the molten iron into the cavity to flow from the bottom of the cavity up, permitting the escape of gases formed in the mold during the casting operation and heating the fins after the escape of the greater portion of said gases, and permitting the casting and

the heating means to cool at substantially the same rate.

9. The method of attaching to cast iron cylinders, fins of a metal having a greater co-efficient of expansion than cast iron, comprising pouring the iron into a mold cavity in which the margins of the fins are exposed, and causing the metal to flow from along the margins of the fins from the lower ends of the fins toward the upper ends thereof, and from the upper ends of the fins toward the lower ends thereof, permitting the gases formed during the casting operation to escape, heating the fins after the gases or greater portions thereof have escaped, to a temperature approximating or greater than that of the casting, after the escape of such gases, and allowing the casting and the heating means for the fins to cool.

In testimony whereof, I have hereunto signed my name, at Syracuse, in the county of Onondaga, and in the State of New York, this 24th day of March, 1924.

CHARLES P. GRIMES.