May 29, 1923. 1,456,855

T. MIDGLEY, JR

METHOD OF JOINING METALS

Filed June 30, 1919

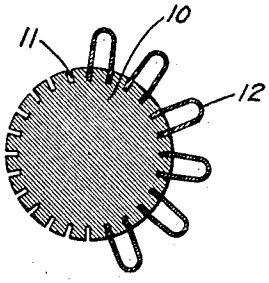


Fig. 1.

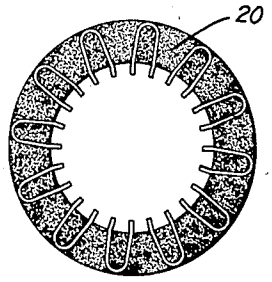


Fig. 4.

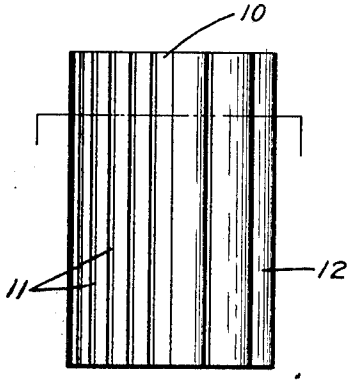


Fig. 2.

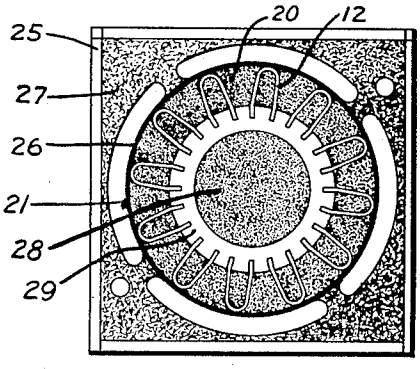


Fig. 5.

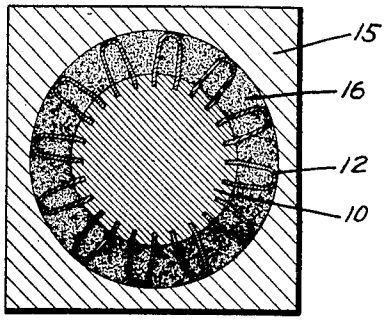


Fig. 3.

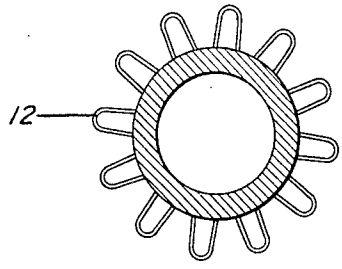


Fig. 6.

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UNITED STATES PATENT OFFICE.

THOMAS MIDGLEY, JR., OF DAYTON, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO GENERAL MOTORS RESEARCH CORPORATION, OF DAYTON, OHIO, A CORPORATION OF DELAWARE.

METHOD OF JOINING METALS.

Application filed June 30, 1919. Serial No. 307,640.

To all whom it may concern:

Be it known that I, THOMAS MIDGLEY, JR., a citizen of the United States of America, residing at Dayton, county of Montgomery, State of Ohio, have invented certain new and useful Improvements in Methods of Joining Metals, of which the following is a full, clear, and exact description.

This invention relates to the joining of dissimilar metals, and more particularly to the joining of two metals by means of casting.

One of the principal objects of this invention is to provide means for uniting to a metal which has a high co-efficient of conductivity another metal by casting such last named metal around, or in contact with, the metal of high conductivity.

Other objects and advantages of the present invention will be apparent from the description set out below, when taken in connection with the drawings.

Where two similar metals are to be joined together, such for instance as iron and steel, it is quite common practice to secure the desired union by incorporating one of the metals in a mold and casting the other in contact with it. I have found, however, that where it is desired to unite a metal having a high coefficient of heat conductivity to another metal by casting, satisfactory results are not readily secured where the conventional casting method is used. If it is desired, for example, to unite copper to cast iron by casting iron around, or in contact with, the copper it is extremely difficult to secure a true bonding or union of the two metals by the use of any casting method heretofore known to me. It appears that when copper is incorporated in a mold and molten iron is poured into the mold, and into contact with the copper, there is such a rapid transfer of heat from the molten iron through the copper that chilling of the iron in contact with the copper results. Consequently a good bond of the copper and iron will probably not result. This condition would also obtain with other metals, besides copper, having a high co-efficient of heat conductivity.

Where a metal, such as iron, is cast in contact with a metal of high heat conductivity, such as copper, I have found that a good bond of the two metals may be secured if the good conducting metal is heated, before the casting operation, to a temperature approximating the temperature of the molten iron. By thus preheating such metal chilling of the iron which first contacts with it is prevented.

In the drawing herewith is illustrated apparatus for carrying this method into effect. The method will be described particularly in connection with the joining of copper radiating fins to a cast iron engine cylinder, although it is quite obvious that the invention is by no means limited to this specific disclosure.

In the drawing:

Fig. 1 illustrates, what is termed, a former, showing several fins positioned in place preparatory to the making of that part of the mold which contains the copper with which the iron is to be cast in contact;

Fig. 2 is an elevational view of the former and fins which are shown in section in Fig. 1;

Fig. 3 shows the former and fins positioned within a core box, sand being shown as tamped in place within the spaces surrounding the fins, preparatory to baking to form a core;

Fig. 4 shows a completed core after the assembly shown in Fig. 3 has been baked and the core box and former removed therefrom;

Fig. 5 shows a complete mold ready for the casting operation; and

Fig. 6 discloses an engine cylinder, with copper fins, resulting from a casting operation within the mold shown in Fig. 5.

Each of the Figs. 1, 3, 4, 5 and 6 represents a section taken through the apparatus along a line corresponding approximately with that shown in Fig. 2.

In carrying out this method of uniting iron and copper, for example, the joining of copper fins to a cast iron engine cylinder, an assembling member 10, which for convenience is called a "former," the dimensions of which correspond to the dimensions of the cylinder to be cast, is made up, such former being of any desired material, as for instance steel or aluminum. Longitudinal grooves 11 are cut in the outer surface of this former, such grooves being adapted to receive the fins 12 which are to be united to the engine cylinder. The former and fins having been assembled are then placed in a core box 15 and sand 16, or some analo-

gous material, mixed with some binding material, such as linseed oil, is tamped into place around the fins. When properly tamped into place the core box is then preferably placed in a heating oven and baked so that the sand 16 with the fins 12 forms a hard core, free from moisture, which is designated generally by the numeral 20, and which is shown clearly in Fig. 4.

The core 20 having been properly prepared is then covered over with a layer of paper, or analogous material, 21, which paper is painted or coated with some material adapted to protect certain portions of the copper incorporated within the core. In actual practice the coating for this paper preferably comprises a mixture of graphite and water glass. The core with its covering 21 is then incorporated in a mold, the mold being made up in a convenional box 25. Surrounding the core is a plurality of pouring sections 26 formed in the sand 27 which constitutes the body of the mold. The purpose of these sections is to permit of pouring molten metal adjacent the copper elements before the actual casting operation so as to preheat the copper to a temperature approximating the temperature of the molten metal to establish a low temperature differential between the copper and the molten iron. The function of the coated covering 21 is to prevent the metal of the preheating sections from forming a bond with the copper, the graphite and water glass coating this covering being adapted to prevent such bonding. The sand of the mold is also preferably mixed with a binder and baked, as is the core 20. Within the central opening through the core 20 is placed a similarly baked core 28. This core is of such dimensions as to leave a space 29 adapted to receive the molten metal which is to constitute the engine cylinder. As is quite evident from the drawing, the inner ends of the fins 12 when incorporated within the mold extend a substantial distance into this space, and when the molten iron is poured into the space 29 it flows around these ends of the fins, forming a good bond with them. In Fig. 6 is shown a cylinder made by casting in a mold such as described.

The method of carrying out this casting operation is as follows: The aim is to secure a good bonding of the molten iron where it comes in contact with the metal of good conductivity, or copper, and to secure this desired condition I preheat such metal. In the mold shown, this preheating is secured by first pouring molten iron into the preheating sections 26. This iron is prevented from adhering to the metal incorporated within the core by means of the covering 29 and its graphite and water glass coating. A sufficient time is allowed, after this preheating metal is poured into place, to permit of the metal members 12 being raised to a temperature sufficiently high to prevent chilling of the metal forming the body of the casting. In actual practice the duration of this preheating period will vary, from five minutes to ten minutes being generally sufficient, the length of the period being of course dependent upon the amount of metal to be preheated. The metal having been properly preheated the molted iron is then poured into the space 29, the low temperature differential between the iron and copper being maintained by the members 12 acting to prevent escape of heat from the copper. When the mold has cooled down sufficiently it is broken away; and the preheating sections removed. The sand 16 forming the core 20 is also removed and a finished article, such for instance as illustrated in Fig. 6, is left.

This method of casting is described in connection with the casting of engine cylinders having copper radiating fins thereon. It is quite obvious that it is not limited to the making of articles of this specific character. This method of casting may be useful whenever it is desired to cast a metal in contact with another metal having a high coefficient of heat conductivity. This is especially true in the casting of iron around such a metal, as the iron hardens upon chilling. This chilling not only tends to prevent a good bond but produces hard spots within the iron which make proper machining extremely difficult.

The mold described above is one in which the various parts of the mold, with an incorporated bonding material, are baked before casting. Although this seems especially desirable in the attachment of copper fins to a cast iron cylinder, inasmuch as the use of an unbaked mold seems to cause a brittleness of the copper, it is not essential, particularly where large masses of copper are being dealt with. And in the majority of casting operations a mold made in the conventional manner, and without baking, but adapted to preheating of the metal of good conductivity, would function satisfactorily.

It is to be further understood that this method may be carried on quite satisfactorily with the use of other means for preheating the metal of high conductivity. For example electric heating units might be incorporated within the core in such wise as to permit of preheating such metal to the desired temperature.

While the method defined above constitutes a preferred embodiment of my invention, that invention is by no means limited to the precise disclosure above set forth and for a true definition thereof reference should be had to the appended claims.

It should be noted that the present application contains no broad claims to the article

produced by this process as such claims are being presented in an application filed in the name of C. F. Kettering, Serial No. 354,770, under date of June 29, 1920. The broad claims to a method of producing an engine cylinder in which true thermal contact is had between the fins and the metal of the cylinder, are also being presented in this latter application.

What I claim is as follows:

1. The method of casting iron around a metal which is a good conductor of heat, which comprises preheating said metal within the mold before the casting operation to establish a low temperature differential between the good conducting metal and the casting metal, and substantially maintaining the low temperature differential during the casting operation.

2. The method of casting iron around a metal which is a good conductor of heat; which comprises heating said metal to a temperature approximately the temperature of molten iron to establish a low temperature differential between the good conducting metal and the casting metal, then casting the iron in contact with such heated metal and substantially maintaining the low temperature differential during the casting operation.

3. The method of casting iron around a metal which is a good conductor of heat; which comprises positioning heating sections in heating relation to such metal; heating said metal to a temperature approximately that of molten iron to establish a low temperature differential between the good conducting metal and the casting metal, then pouring molten iron into contact with such heated metal and substantially maintaining the low temperature differential during the casting operation.

4. The method of uniting copper to iron which comprises incorporating the copper in a mold; preheating the copper to a temperature approximating the temperature of molten iron and pouring molten iron into the mold and into contact with the copper.

5. The method of uniting copper to iron which comprises incorporating the copper in a mold; preheating the copper by means of heating sections within the mold, and in heat transferring relation with the copper; and then pouring molten iron into the mold and in contact with the copper.

6. The method of uniting copper to iron which comprises covering parts of the copper with a material adapted to prevent the adhesion of molten iron to said copper, incorporating such partly covered copper in a mold; pouring molten iron into heat transferring relation with the covered parts of the copper, to heat the copper to a temperature approximating the temperature of the molten iron; and then pouring molten iron into the mold and in actual contact with parts of the copper which are not covered.

7. The method of uniting copper to iron which comprises incorporating the copper in a mold; baking the mold; preheating the copper within the mold; and pouring molten iron into the mold and into contact with the copper.

8. The process of uniting copper to iron which comprises preheating the copper by placing in proximity thereto, but out of contact with said copper, a mass of molten iron and subsequently casting a further portion of molten iron in contact with the copper.

In testimony whereof I affix my signature.

THOMAS MIDGLEY, JR.

Witnesses:
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A. C. LEHMAN.