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J. B. THOMAS
METHODS AND APPARATUS FOR MAKING CYLINDER
BLOCK CONSTRUCTIONS OR THE LIKE

3,276,082

Original Filed Sept. 22, 1961

3 Sheets-Sheet 1

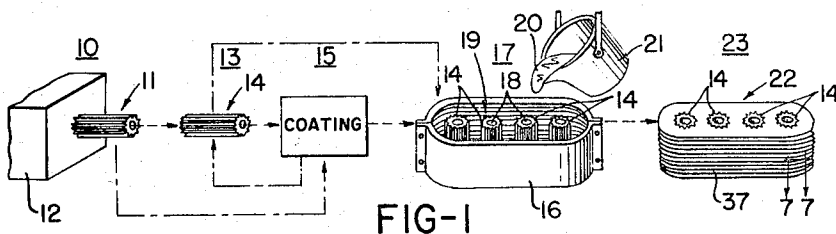


FIG-1

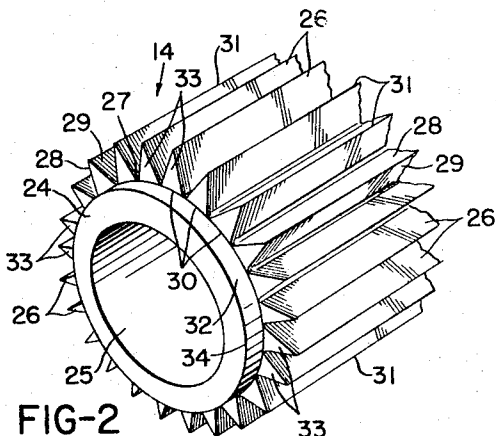


FIG-2

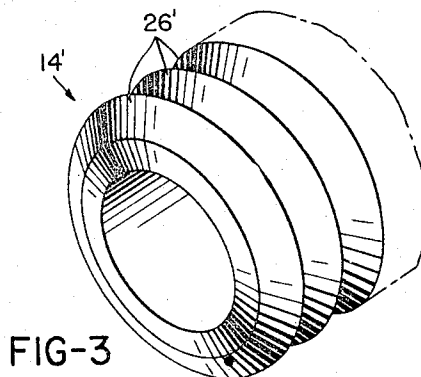


FIG-3

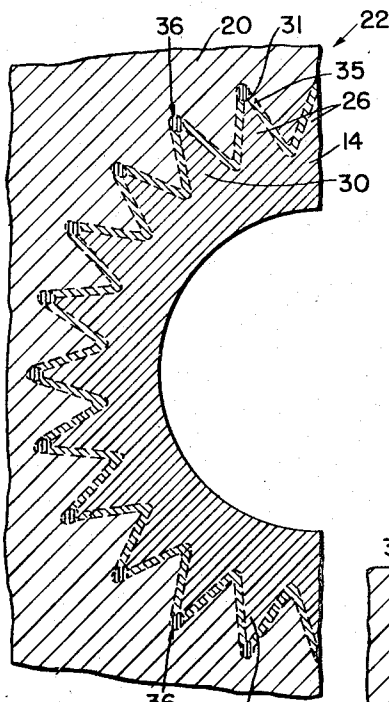


FIG-4

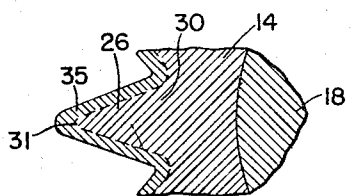


FIG-5

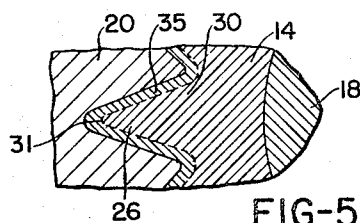


FIG-6

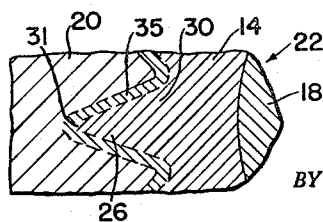


FIG-7

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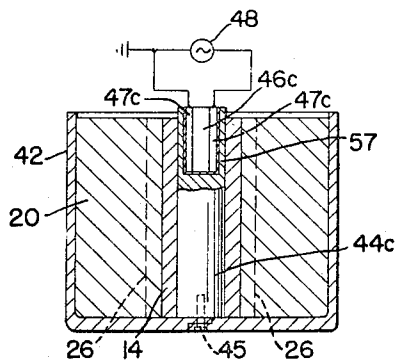
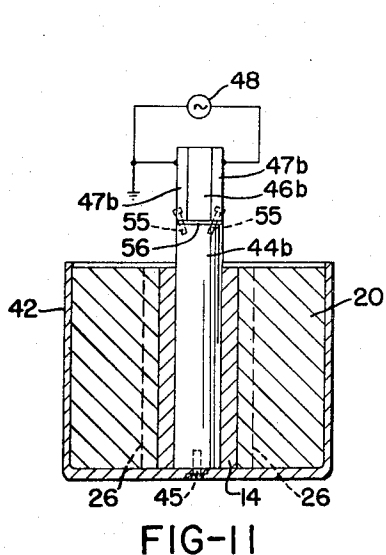
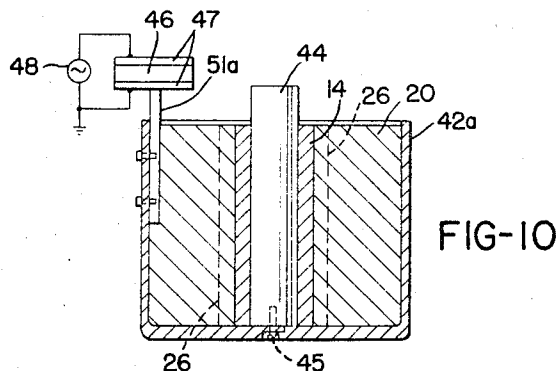
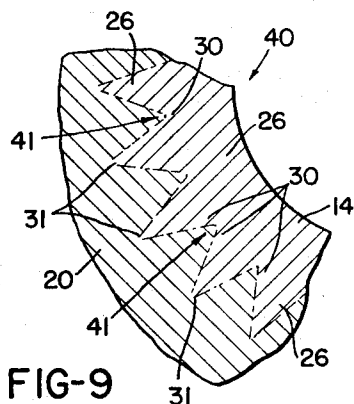
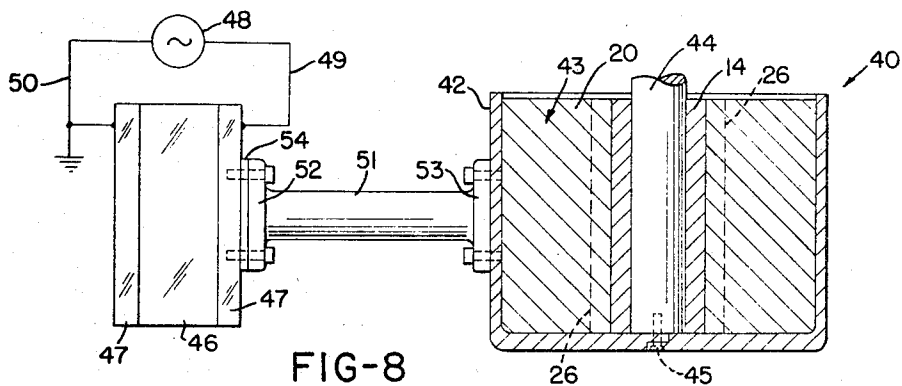
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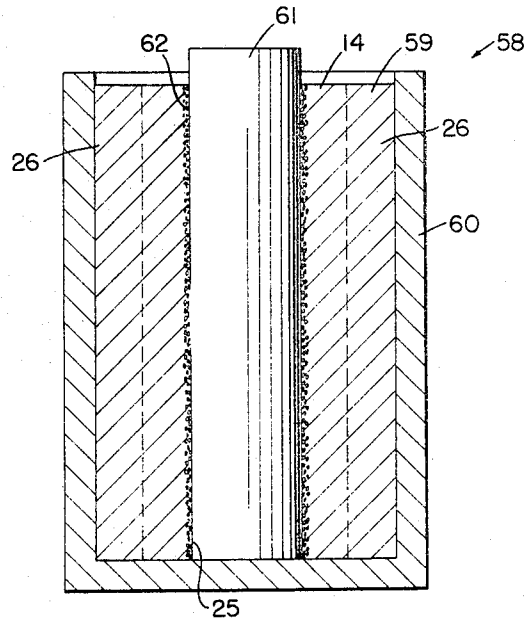


FIG-13

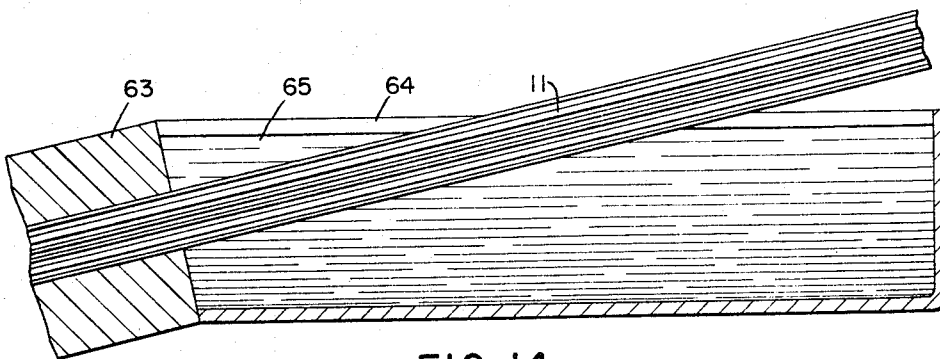


FIG-14

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3,276,082

METHODS AND APPARATUS FOR MAKING CYLINDER BLOCK CONSTRUCTIONS OR THE LIKE

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Original application Sept. 22, 1961, Ser. No. 140,111, now Patent No. 3,165,983, dated Jan. 19, 1965. Divided and this application June 30, 1964, Ser. No. 379,214
5 Claims. (Cl. 22-204)

This application is a divisional application of Serial No. 140,111, filed September 22, 1961, now Patent No. 3,165,983.

This invention relates to improved cylinder block constructions or the like and to improved methods and apparatus for making such cylinder block constructions or the like.

It is well known in the art that cylinder blocks for internal combustion engines and the like have been formed by casting or otherwise surrounding cylinder block material, such as aluminum-containing metallic material and the like, about one or more cylinder-defining members formed of steel or the like whereby the cylinder-defining members are formed of wear resistant materials and the remainder of the cylinder block construction is formed of good heat conducting and light-weight materials. The cylinder block material is usually bonded to the cylinder-defining members or mechanically locked thereto.

However, it has been found that such prior known bonding or mechanically locking means are inadequate and the cylinder-defining members tend to readily break loose from the cylinder block material during continued use of the cylinder block constructions. Such cylinder block failures particularly aggravated when the cylinder-defining members are formed of one aluminum alloy and the cylinder block material is formed of another aluminum alloy.

According to the teachings of this invention, however, an improved cylinder block construction and method and apparatus for making the same are provided wherein the cylinder-defining member or members thereof are firmly secured to the cylinder block material regardless of the combination of materials utilized and will not tend to break loose through continued use of the cylinder block construction.

In particular, one cylinder block construction of this invention includes a cylinder-defining member having a plurality of outwardly tapering flanges extending from the exterior thereof, each flange tapering to a point like tip disposed remote from the main body portion of the cylinder-defining member.

The exterior of the flanged cylinder-defining member is subsequently covered by a coating that bonds itself to the cylinder-defining member and is adapted to bond itself to the desired cylinder block material.

Thereafter, the cylinder block material is cast about the coated cylinder-defining member and, either by the heat of the molten cylinder block material or auxiliary heating means or both, the tips of the flanges of the cylinder-defining members are melted and fused with the cylinder block material to form substantially homogeneous structures at the ends of the flanges of the cylinder-defining member. The cylinder block material is also bonded to the coating on the flanges of the cylinder-defining member from the fused tips thereof toward the bases of the flanges. Thus, the cylinder block material becomes metallurgically bonded to the cylinder-defining member in such a manner that the cylinder-defining member cannot readily break loose from the subsequently solidified cylinder block material.

Another cylinder block construction of this invention

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is formed from one or more of the aforementioned cylinder-defining members except that the cylinder-defining member or members are not covered by the aforementioned coating.

Such cylinder-defining members are telescoped over suitable mandrels disposed in a mold chamber of a mold device whereby the molten cylinder block material can be subsequently disposed in the mold chamber and surround the cylinder-defining members.

Thereafter, either the mold device or the cylinder-defining members are vibrated, preferably by ultrasonic vibrating means, in such a manner that fusion or welding is effected between the cylinder block material and the cylinder-defining members at the flanges of the cylinder-defining members, such fusion or welding not only taking place at the tips of the flanges of the cylinder-defining members but even extending into the valleys between adjacent flanges.

In this manner, the cylinder-defining members of the resulting cylinder block construction are metallurgically bonded to the cylinder block material and cannot readily break loose from the subsequently solidified cylinder block material.

Accordingly, it is an object of this invention to provide an improved cylinder block construction having one or more of the novel features set forth above or herein-after shown or described.

Another object of this invention is to provide an improved method for making such a cylinder block construction or the like.

A further object of this invention is to provide an improved apparatus for making such a cylinder block construction or the like.

Other objects, uses, and advantages of this invention are apparent from a reading of this description, which proceeds with reference to the accompanying drawings forming a part thereof and wherein:

FIGURE 1 is a schematic, flow diagram illustrating one method of this invention for forming an improved cylinder block construction of this invention.

FIGURE 2 is an enlarged, fragmentary, perspective view of an improved cylinder-defining member of this invention.

FIGURE 3 is a view similar to FIGURE 2 and illustrates another embodiment of the cylinder-defining member of this invention.

FIGURE 4 is a fragmentary cross-sectional view illustrating a coated cylinder-defining member of this invention disposed over a mandrel in the mold chamber of a mold device.

FIGURES 5 and 6 are fragmentary, cross-sectional views similar to FIGURE 4 and illustrate various stages in the method of bonding the cylinder block material to the cylinder-defining member of this invention.

FIGURE 7 is an enlarged, fragmentary, cross-sectional view of the completed cylinder block construction of this invention and is taken substantially on line 7-7 of the right-hand terminal view of FIGURE 1.

FIGURE 8 is a schematic cross-sectional view illustrating the method and apparatus of this invention for forming another cylinder block construction of this invention.

FIGURE 9 is an enlarged, fragmentary, cross-sectional view illustrating the cylinder block construction formed by the method and apparatus of FIG. 8.

FIGURES 10-12 are views similar to FIGURE 8 and illustrate other embodiments of the method and apparatus of this invention.

FIGURE 13 is an axial cross-sectional view illustrating another method for forming the cylinder-defining members of this invention.

FIGURE 14 is an axial cross-sectional view illustrating

still another method for forming the cylinder-defining members of this invention.

While the various features of this invention are hereinafter described in connection with a cylinder block construction for an internal combustion engine or the like, it is to be understood that any other desired structures can be secured together by the methods and apparatus of this invention to produce a desired construction. Therefore, this invention is not to be limited to only the applications thereof illustrated in the drawings, as the drawings are merely illustrative of one of the wide variety of uses of this invention.

Referring now to FIGURE 1, one of the methods of this invention for forming a cylinder block construction or the like is schematically illustrated and comprises the following steps.

As illustrated at station 10 in FIGURE 1, a length of cylinder-defining member stock 11 is extruded by a conventional extruding apparatus 12. The extruded stock 11 is subsequently cut at station 13 into a plurality of cylinder-defining members 14 of the desired length and machined to any desired degree. Thereafter, each cylinder-defining member 14 is coated at station 15 by a suitable material that bonds itself to the exterior surface of the cylinder-defining member 14 and is adapted to be bonded to the desired cylinder block material. The thus coated cylinder-defining members 14 are disposed in a suitable cylinder block mold device 16 at station 17, the cylinder-defining members 14 being placed over suitable, heatable mandrels 18 disposed in the mold chamber 19 of the mold device 16. Thereafter, the desired cylinder block material 20 is dispensed from suitable apparatus 21 into the mold chamber 19 of the mold device 16 to be cast around the cylinder-defining members 14 and be metallurgically bonded thereto in a manner hereinafter described. After the cylinder block material 20 has solidified, the resulting cylinder block construction 22 is removed from the mold device 16 and suitably machined, if required, at station 23 to form the completed cylinder block construction 22.

The cylinder-defining members 14 can be formed from any desired material or combination of materials, and, in the embodiment illustrated in the drawings, the cylinder-defining members 14 are formed from an extrudable high silicon aluminum-containing metallic material which is particularly adaptable for forming a wear-resistant cylinder-defining structure for an internal combustion engine or the like. However, the cylinder-defining members 14 can be formed from copper or magnesium alloy, if desired.

As illustrated in FIGURE 2, each extruded cylinder-defining member 14 comprises a main cylindrical body portion 24 having a cylinder bore 25 passing therethrough. A plurality of outwardly tapering, radially disposed flanges or fins 26 extend longitudinally from the exterior surface 27 of the main body portion 24 of the cylinder-defining member 14. Each flange 26 has a pair of opposed side walls 28 and 29 which converge from the base 30 of the respective flange 26 to the tip or outer end 31 thereof. While the opposed sides 28 and 29 of each flange 26 are illustrated as converging together to form a knife-edge-like tip 31 and defining a triangular cross-sectional configuration, it is to be understood that the opposed sides 28 and 29 of each flange 26 can define any desired cross-sectional configuration whereby the tips 31 of the flanges 26 have relatively small cross-sectional widths, as compared to the cross-sectional widths of the bases 30 thereof, for a purpose hereinafter described.

At the time of casting, these small areas are melted away; thus assuring a metallurgical bond. The degree of metallurgical bond obtained is controlled by the initial temperature of the finned cylinder-defining member 14 and the temperature of the molten aluminum, or other molten metal, which is cast around the cylinder-defining member 14.

If desired, the opposed ends of the flanges 26 of each cylinder-defining member 14 can be cut away, as at 32, to provide a mechanical locking effect of the cylinder-defining member 14 with the cylinder block material 20 when the cylinder block material 20 is cast over the ends 33 and disposed flush with the outer ends 34 of the main body portion of the cylinder-defining member 14.

When the cylinder-defining members 14 are formed from the extruded stock 11, the cylinder-defining members 14 can be cut from the stock 11 and subsequently coated by a suitable bonding material 35, FIGURE 4, at station 15, FIGURE 1, the thickness of the bonding material 35 being greatly exaggerated in the drawings. Alternately, the extruded stock 11 can be coated with the bonding material 35 immediately after the stock 11 has been extruded by the apparatus 12. Thereafter, the cylinder-defining members 14 can be subsequently cut from the coated stock 11 when needed.

As previously stated, the bonding material 35 must be of a type which will readily bond to the exterior surface of the cylinder-defining member 14 and also be adapted to be bonded to the cylinder block material 20 in a manner hereinafter described. It has been found that when the cylinder-defining member 14 is formed from the aforementioned aluminum-containing metallic material, zinc, silver, molybdenum, tin, indium, or copper form suitable bonding materials 35 for subsequently bonding an aluminum-containing metallic cylinder block material 20, such as aluminum alloy 13, to the aluminum cylinder-defining member 14.

When the bonding material 35 is formed from zinc, and the cylinder-defining member 14 is formed from an aluminum alloy, the coating 35 can either be electroplated or vacuum-deposited onto the cylinder-defining member 14 or the extruded stock 11. Similarly, the extruded stock 11 or cylinder-defining members 14 can be immersed in a bath of molten zinc, if the extruded stock 11 and cylinder-defining members 14 are clean or pre-cleaned.

While the cylinder-defining members 14 are illustrated as being formed from the extruded stock 11, it is to be understood that the cylinder-defining members 14 can be formed by a casting operation, if desired. However, it has been found less expensive to extrude the cylinder-defining members 14 than to cast the same. Therefore, the flanges 26 are designed to run longitudinally relative to the cylinder-defining members 14 to accommodate such extrusion operation. It is to be understood, however, that the flanges 26 can be disposed in any desired position around the outer peripheral surface 27 of the cylinder-defining member 14.

For example, as illustrated in FIGURE 3, the outwardly tapering flanges 26' of the cylinder-defining member 14' of this invention are disposed circumferentially therearound and function in the same manner as the flanges 26 of the cylinder-defining member 14. Since the cylinder-defining member 14' cannot be extruded, the same can be formed by any suitable casting operation or the like. In particular, the cylinder-defining member can be die cast, permanent mold cast, or sand cast. Further, the cylinder-defining member 14' can be formed by sintering aluminum alloy particles together with or without wear resistant iron pellets or the like.

After the coated cylinder-defining members 14 have been provided, the same are disposed over the mandrels 18 in the mold chamber 19 of the mold device 16, the mandrels 18 preferably being heatable to desired temperatures to supplement the temperature of the molten cylinder block material 20 in forming the subsequent metallurgical bond between the cylinder-defining members 14 and the cylinder block material 20.

While the cylinder block construction 22 illustrated in FIGURE 1 is illustrated as having four cylinder-defining members 14 provided therein, it is to be understood that the cylinder-block construction 22 could have one or any

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desired number of cylinder-defining members 14, as desired.

As illustrated in FIGURES 1 and 5, the molten block material 20 is cast around the coated cylinder-defining members 14, and the heat of the molten cylinder block material together with or without the heat supplied by the heatable mandrels 18 causes the coating 35 to begin to bond to the cylinder block material 20, as illustrated in FIGURE 6. Since the flanges 26 of the cylinder-defining members 14 taper toward the tips 31 thereof, the tips 31 of the flanges 26 initially heat to a greater degree than the remaining portions of the flanges 26. Therefore, the cylinder block material 20 first begins to become bonded to the tips 31 of the flanges 26. Subsequently, as the flanges 26 tend to heat up from the tips 31 thereof toward the bases 30, the cylinder block material becomes bonded to the coating 35 inwardly from the tips 31 toward the bases 30 as schematically illustrated in FIGURE 7.

Further, as the relatively narrow tips 31 of the flanges 26 are heated, the same tend to melt in the manner illustrated in FIGURE 7, to fuse with the coating 35 and molten cylinder block material 20 to provide substantially homogeneous metallic structures 36 at the free ends of the flanges 26. In this manner, the homogeneous structures 36 metallurgically bond the cylinder block material 20 to the cylinder-defining member 14. Because the molten cylinder block material 20 cools or solidifies at a relatively rapid rate, such melting of the flanges 26 takes place only at the tips 31 thereof. However, the heat provided by the molten cylinder block material 20, with or without the heat supplied by the mandrels 18, is sufficient to cause the cylinder block material 20 to bond to the coating 35 from the fused ends 36 of the flanges 26 toward the bases 30 thereof. The extent to which the cylinder block material 20 is bonded to the coating 35 of the cylinder-defining members 14 throughout the length of the flanges 26 depends on how long and to what temperature the flanges 26 are heated, such factors being controlled by the heatable mandrel 18 and the temperature of the poured metal.

However, it has been found that when the tips 31 of the flanges 26 of the cylinder-defining member 14 are fused to the cylinder-block material 20 in the manner previously described to provide the metallurgically bonded homogeneous structures 36, a sufficient amount of the coating 35 on the flanges 26 is bonded to the cylinder block material 20 from the fused end of the flanges 26 toward the bases 30 thereof to provide a good bond between the cylinder block material 20 and the cylinder-defining members 14.

Therefore, not only has it been found that such metallurgical bonding method produces a cylinder block construction wherein the cylinder-defining members are permanently bonded to the cylinder block material and cannot break loose therefrom under adverse conditions, but also it has been found that such metallurgical bonding method provides a cylinder block construction wherein greater heat conductivity is provided between the cylinder-defining members and the cylinder block material than is provided by prior known constructions and methods. Thus, the cylinder block constructions of this invention are cooler during operation thereof than prior known constructions, because the cylinder block material of the cylinder block constructions of this invention readily conducts the heat away from the cylinder-defining members thereof.

While any number of flanges 26 may be provided on each cylinder-defining member 14, it has been found that the greater the number of flanges 26 provided, the greater the surface area provided for such bonding operation.

After the cylinder block construction 22 has been formed in the above manner, the same is removed from the molding device 16. Thereafter, the cylinder block construction 22 can be suitably machined to provide air-cooling fins 37 or suitable liquid cooling means thereon.

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However, the fins 37 could be formed by the molding device, if desired.

Another apparatus and method of this invention is illustrated in FIGURE 8 and is utilized for forming another cylinder block construction 40 of this invention which is illustrated in FIGURE 9, the cylinder block construction 40 comprising one or more cylinder-defining members 14 metallurgically bonded to the cylinder block material 20 in a manner hereinafter described.

As illustrated in FIGURE 9, the exterior surfaces of the cylinder-defining members 14 are not covered with the coating 35 previously described and are fused or metallurgically secured to the cylinder block material 20 not only at the tips 31 of the fins 26 thereof but also at the bases 30 of the fins 26 and in the valleys 41 between adjacent fins 26 whereby the cylinder-defining members 14 will not readily break loose from the cylinder block material 20 during subsequent use of the cylinder block construction 40.

The cylinder-defining members 14 and cylinder block material 20 of FIGURE 9 are metallurgically secured together by the method and apparatus of FIGURE 8 in the manner now to be described.

As illustrated in FIGURE 8, a suitable mold device 42, similar to the mold device 16 previously described, has a mold chamber 43 adapted to receive one or more cylinder-defining members 14 and molten cylinder block material 20 in the manner previously described.

In particular, suitable, heatable mandrels 44, similar to the mandrels 18 previously described, are secured in the proper positions in the mold chamber 43 of the mold device 42 in any suitable manner, such as being bolted therein by bolts 45 or the like, whereby the cylinder-defining members 14 are adapted to be respectively telescopically disposed over the mandrels 44 and be properly positioned in the mold chamber 43 of the mold device 42.

After the cylinder-defining members 14 have been so positioned in the mold device 42, molten cylinder block material 20 is poured into a mold chamber 33 to surround the cylinder-defining members 14 and the metallurgically bonded thereto by an ultrasonic welding operation.

The ultrasonic welding operation is provided by ultrasonically vibrating either the mold device 42 or the cylinder-defining members 14 as the molten cylinder block material 20 is being poured into the mold chamber 43, whereby the cylinder block material 20 is welded or fused to the fins 26 of the cylinder-defining members 14 in the manner illustrated in FIGURE 9 and previously described.

One means for ultrasonically vibrating the mold device 42 is illustrated in FIGURE 8 and comprises a piezoelectric crystal 46 secured between suitable mounting plates 47 which are, in turn, electrically connected to an alternator or other source of power 48 by leads 49 and 50. The plates 47 not only improve the fatigue life of the crystal 46 but also assure uniform transfer of the electric power from the alternator 48 to the crystal 46.

In this manner, the current supplied by the alternator 48 passes through the crystal 46 and causes the same to vibrate in the desired direction, depending upon the particular cut of the crystal 46, whereby the vibrations produced by the crystal 46 are transferred to the mold device 42 by a suitable connecting rod 51 secured to the plate 47 at one end 52 thereof and to the mold device 42 at the end 53 thereof.

While the crystal 46 and alternator 48 can be designed in any manner well known in the art to cause vibrations at any desired frequency, it is preferred that the crystal 46 vibrate at a frequency greater than 20 kilocycles so as to be beyond the audio frequency range, although lower frequencies would work, such as 10 kilocycles or the like.

Preferably, the rod 51 is formed from a low heat conducting material such as a high nickel or chromium steel, so that the heat of the mold device 42 will not be transferred to the crystal 46. Further, the rod 51 can be elec-

trically and thermally insulated from the crystal 46 by interposing suitable insulating means 54 between the supporting plate 47 and the end 52 of the rod 51. Alternatively or additionally, the insulating means 54 can be disposed between the mold device 42 and the end 53 of the rod 51.

By thus vibrating the mold device 42 at the ultrasonic frequencies produced by the crystal 46, it has been found that the cylinder block material 20 will be completely fused or welded to the fins 26 of the cylinder-defining members 14 without utilizing the previously mentioned coating 35 on the cylinder-defining members 14, although the cylinder-defining members 14 and cylinder block material 20 are formed from dissimilar or similar aluminum alloys or the like.

However, it is to be understood that the cylinder-defining members 14 can be covered with the coating 35 whereby the cylinder block material 20 will be welded or fused to the coating 35 in the above manner when the mold device is vibrated.

While the vibration transfer rod 51 is illustrated in FIGURE 8 as being attached externally to the side wall of the mold device 42, it is to be understood that the same can be attached to the mold device 42 in any desired position, such as to the bottom wall thereof, if desired, to produce the aforementioned welding or fusion operation.

Further, the vibration transfer rod 51 can be attached to the internal surface of the mold device 42, if desired. For example, the vibration transfer rod 51a of FIGURE 10 is secured to the inside surface of the side wall of the mold device 42a and is vibrated in the above manner to produce the welding or fusing operation. In the embodiment illustrated in FIGURE 10, the vibration transfer 51a is formed of any suitable material that is able to withstand the heat of the molten cylinder block material 20 which is poured into the mold device 42a and which will not be fused or otherwise secured to the cylinder block material 20 whereby the subsequently formed cylinder block construction can be readily removed from the mold device 42a.

As previously stated, the cylinder-defining members 14 and cylinder block material 20 can be ultrasonically welded or fused together by either vibrating the mold device 42 of FIGURE 8 or the cylinder-defining members 14 thereof.

One means for vibrating the cylinder-defining members 14, rather than directly vibrating the mold device 42, is illustrated in FIGURE 11 wherein each mandrel 44b has a piezoelectric crystal 46b mounted on the upper end thereof and secured thereto by suitable bolts of fastening means 55 passing respectively through the mounting plates 47b and the mandrel 44b. Preferably, the crystals 46b and supporting plates 47b are electrically and thermally insulated from the mandrels 44b by suitable insulation means 56 interposed therebetween.

In this manner, the vibrations of the crystals 46b are respectively transferred to the cylinder-defining members 14 by the mandrels 44b in the same manner that the rod 51 transfers the vibrations from the crystal 46 to the mold device 42 previously described.

Thus, the vibrations set up in the cylinder-defining members 14 of FIGURE 11 by the crystals 46b cause welding or fusion of the cylinder block material 20 to the cylinder-defining members 14 in the manner illustrated in FIGURE 9.

If desired, the vibrating means can be mounted directly in the mandrels 44. For example, as illustrated in FIGURE 12, the crystals 46c and supporting plates 47c are respectively received in suitable cavities respectively provided in the mandrel 44c and are electrically and thermally insulated therefrom by suitable insulation means 57.

Thus, the vibrations produced from the crystals 46c

are respectively transferred to the cylinder-defining members 14 by the mandrels 44c.

Therefore, it can be seen that various means have been provided for either vibrating the mold device or the cylinder-defining members to effect ultrasonic welding or fusion between the cylinder-defining members and the cylinder block material, whereby the resulting cylinder block construction is a substantially unitary structure because the cylinder-defining members are metallurgically bonded to the cylinder block material and will not readily break loose therefrom, as in the prior art.

While piezoelectric crystals have been illustrated in the drawings as providing the means for vibrating the mold device or cylinder-defining members, it is to be understood that other vibrating means may be utilized, as desired.

It has been found that not only does the ultrasonic vibrations cause fusion or welding between the cylinder-defining members 14 and cylinder block material 20, but also the ultrasonic vibrations improve the physical properties of the resulting casting by reducing the growth of large crystals and retards alloy segregation.

While it is not illustrated, it is to be understood that the vibratory rods interconnecting the ultrasonic transducers with the various mold devices could be cooled in any desired manner. For example, the vibratory rods can be cooled by circulating a heat exchange media through the interior of the rods.

Returning now to the features of this invention concerning the coating of the exterior of the cylinder-defining members 14 can be zincated to provide the coating 35 for the above purpose.

In particular, each cylinder-defining member 14 is first caustic etched and rinsed. Thereafter, each cylinder-defining member 14 is deoxidized and rinsed. The deoxidized and rinsed cylinder-defining member 14 is then dipped in a zincate solution for approximately thirty seconds and then rinsed. Subsequently, the zincated cylinder-defining member 14 is dipped in a nitric acid solution of approximately 50% concentration for approximately ten seconds.

Thereafter, the zincated cylinder-defining member 14 is again dipped into a zincate solution for approximately thirty seconds and then rinsed to complete the zincating process.

It has been found that the zincate solution can consist of 100 grams of zinc oxide and 525 grams of caustic per liter of water. Optionally, a small percentage of half and half Rochelle salts and ferric chloride can be added to the zincate solution.

This zincating process produces a superior zinc coating 35 on the cylinder-defining members 14 and can be economically automated.

The thus zincated cylinder-defining members 14 can be utilized in any of the above methods to produce the desired cylinder block constructions or the like.

In addition, it has been found that the cylinder-defining members 14 can be formed by the method and apparatus 58 illustrated in FIGURE 13.

In particular, a cylinder-defining member 14 is formed by casting the desired metallic material 59 in a suitable mold device 60, the mold device 60 being so constructed and arranged that the same will produce the longitudinally disposed or circumferentially disposed fins 26 or 26' on the exterior surface of the cylinder-defining member 14 during the casting operation.

A mandrel 61 is disposed in the central portion of the mold device 60 and cooperates therewith to define the central bore 25 passing through the cylinder-defining member 14.

If desired, suitable thin, disc-shaped permanent or electric magnets can be incorporated in the mandrel 61 to hold in position a proper amount of iron particles 62 or the like that will subsequently line the interior surface

of the cylinder-defining member 14 to provide a wear-resistant surface.

For example, the iron particles 62 can be disposed around the mandrel 61 and will adhere thereto in the proper thickness because of the aforementioned magnets. Thereafter, the molten metallic material 59 is cast into the mold device whereby the layer of iron particles 62 are cast in the molten metallic material 59 and form the interior surface thereof.

The resulting cylinder-defining member 14 can be utilized in any of the above procedures to form the desired cylinder block construction or the like.

While there are many ways to produce the cylinder-defining members 14 by extruding the same, it is desirable to prevent the exterior surface thereof from oxidizing before the cylinder-defining members 14 are covered by the aforementioned coating 35.

One such method would be to surround the extruded stock 11 as it leaves the extruding apparatus 12 of FIGURE 1 with an inert gas shield whereby no oxidation of the aluminum-containing extruded stock 11 can take place.

While the extruded stock 11 is surrounded by the inert gas shield, various metals can be sprayed or impinged upon the exterior surface of the extruded stock 11 to form the aforementioned coating 35.

Another such method is to extrude the stock 11 directly into a molten bath of zinc or the like as it leaves the extruding apparatus so that the aforementioned coating 35 can be formed on the extruded stock 11 before the same is exposed to the atmosphere and oxidizes.

For example, see FIGURE 14 wherein the extruding apparatus 63 has the extruding end thereof forming one side of a container 64 carrying a molten bath 65 of zinc or the like.

In this manner, the stock 11 is directly extruded into the molten metal bath 65 as it leaves the extruding apparatus 63 so as to be completely covered by the coating 35 before any oxidation of the exterior surface of the extruded stock 11 can take place.

If desired, the extruding apparatus 63 can be tilted in such a manner that the extruded stock 11 passes out of the bath 65 so as to be subsequently cut into the desired lengths as the stock 11 is being continuously formed and coated.

Therefore, it can be seen that there has been provided improved cylinder block constructions and improved methods and apparatus for making the same or the like, whereby the cylinder-defining members are metallurgically bonded to the cylinder block material and will not tend to break loose therefrom during subsequent use of the cylinder block constructions.

While the form of the invention now preferred has been disclosed as required by the statutes, other forms may be used, all coming within the scope of the claims which follows.

What is claimed is:

1. A method for making a cylinder block construction comprising the steps of extruding a length of cylinder-defining stock having a plurality of outwardly tapering fins extending from the exterior surface thereof, cutting a cylinder-defining member from said stock, coating the exterior surfaces of the fins of said cylinder-defining member with bonding material, disposing said coated cylinder-defining member in a mold chamber of a cylinder block defining mold, thereafter, casting molten metallic cylinder block material around said cylinder-defining member in said mold chamber to cause the tips of said fins to fuse with said cylinder block material to form substantially

homogeneous structures at the tips of said fins and cause said cylinder block material to be metallurgically bonded to said fins by said coating from said fused tips of said fins toward the bases thereof, and subsequently solidifying said cylinder block material to form with said cylinder-defining member a cylinder block construction in said mold chamber.

2. A method as set forth in claim 1 and including the step of ultrasonically vibrating said mold device during said casting step.

3. A method for making a cylinder block construction comprising the steps of providing a cylinder-defining member having outwardly tapering fins extending from the exterior thereof, telescoping said cylinder-defining member onto a mandrel in a mold chamber of a cylinder block defining mold, heating said mandrel to heat said cylinder-defining member, casting molten metallic cylinder block material around said cylinder-defining member in said mold chamber, to secure said cylinder block material to said cylinder-defining member by fusing the tips of said fins to said cylinder block material to form substantially homogeneous structures at the tips of said fins and by metallurgically bonding said cylinder block material to said fins from the fused tips thereof toward the bases thereof, and subsequently solidifying said cylinder block material to form with said cylinder-defining member a cylinder block construction in said mold chamber.

4. A method as set forth in claim 3 and including the step of ultrasonically vibrating said mold during said casting step.

5. A method for making a cylinder block construction comprising the steps of disposing a metallic cylinder-defining member in a mold chamber of a mold device by telescoping said cylinder-defining member on a mandrel of said mold device, said cylinder-defining member having outwardly tapering fins extending from the exterior thereof, casting molten metallic cylinder block material in said mold chamber to surround said cylinder-defining member, ultrasonically vibrating just said mandrel of said mold device to fuse said material to said fins from the tips thereof toward the bases thereof whereby said material is metallurgically bonded to said cylinder-defining member at said fins, and subsequently solidifying said material to form with said cylinder-defining member a cylinder block construction in said mold chamber.

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