March 5, 1957 J. DOLZA ET AL 2,783,510

CYLINDER BLOCK CORING FOR V-ENGINES

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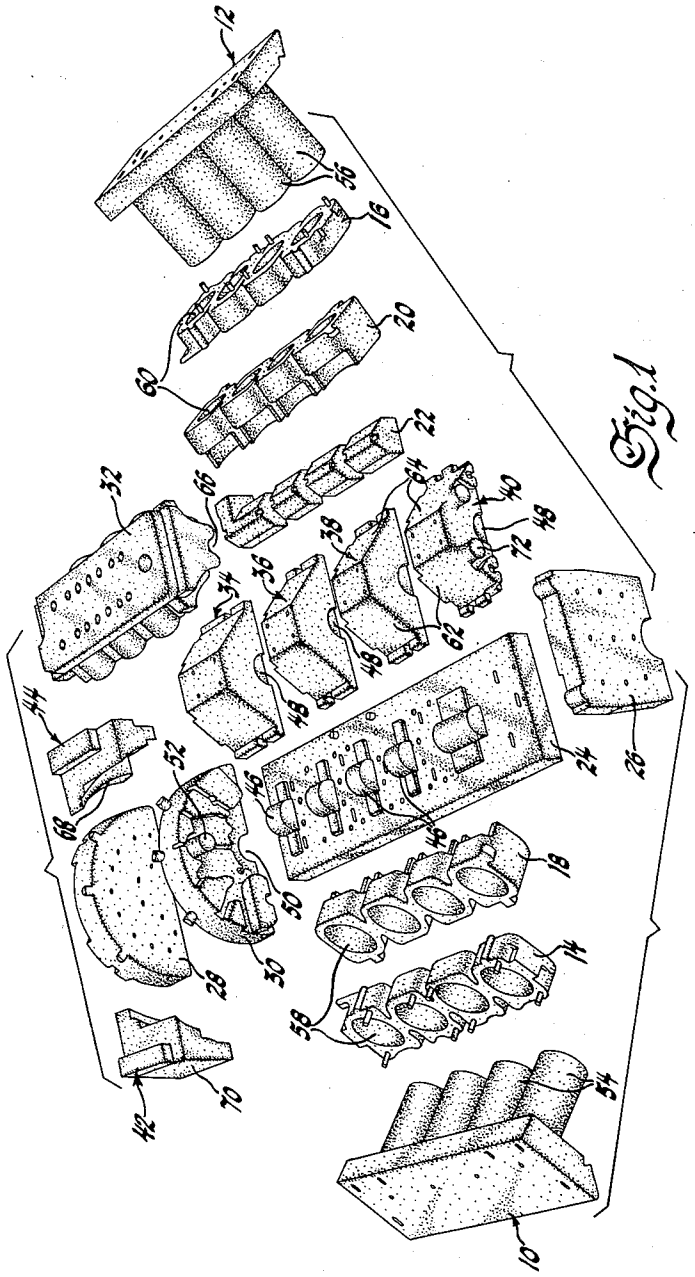



Fig. 1

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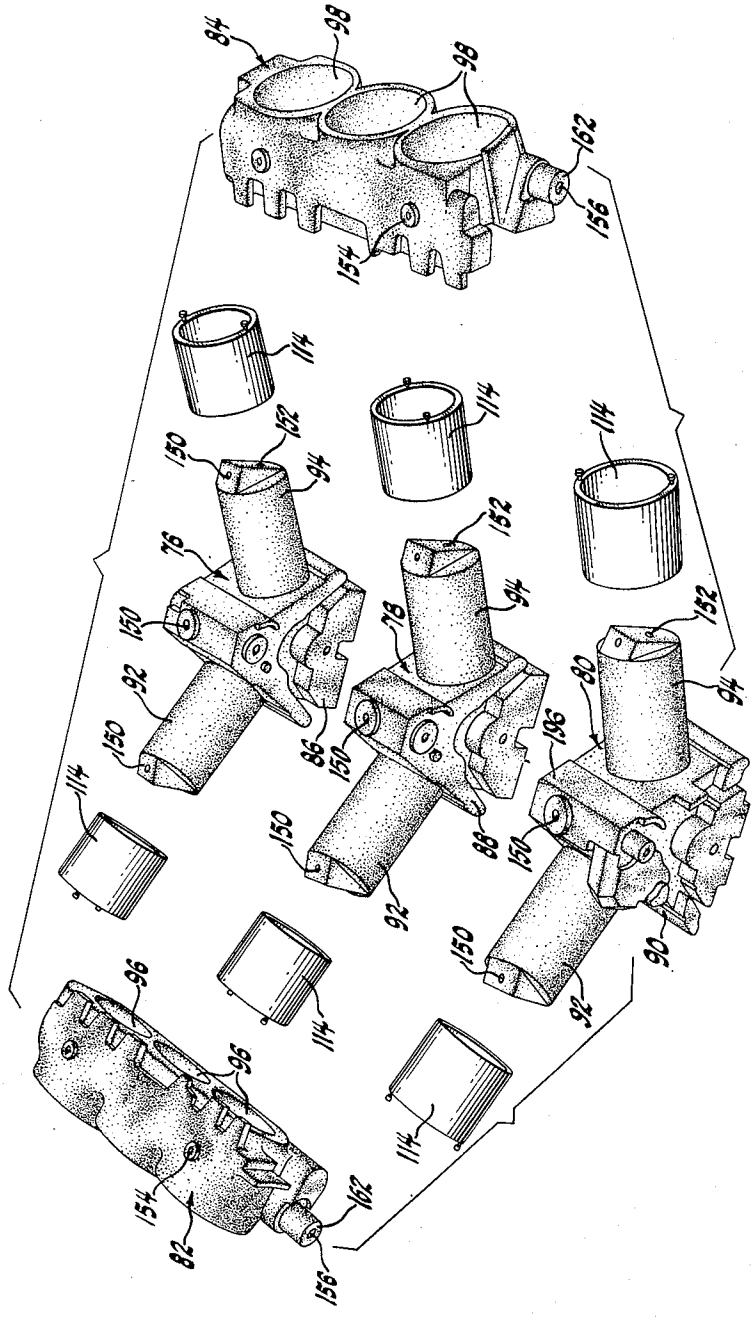



Fig. 2

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CYLINDER BLOCK CORING FOR V-ENGINES

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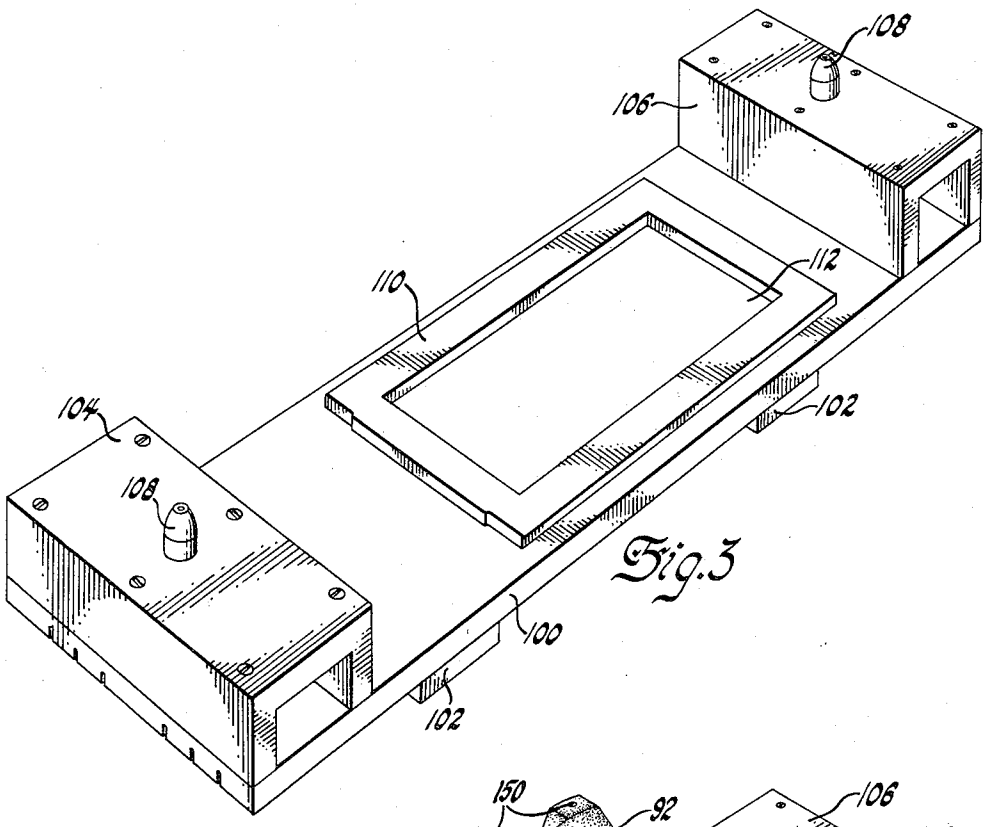



Fig. 3

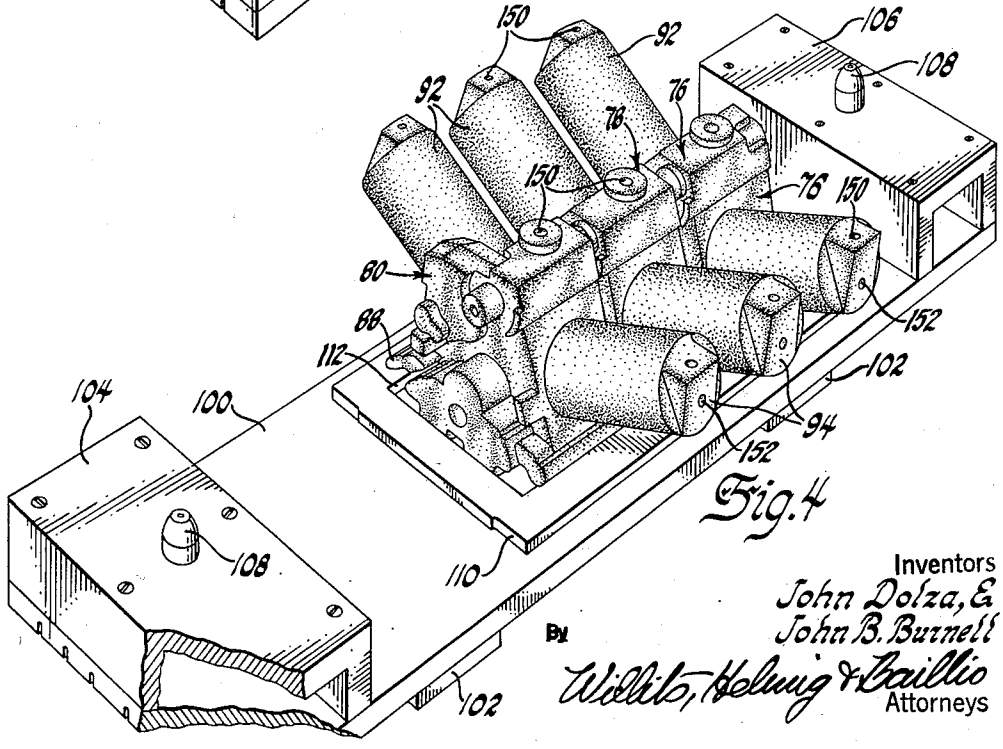



Fig. 4

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CYLINDER BLOCK CORING FOR V-ENGINES

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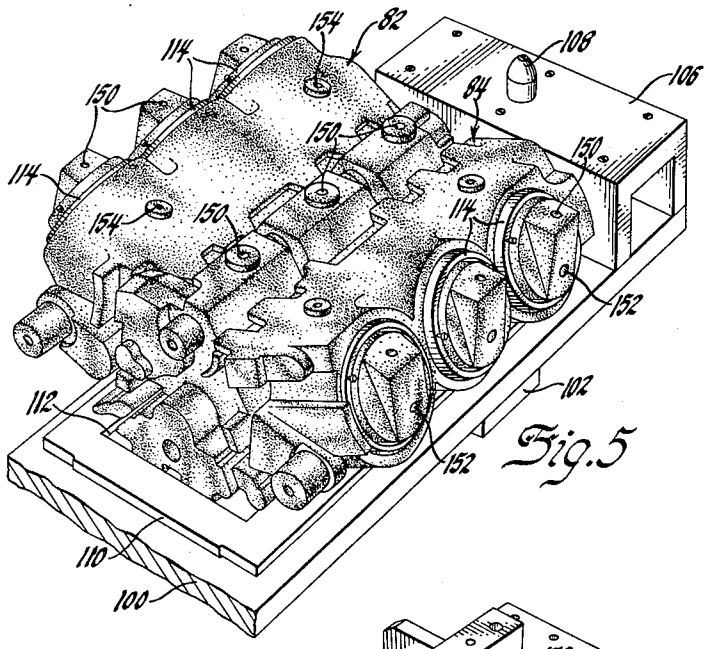



Fig. 5

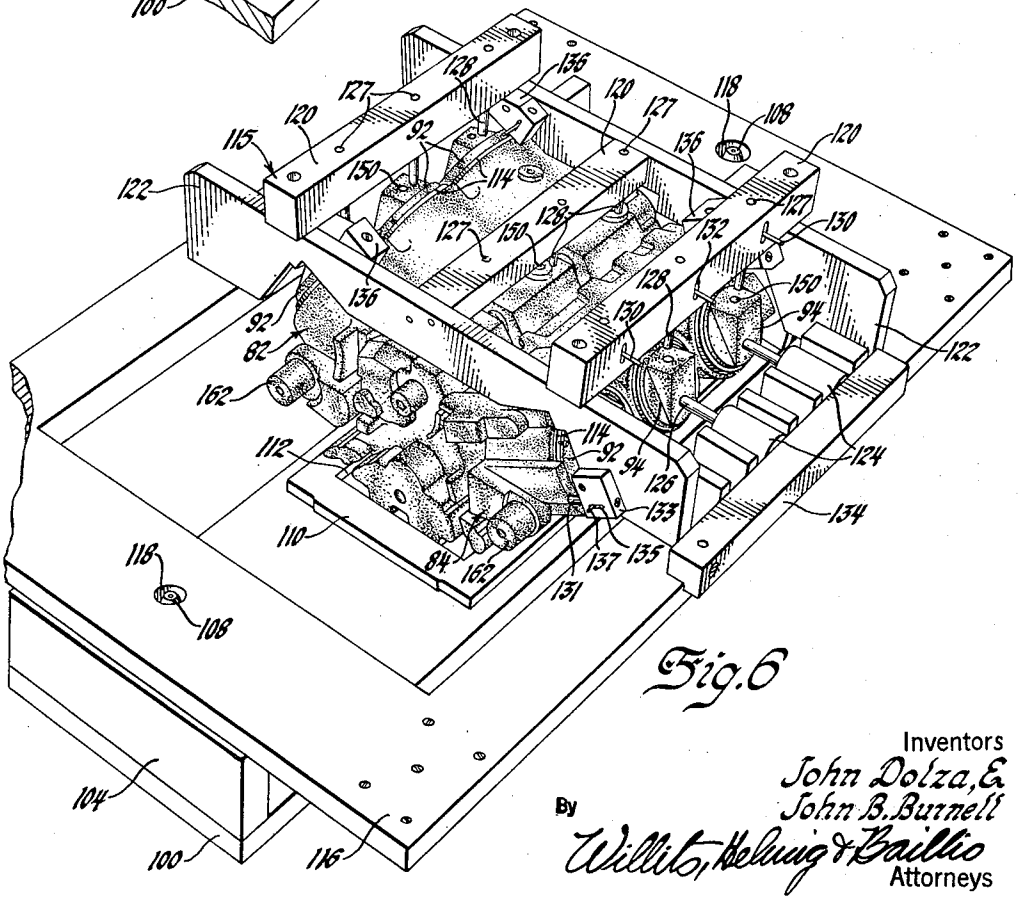



Fig. 6

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CYLINDER BLOCK CORING FOR V-ENGINES

Filed Feb. 26, 1953 7 Sheets-Sheet 5

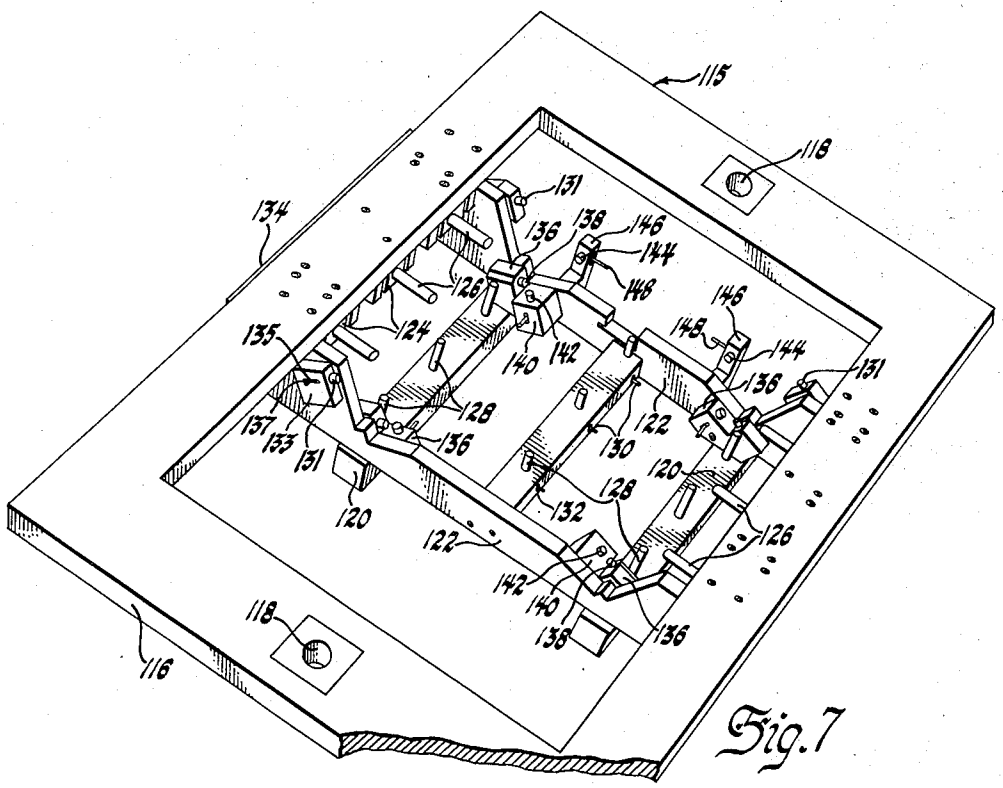



Fig. 7

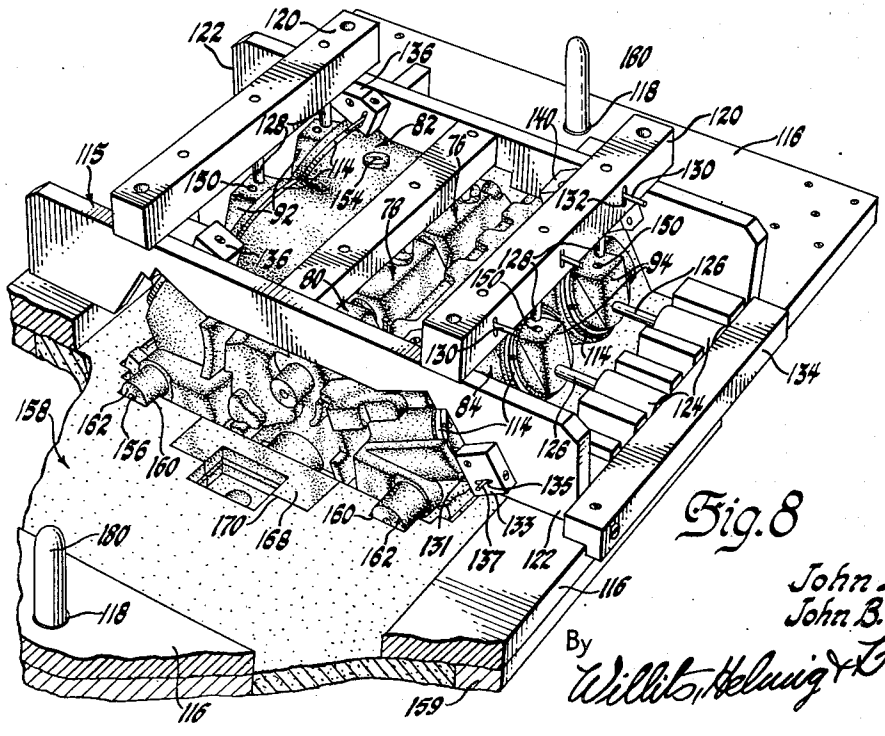



Fig. 8

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CYLINDER BLOCK CORING FOR V-ENGINES

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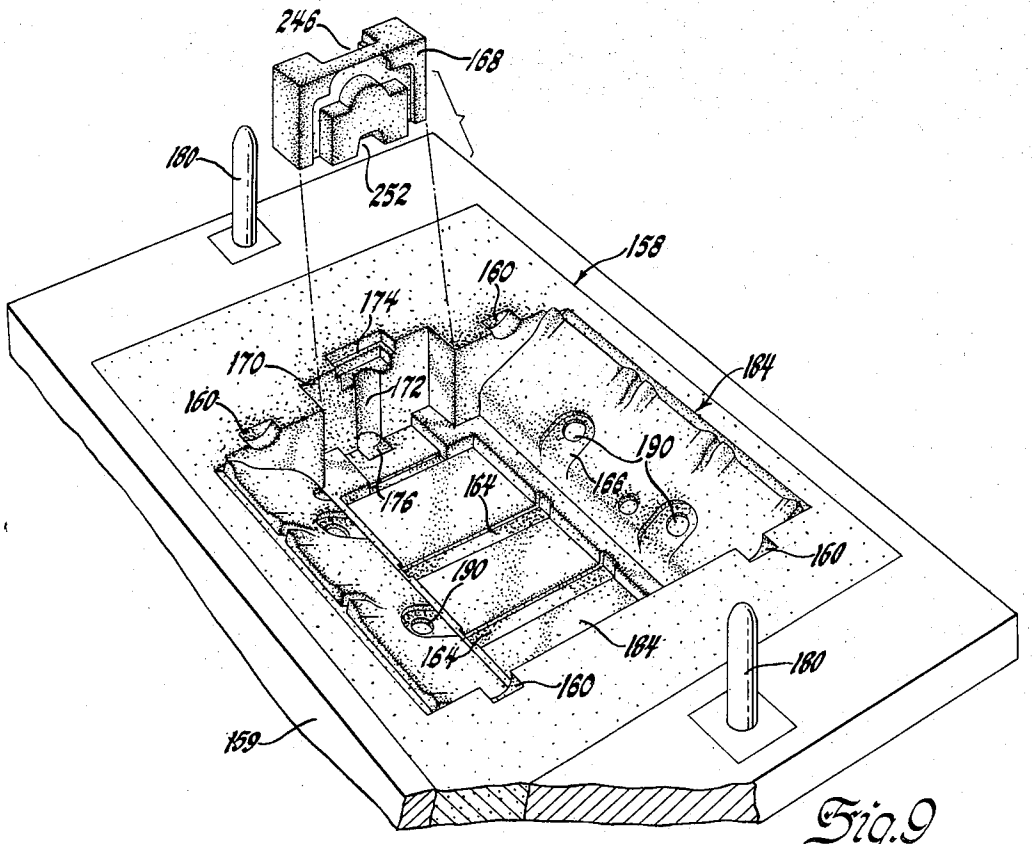



Fig. 9

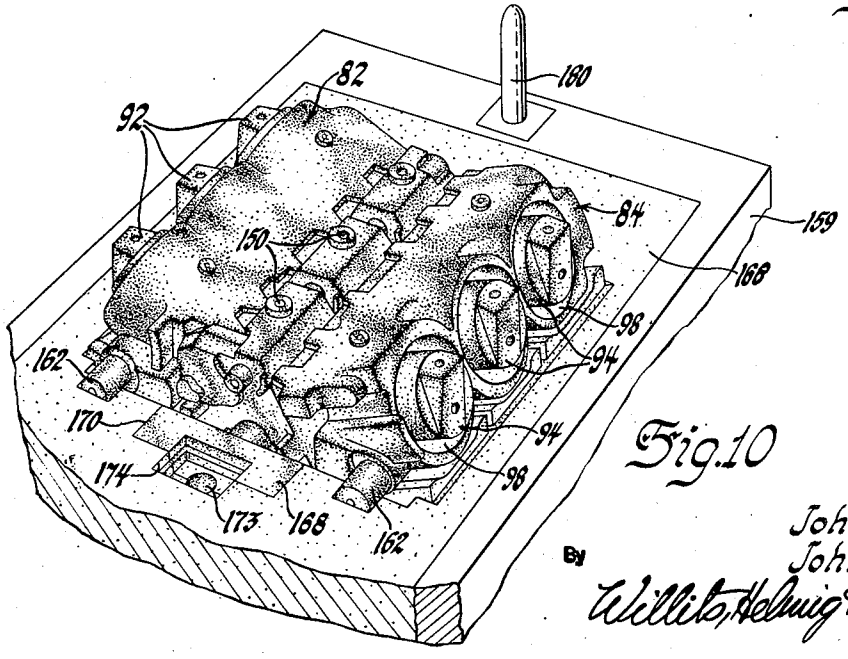



Fig. 10

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CYLINDER BLOCK CORING FOR V-ENGINES

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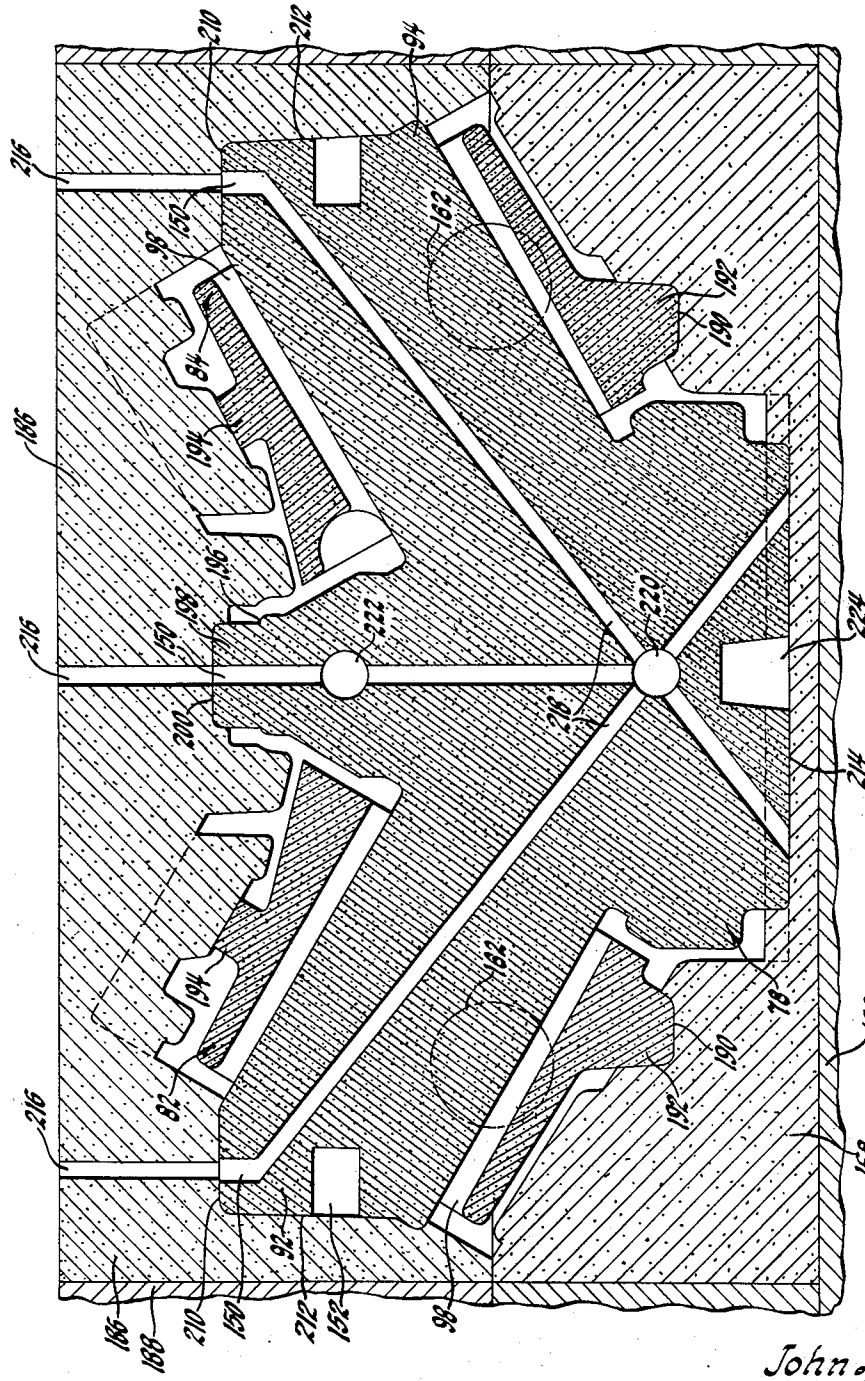



Fig. 11

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2,783,510

# CYLINDER BLOCK CORING FOR V-ENGINES

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Application February 26, 1953, Serial No. 339,098

8 Claims. (Cl. 22—131)

This invention relates to coring for engine castings and particularly to a coring arrangement and process for forming cylinder blocks of V-type engines. The features of this invention include a substantial reduction in the number of cores which must be employed and the elimination of excessive handling and sub-assembly.

Heretofore the conventional methods of arranging and assembling cores preparatory to casting cylinder blocks of internal combustion engines have required the forming, handling and assembling of a multiplicity of cores to form the final coring assembly. This coring problem is a particularly complicated one with respect to casting V-type engines. For example, conventional V-engines normally have required approximately 19 or 20 cores for the cylinder block, including cores which, in accordance with the present invention, are eliminated by a unique method of using the green sand of the mold.

Moreover, conventional coring arrangements and the assembling processes require extensive sub-assembly, including wiring, nailing and pasting of the cores. Each of the many cores is subject to some breakage due to handling, of course; and whenever cores are sub-assembled by pasting, as is conventionally done, there are numerous instances in which thin fins of metal remain. When these fins protrude into the water jacket passages, they tend to restrict water circulation so as to interfere with the proper operation of the engine. Such metal flashing also necessitates the use of increased machining operations, thus adding to the cost of the engine. Comparatively large amounts of core sand and binder must also be used in the conventional design.

A principal object of the present invention, therefore, is to provide a cylinder block coring arrangement and process for assembling the same in which the number of cores and quantity of core sand required are greatly reduced and sub-assembly of the cores is eliminated. A further object of this invention is to provide such an assembly and process which results in less core grinding, the eliminating of pasting, nailing and wiring of cores, less handling and core breakage, superior castings and lower overall foundry costs with respect to both personnel and materials.

These and other objects are attained in accordance with our invention by a cylinder block coring assembly in which a plurality of sand cores each having a pair of radially extending barrel portions are used to replace the multiplicity of base slab cores, end slab cores, bulkhead cores and barrel cores heretofore used. Moreover, the present invention employs only a single water jacket core for each cylinder bank, rather than the relatively complex water jacket core assemblies conventionally used, the latter necessitating grinding and pasting of the joined surfaces. By utilizing the green sand mold to full advantage



our arrangement also eliminates the need for a separate base slab core, venting cores, and a special camshaft gallery-defining core, thereby further reducing costs. The effective use of the green sand mold likewise results in a sounder cylinder block casting due to the greater porosity of the green sand as compared with the core material.

Other objects and advantages of this invention will more fully appear from the following detailed description of a preferred embodiment of the invention shown in the accompanying drawings, in which:

Figure 1 is an exploded perspective view of the multiplicity of cores heretofore conventionally used in casting a V-type engine cylinder block;

Figure 2 is an exploded perspective view of the five cores used to form a V-engine cylinder block in accordance with the present invention, spacer sleeves which may be employed in assembling the cores also being shown;

Figure 3 is a perspective view of the base of a core transfer fixture which may be used in assembling the cores shown in Figure 1;

Figure 4 is a perspective view, with parts broken away and in section, showing barrel-bulkhead cores of Figure 1 positioned on the base of the transfer fixture;

Figure 5 is a perspective view, with parts broken away and in section, of the base of the transfer fixture with the spacer sleeves and water jacket cores in assembled position on the barrel-bulkhead cores;

Figure 6 is a perspective view, with parts broken away and in section, showing the upper portion of the core transfer fixture in position over the core assembly and fixture base;

Figure 7 is a perspective bottom view, with parts broken away and in section, of the upper half of the core transfer fixture;

Figure 8 is a fragmentary perspective view showing the mold assembly positioned in the drag half of a green sand mold while attached to the upper half of the core transfer fixture;

Figure 9 is a perspective view, with parts broken away and in section, showing the details of the drag half of the green sand mold, together with an end slab sand core which may be used in conjunction therewith;

Figure 10 is a fragmentary perspective view of the drag half of the green sand mold in which is placed the sand core assembly with the temporary spacer sleeves removed preparatory to the positioning of the cope half of the mold and the pouring of the molten casting metal; and

Figure 11 is a sectional view through the core assembly and the green sand mold.

Referring more particularly to the drawings, in Figure 1 is shown a multiplicity of cores, in this instance 18 in number, which constitute a typical coring assembly for a cylinder block of a conventional 90° V–8 internal combustion engine. This arrangement includes barrel cores **10** and **12**, upper water jacket cores **14** and **16**, lower water jacket cores **18** and **20**, and camshaft core **22**. Such an assembly also requires the employment of a large base slab core **24**, front end slab core **26**, and a pair of rear end slab cores **28** and **30**. An upper block or face core **32** is also necessary as well as a plurality of separate bulkhead cores **34**, **36**, **38** and **40**. The last two cores necessary to complete the assembly are the end side cores **42** and **44**.

With this conventional coring arrangement for a V-type engine the adjacent faces of the upper and lower water jacket cores are initially ground to provide smooth sur-

faces and even contact between these parts. Then the upper water jacket core **14** is pasted to the lower water jacket core **18**, and the upper water jacket core **16** is pasted to the lower water jacket core **20** to thereby form two separate sub-assemblies. Similarly, the adjacent faces of the rear end slab cores **28** and **30** are ground to provide the smooth mating surfaces, and these faces are pasted together into a third sub-assembly.

After the completion of the above-described coring sub-assemblies, the base slab core **24** is positioned in the drag half of a green sand mold, and the four bulkhead cores **34**, **36**, **38** and **40** are placed in position on the upper surface of the base slab core between the generally cylindrical projections **46** formed thereon. The core prints **48**, which are provided on both end faces near the bases of each of the bulkhead cores, engage the end portions of the core print projections **46**. In this manner the bulkhead cores are maintained in proper longitudinal and lateral alignment with respect to the base slab core **24**.

The end slab core sub-assembly, consisting of cores **28** and **30**, is then positioned in the end of the green sand mold and abuts the end of the base slab core **24** and the adjacent face of the bulkhead core **34**. The recess **50** formed in the bottom of the end slab core **30** rests upon and engages the nearest end projection **46** on the base slab core **24**, thereby maintaining the rear end slab core assembly in proper lateral position with respect to the assembled bulkhead cores and base slab core.

Next the camshaft core **22** is placed on top of the smooth upper surfaces of the abutting bulkhead cores **34**, **36**, **38** and **40**. The rear end of the camshaft core **22** is positioned against and maintained in longitudinal alignment by the core print projection **52** which extends forward from the inner face of the rear end slab core **30**. Then the barrel portions **54** and **56** of the barrel cores **10** and **12** are inserted through the openings **58** and **60** provided in the water jacket core sub-assemblies formed by water jacket cores **14** and **18** and **16** and **20**, respectively. The assembled barrel cores and water jacket cores sub-assemblies are next positioned in the green sand in the drag half of a mold so that the ends of the barrels abut the flat sloping side faces **62** and **64**, respectively, of the bulkhead cores. The upper block wall core **32** is then placed over the assembled cores so that the recess or slot **66** in its lower surface rests on and is guided by the camshaft core **22**.

Following the positioning of the core **32**, the rear end side cores **42** and **44** are placed over the rear end slab core assembly formed by cores **28** and **30** so that the inner arcuate walls **68** of the former are seated upon the outer semi-cylindrical surfaces of the end slab core assembly. When the cores **42** and **44** are in this position, the green sand in the drag supports their lower edges and their outer vertical faces **70**, thus maintaining these cores in proper location. Positioning of the front end slab core **26** against the projections **72** on the bulkhead core **40** completes the assembly. The outer end face of core **26** abuts a smooth inner end surface of the green sand in the mold, as does the analogous end face of rear end slab core **28**.

It will be understood, of course, that various of the above-described cores could be arranged in sub-assemblies by pasting, wiring, nailing or other known means in a manner other than that described. The assembling procedure indicated above, however, is one frequently used in automobile cylinder block manufacture. In most instances, a considerable number of these cores are first sub-assembled in a core transfer fixture and deposited by means of this fixture in the green sand in the drag half of the mold. The green sand in the cope is then placed in position over the assembled cores and the green sand in the drag, and molten casting metal is poured into the mold and around the cores.

Referring now to Figure 2, showing a coring arrangement embodying the present invention, it will be noted



that only five basic cores are required to cast a V-type cylinder block of a 120° six-cylinder internal combustion engine. Three combined barrel and bulkhead cores **76**, **78** and **80** and a pair of water jacket cores **82** and **84** are all that are required. If it is desired to cast a V–8 cylinder block, instead of a V–6 engine block, this can be done by employing the same basic cores and necessitates the use of only one additional barrel-bulkhead core, bringing the total number of cores required to six. Of course, slightly longer water jacket cores would be used, each containing an additional opening for receiving the two extra barrels. These five and six core arrangements, therefore, compare with the approximately twenty cores conventionally required.

As shown in Figure 2, the barrel-bulkhead cores **76**, **78** and **80** comprise body or bulkhead-defining portions **86**, **88** and **90**, respectively, which are approximately triangular in vertical transverse cross-section, and generally cylindrical barrel portions **92** and **94**, which define the left and right cylinder banks, respectively. The assembly of the cores shown in Figure 2 results in a coring arrangement in which the body or bulkhead-defining portions **86**, **88** and **90** of the barrel-bulkhead cores have their adjacent end faces abutting one another and their bottom surfaces resting in the green sand in the drag half of the mold. The water jacket core **82** is positioned so that the adjacent generally cylindrical barrel portions **92** of the barrel-bulkhead cores extend through a plurality of openings or bores **96** formed in the water jacket core **82**. Likewise, the water jacket core **84** is provided with a plurality of openings **98** which extend through the core and into which the adjacent barrel portions **94** of the barrel-bulkhead cores project. In this manner the various segments of the water jacket cores each, in effect, forms a sleeve having internal cylindrical walls which are spatially separated from the barrel portions **92**. Figure 11 best shows this arrangement of the cores after they are assembled in the green sand mold.

A preferred method of assembling the cores in the green sand mold, in accordance with our invention, is shown in Figures 3 through 10, a core transfer fixture preferably being used to expedite the assembly of these cores. The base of the transfer fixture is shown in Figure 3 and includes a generally flat, horizontal plate **100** to the bottom of which are attached supports or legs **102**. A pair of box or end frame portions **104** and **106**, each of which is provided with an upstanding aligning pin or dowel **108**, are mounted on the base plate near the ends thereof.

Between these box portions and fastened to the upper surface of the bottom plate **100** is a generally rectangular guide frame **110**. In assembling the cores on the base of the transfer fixture, the bottom portions of the barrel-bulkhead cores are placed within the recess **112** defined by the upper surface of the base panel **100** and the inner surfaces of the frame **110**. Figure 4 shows the exact positions of the barrel-bulkhead cores on the base of the transfer fixture. The adjacent end faces of the barrel-bulkhead cores abut one another, and the lower lateral edges of the cores are in contact with the inner surfaces of the guide frame **110**. Once so assembled on the base of the transfer fixture, these cores are securely maintained in position by the frame and are prevented from sliding either longitudinally or laterally.

After the barrel-bulkhead cores **76**, **78** and **80** are positioned within the recess **112**, a plurality of metallic spacer sleeves **114** may be employed to properly space the water jacket cores **82** and **84** from the barrel portions **92** and **94** of the barrel-bulkhead cores. These sleeves, which are best shown in Figure 2, are preferably slightly conical in shape and their smallest internal diameters are somewhat smaller than the outside diameters of the barrel portions of the barrel-bulkhead cores. Thus, when the spacer sleeves are assembled over the barrel portions of the barrel-bulkhead cores, the outward taper of their inner surfaces prevents their sliding downwardly on these barrel portions to an excessive extent. Thus these sleeves are

so designed and are of such a length that their inner or lower edges are spatially separated from the sloping side surfaces of the body or bulkhead-defining portions **86**, **88** and **90** of the barrel-bulkhead cores. When the spacer sleeves **114** are securely in position around the barrel portions **92** and **94** of the barrel-bulkhead cores, the two water jacket cores **82** and **84** are placed over the sleeves and the barrel portions so that the latter protrude completely through the openings **96** and **98** in the water jacket cores. This assembly of these cores on the base of the core transfer fixture is shown in Figure 5.

The upper half of the core transfer fixture, indicated generally by **115**, the details of construction of which are best shown in Figure 6 through 8 and which will be hereinafter more fully described, is then placed in position over the assembled cores and the base of the transfer fixture. This upper half of the transfer fixture includes a generally rectangular frame **116**, the inner edges of which define an elongated opening through which the upper portions of the assembled molds project. A pair of openings **118**, one at each end of the frame, are provided in the frame for receiving the aligning pins **108** projecting from the base of the fixture. The core-clamping portion of the upper half of the fixture is formed by a plurality of longitudinally extending bracket members **120** and transversely extending members **122** secured together by screws or other suitable means. Members **122** in turn are rigidly affixed to the frame **116**.

A plurality of blocks **124**, which are shown as being generally semi-cylindrical in shape, are attached to the upper surface of frame **116** and function as cylinders for transversely extending retaining pins **126** which are slidably mounted therein. The longitudinally extending bracket members **120** are similarly provided with openings **127** in which vertical pins **128** are slidable. Levers or handles **130** may be affixed to these vertically retractible pins and project laterally through slots **132** formed in the side surfaces of members **120**, as shown. Such a construction permits vertical movement of the handles **130** in slots **132** to vertically slide the pins **128**, and these handles may also serve as means for retaining the pins within the supporting members **120**. The blocks or cylinders **124** may likewise be provided with slots or handles, not shown, or the longitudinally extending bars **134** may be affixed to the ends of pins **126** and laterally movable therewith. In this manner, the bars **134** may serve as handles by means of which the pins **126** may be reciprocated into and out of mold-engaging position.

Angularly extending retaining pins **131** likewise are shown as provided in blocks **133** rigidly secured to the outer side surfaces of transversely extending supporting members **122**. These blocks also may be provided with slots **135** through which levers or handles **137** project. The handles, of course, are affixed to the retractible pins **131** and are slidable within the slots to reciprocate the pins at an angle relative to the frame of the core transfer fixture. This angle is preferably such that the pins **133** are slidable in a direction generally parallel to the barrel portions of the barrel-bulkhead cores.

If desired, other angularly arranged blocks **136** may be affixed to the inner face of the transverse bracket members **122**, and provided with retractible pins **138** which are slidable in a direction normal to the core barrels. Still other blocks **140** may be mounted on members **122** and provided with retaining pins **142** which are reciprocable generally perpendicular to the axes of pins **138**. Longitudinally slidable pins **144** are also shown as supported by vertically extending arms **146** provided at the rearward end of the core transfer fixture. As with the other retaining pins, these pins may be actuated by means of handles **148**.

In removing the assembled cores from the base of the core transfer fixture, the upper half of the fixture is lowered over the base so that the aligning pins or dowels **108** project through the openings **118** and prevent either longitudinal or lateral movement of the upper half of the transfer fixture relative to the fixture base. To retain the molds in proper assembled position during transfer from the base of the mold transfer fixture to the drag half of the green sand mold, the various retractible retainer pins are inserted into special openings provided in the cores. More specifically, the handles **130** are depressed, thereby lowering pins **128** into openings **150** provided in the upper face of the bulkhead portions **86**, **88** and **90** of the barrel-bulkhead cores **76**, **78** and **80** and in the barrel portions **92** and **94** of these cores near the ends thereof. Similarly, pins **126** are moved radially inwardly toward the center of the core assembly to engage openings **152** in the vertical end surfaces of the barrel portions of the barrel-bulkhead cores. In like manner, pins **142** may be used to engage openings **154** in the upper surfaces of the water jacket cores or such pins may be used merely to engage the outer surfaces of the water jacket cores. If it is desired to do so, any of the other retractible pins may be moved into mold-retaining position.

All of the aforementioned pins and holes are not shown in the drawings to be in alignment, and it is not necessary to have all of the retractible pins engaging the cores in order to retain the latter in assembled position during transfer. Actually, only pins **126** are required to hold the assembly for transfer to the drag. The various other retractible pins are primarily designed as checking pins to check the core assembly for proper core location, alignment of vent passages and core supports, etc. Moreover, some of these pins may be used in place of sleeves **114** to space the water jacket cores from the barrel-bulkhead cores.

Upon positioning a suitable number of the retractible pins in the appropriate locating holes, as indicated above, the assembled cores are in condition to be transferred to the green sand **158** in the drag half **159** of the metal flask. As shown in Figure 9, the green sand in the drag has been molded so as to provide core prints **160** in which core print projections **162** at the ends of the water jacket cores **82** and **84** may rest. The various other indentations, such as grooves or slots **164** and recesses **166**, are provided to form appropriate crankcase parts of the cylinder block casting.

A sprue core **168** is shown in Figure 8 as insertable within a generally rectangular recess **170** in the green sand in the drag. A vertically extending groove **172** formed in the end wall of the green sand mold cooperates with a similar groove **173** in the sprue core to form a sprue for the molten casting metal. This sprue, of course, is open to the atmosphere at its enlarged, rectangular upper end **174** and communicates with the mold cavity at its lower end by means of the longitudinally extending recess **176** provided in the green sand of the drag. The sprue core **168** is provided with a similar recessed design to form a generally cylindrical gate and sprue. When the sprue core is inserted within the recess **170** and the other cores are in assembled position within the mold, the inner face of the sprue core abuts the adjacent end or rear face of the end barrel-bulkhead core **80**, as shown in Figures 8 and 10. These two cores provide an interjacent cavity which forms the rear main bearing block of the cylinder block.

Upon transfer of the assembled cores and the upper half **115** of the assembly fixture to the green sand **158** in the drag **159**, the fixture is positioned over the drag so that aligning pins or dowels **180** projecting from the upper surface of the mold drag extend through the openings **118** in the upper half of the transfer fixture and maintain the fixture and assembled cores in proper alignment with respect to the drag. When the cores are thus properly located within the mold cavity, the bases of the barrel-bulkhead cores **76**, **78** and **80** are seated on the upper surfaces **184** of the bottom of the mold cavity and the core projections **162** of the water jacket cores **82** and **84** are supported by the core prints **160** in the green sand

in the drag. The various locating pins in the upper half of the transfer fixture are then retracted from the locating holes in the cores, and the fixture is removed from the drag, leaving the core assembly in proper assembled position in the drag half **158** of the green sand mold.

The spacer sleeves **114** may then be withdrawn from the openings **96** and **98** in the water jacket cores and from around the barrel portions **92** and **94** of the barrel-bulkhead cores. As will be hereinafter more fully explained, the support provided at appropriate locations by the bottom surfaces of the green sand maintains the barrel-bulkhead cores in proper position. Similarly, the core prints **160** which support the core print projections **162** retain the water jacket cores in assembled position and spatially separate these cores from the barrel portions **92** and **94** of the barrel-bulkhead cores. In this manner annular cylinder walls having equal thicknesses throughout their circumferences are formed in the cylinder block. Although spacer sleeves **114** are employed in the embodiment of the invention shown in the drawings, it will be understood, as hereinbefore indicated, that the transfer fixture could equally well be designed to retain the spatial relationship between the water jacket cores and the barrel-bulkhead cores without the use of such spacer sleeves by the provision of other suitable retractible locating pins. Such a construction generally would be preferable to one using spacer rings and would facilitate assembly of the cores and mold.

The arrangement of the cores assembled in the green sand mold after removal of the upper half of the transfer fixture is shown in Figure 10. The cope half **188** of the flask containing green sand **186** is then placed in position over the drag and retained in alignment by the locating pins or dowels **180**. Thus assembled, the green sand mold and cores are in condition for pouring of the molten casting metal. The formed sprue and gate **172—173—174—176** may be connected to another sprue portion in or through the green sand in the cope. The exact positioning of the cores relative to the green sand in both the cope and the drag is best shown in the sectional view of Figure 11. It will be seen from Figures 9 and 10 that the water jacket cores **82** and **84** are supported by means of core prints **190** in the sloping side walls of the green sand of the drag, these core prints engaging the core print projections or core locators **192** formed on the lower surfaces of the water jacket cores **82** and **84**. This support is in addition to that provided by the longitudinal core print projections **162** which are seated in core prints **160** formed in the green sand on the mold parting line at both ends of the mold cavity.

As shown in Figure 11, generally cylindrical projections or mold locators **194** are shown as formed on the upper surfaces of the water jacket cores and, when these cores are assembled within the mold, engage the lower surfaces of the green sand **186** in the cope. These locators prevent floating of the water jacket cores during the metal pouring operation. If desired, the core locators **194** may be printed into the cope in order to perform a further locating function. Likewise, the top surfaces of the upper camshaft gallery-defining portion **196** of the barrel-bulkhead cores may be provided with vertically extending, generally cylindrical projections or core locators **198** which, as shown in Figure 11, may be adapted to engage core prints **200** formed in the green sand of the cope. The lower lateral surfaces of the green sand in the cope rest upon the upper horizontal wall surfaces **210** of the barrel portions of the barrel-bulkhead cores and abut the generally vertical end walls of the barrel portions, as shown at **212**. The only other areas of contact between the green sand and the core assembly are where the bottom surfaces **214** of the bases of the barrel-bulkhead cores are supported by the green sand of the drag half of the mold.

A plurality of appropriate vertically extending vents **216** are formed in the cope to permit the escape of the core gases generated during and after pouring of the molten casting metal. These vents communicate with the openings **150** extending through the upper surfaces of barrel portions **92** and **94** and camshaft gallery-defining portions **196** of the barrel-bulkhead cores **76**, **78** and **80**. The openings **150** in each of the barrel portions of the barrel-bulkhead cores are angularly extended, as indicated at **218**, through the barrel portions to the bottom of these cores. As shown in Figure 11, these openings or passages intersect at a lower longitudinally extending vent **220**. Likewise, each of the openings or vents **150** in the bulkhead portions of the barrel-bulkhead cores preferably extends vertically through almost the entire height of the barrel-bulkhead core in which it is formed, intersecting an upper horizontal, longitudinally extending vent **222** and terminating at the lower longitudinal vent **220**. It will be noted that the venting arrangement in this coring assembly is exceedingly simple and requires no special venting or breather cores as have heretofore normally been used in engine block coring.

Longitudinally extending gates **224** are shown in Figure 11 as being provided in the bases or bottom portions of the barrel-bulkhead cores and communicate with the sprue **176—172—173—174** distributing the molten casting metal through laterally and upwardly extending grooves **164** in the green sand in the drag. Of course, the gating can be varied to suit the needs of the particular foundry using this coring assembly, the gating system shown being merely an example of one arrangement which has proved to be highly satisfactory.

In order to reduce the amount of cast iron required and to simplify the cooling problem, in some instances it may be desirable to add a rear end slab core and/or a front end slab core. Moreover, if the fly wheel housing and front cover for the timing mechanism housing are desired to be incorporated in the cylinder block casting, a fly wheel housing core as well as a front end core should be included in the coring assembly.

Apart from a reduction of the total number of cores required, the above-described novel method of core assembly provides many additional advantages. For example, as hereinbefore indicated, this arrangement eliminates the special breather or venting cores normally employed to provide for the escape of core gases. Moreover, our arrangement involves only one core assembly rather than the several sub-assemblies heretofore required, thus eliminating the necessity of nailing or pasting such core sub-assemblies together. It will also be noted that the green sand in the mold is used considerably more extensively than with the coring arrangement previously used, thereby resulting in a considerable saving in both labor and materials. Further savings are provided by a reduction in the amount of core-making equipment, core driers, etc., required, together with the attendant reduction in labor costs. For example, if an end slab core is used, it is the only core which invariably requires the use of a contour drier, unlike conventional coring assemblies requiring a multiplicity of such contour driers. Although it may be desirable for particular engine designs to also employ contour driers with the barrel-bulkhead cores, only plate driers are needed for the remaining cores of the present invention. With respect to reducing the amount of materials necessary, it will be observed that the core sand bulk necessary with our arrangement is substantially decreased as compared with the arrangement shown in Figure 1. Moreover, the present invention makes it possible to use green sand to form sounder cylinder block castings at a considerably reduced cost as compared with methods heretofore used.

While a specific embodiment of our invention has been shown and described in detail, it will be understood that various changes in the details of construction of the coring arrangement and in the methods of assembling the cores and mold may be made without departing from

the scope of the invention as set forth in the following claims.

We claim:

1. A coring assembly for insertion in a green sand mold for casting a cylinder block of a V-type internal combustion engine, said coring assembly comprising a plurality of sand cores having end faces adapted to be placed in abutting relationship, said cores each having a generally triangular crankcase-defining body portion and an integral upper portion for forming a camshaft gallery of an internal combustion engine, each of said cores having side faces provided with outwardly extending and angularly disposed generally cylindrical barrel portions, and a pair of sand water jacket cores each having a plurality of generally cylindrical openings extending therethrough insertable around said barrel portions, said cores, when so assembled, providing a space interjacent said water jacket cores and said barrel portions for receiving molten casting metal.

2. A mold and coring assembly for casting a cylinder block of a V-type internal combustion engine, said assembly comprising a drag half of a green sand mold having its upper surfaces recessed to partially define a mold cavity, barrel-bulkhead cores positioned in said drag half of the mold, said barrel-bulkhead cores each being provided with a body portion which is generally triangular in cross section and a pair of cylinder-defining portions angularly extending therefrom, the upper parts of said body portions defining a camshaft gallery of the cylinder block to be cast, a pair of water jacket cores having openings in which said barrel portions are positioned, said water jacket cores having core locators depending therefrom and engaging core prints formed in the green sand in the drag, and a cope half of a green sand mold positioned over said cores and said drag half, portions of said cope half contacting the green sand of the drag and the barrel portions of the barrel-bulkhead cores.

3. A mold and coring assembly for casting a cylinder block of a V-type internal combustion engine, said assembly comprising a drag half of a green sand mold having its upper surfaces recessed to partially define a mold cavity, a plurality of sand barrel-bulkhead cores positioned in said drag half of the mold, said barrel-bulkhead cores each being provided with a body portion which is generally triangular in cross section and a pair of extending cylinder-defining barrel portions angularly extending from faces of said body portion, the upper parts of said body portions defining the camshaft gallery of the cylinder block to be cast, a lower surface of said body portion being positioned on an upper surface of the green sand in the drag half of the mold, a pair of water jacket sand cores having generally cylindrical openings in which said barrel portions are positioned, the walls of said openings being spatially separated from the side walls of said barrel-bulkhead cores, said water jacket cores each having core print projections extending from the lower surfaces thereof and engaging core prints formed in the green sand in the drag half of the mold, a plurality of core locators formed on the upper surfaces of the sand water jacket cores and extending generally upwardly therefrom, and a cope half of a green sand mold positioned over said cores and said drag half, said cope half being provided with lateral portions contacting upper surfaces of the green sand in the drag and the ends of the barrel portions of the barrel-bulkhead cores, a portion of said green sand cope being seated upon the camshaft gallery-defining portions of the barrel-bulkhead cores, portions of the green sand in the cope which are laterally intermediate said ends of the barrel portions and said camshaft gallery-defining portions being seated upon the core locators formed on the upper surfaces of the water jacket cores.

4. A process for forming a sand mold and core assembly to be used in casting a cylinder block of a V-type internal combustion engine, said process comprising positioning upon the base of a transfer fixture a plurality of barrel-bulkhead cores each having a pair of outwardly extending cylinder-defining portions, placing a plurality of water jacket cores around said cylinder-defining portions, thereafter positioning the upper half of said transfer fixture over the formed core assembly and base, subsequently engaging openings in said assembly with movable pins in said upper half of the transfer fixture, removing said upper half and attached core assembly from said base and locating said assembly in the drag half of a green sand mold, withdrawing the pins in said fixture from the openings in said assembly and removing the upper portion of the fixture, and thereafter placing the cope half of the green sand mold over said core assembly and drag half.

5. The process of casting a cylinder block of a V-type interal combustion engine, said process comprising positioning upon the base of a core transfer fixture a plurality of sand cores each having a generally triangular crankcase-defining body portion and a pair of outwardly extending and angularly disposed cylinder-defining portions, arranging said cores so that the body portions thereof are in abutting relationship and the corresponding cylinder-defining portions of each core are aligned to form a pair of banks, placing a water jacket sand core having a plurality of generally cylindrical openings on said fixture base so that said cylinder-defining portions extend through said openings, thereafter positioning the upper half of said transfer fixture over the formed core assembly and base, subsequently engaging openings in said assembly with retractible pins in said upper half of the transfer fixture to maintain said cylinder-defining portions and water jacket cores in spaced relationship, removing said upper half and attached core assembly from said base and positioning said assembly in the drag half of a green sand mold, retracting the pins in said fixture from the openings in said assembly and removing the upper portion of the fixture, thereafter placing the cope half of the green sand mold over said core assembly and drag half, and finally pouring molten casting metal into the formed mold cavity between said mold halves and core assembly.

6. A coring assembly for use in a green sand mold for casting a cylinder block of a V-type internal combustion engine, said coring assembly comprising a plurality of sand cores having end faces adapted to be placed in abutting relationship, said cores each having a body portion with an integral upper portion for forming a camshaft gallery of an internal combustion engine, each of said cores being provided with a pair of barrel portions extending outwardly on opposite sides of said body portion, and a pair of sand water jacket cores each having a plurality of generally cylindrical openings extending therethrough insertable around said barrel portions, said cores, when so assembled, providing a generally annular space interjacent said water jacket cores and said barrel portions for receiving molten casting metal.

7. A coring assembly for use in a green sand mold for casting a cylinder block of a V-type internal combustion engine, said assembly comprising a plurality of abutting baked sand cores each having a body portion with an integral upper portion for forming a camshaft gallery of an internal combustion engine, each of said cores also being provided with a pair of angularly disposed cylinder-defining barrel portions extending outwardly from said body portion on opposite sides thereof, all of said barrel portions on one side of said body portions being in alignment with one another, and a pair of baked sand water jacket cores each having a plurality of generally cylindrical openings through which the barrel portions on one side of said body portions extend, said water jacket cores being spatially separated from said barrel portions.

8. A mold and coring assembly for casting a cylinder block of a V-type internal combustion engine, said assembly comprising a drag half of a green sand mold hav-

ing its upper surfaces recessed to partially define a mold cavity, barrel-bulkhead cores positioned in said drag half of the mold, said barrel-bulkhead cores each being provided with a body portion and a pair of cylinder-defining portions angularly extending from said body portion on opposite sides thereof, a pair of water jacket cores having openings in which said barrel portions are positioned, said water jacket cores having core locators depending therefrom and engaging core prints formed in the green sand in the drag, and a cope half of a green sand mold positioned over said cores and said drag half, portions of said cope half contacting the green sand of the drag and the barrel portions of the barrel-bulkhead cores.



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