May 26, 1959 D. HALLIDAY 2,887,744

PATTERN FOR IMPELLER CORE

Filed Sept. 20, 1957 3 Sheets-Sheet 1

Fig. 1.

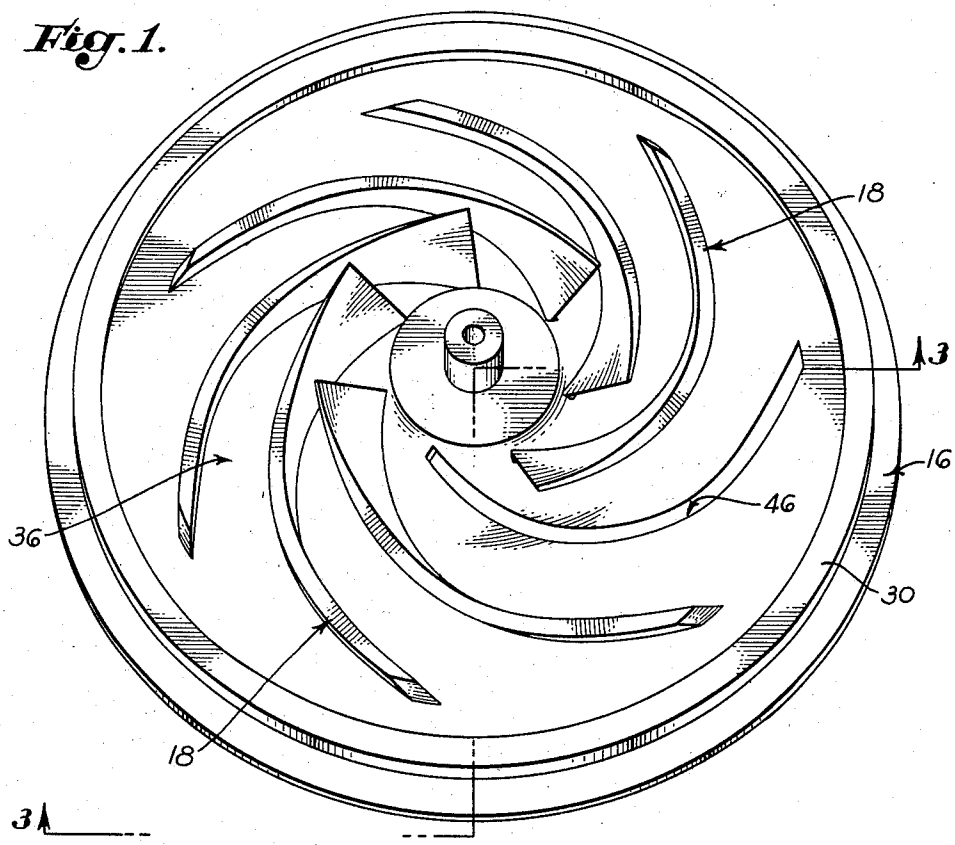
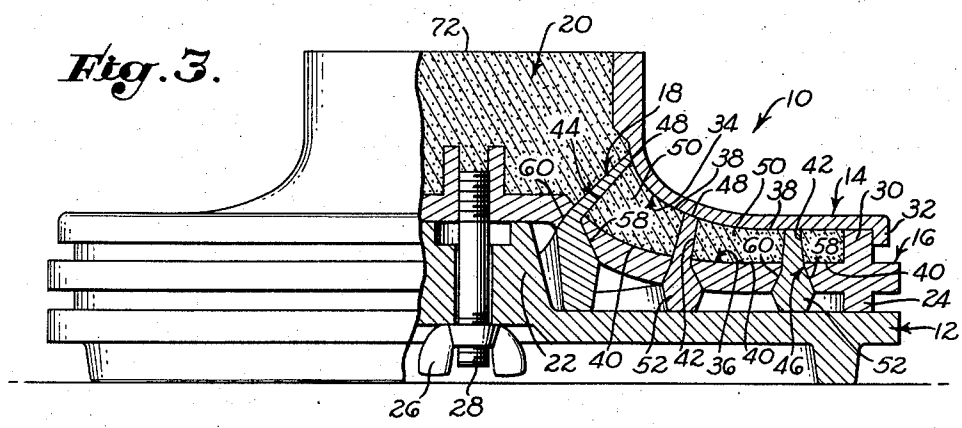


Fig. 3.



INVENTOR.
DAVID HALLIDAY

BY HIS ATTORNEYS.
HARRIS, KIECH, FOSTER & HARRIS

May 26, 1959 D. HALLIDAY 2,887,744

PATTERN FOR IMPELLER CORE

Filed Sept. 20, 1957 3 Sheets-Sheet 2

Fig. 2.

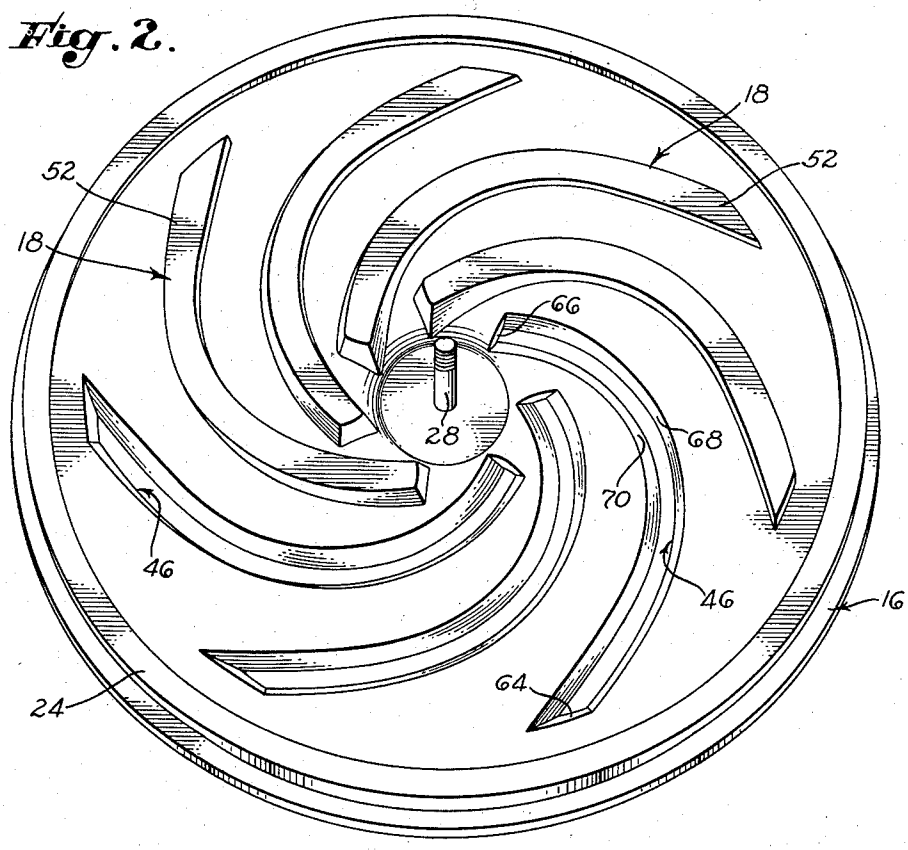
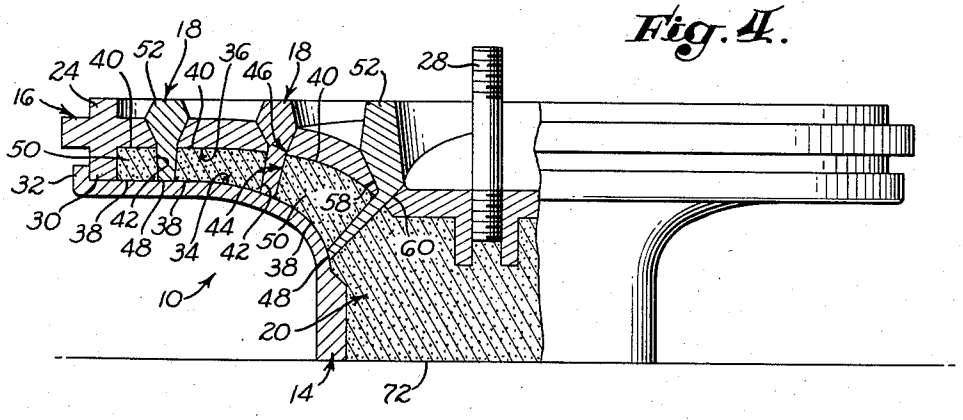


Fig. 4.



INVENTOR.
DAVID HALLIDAY

BY HIS ATTORNEYS.
HARRIS, KIECH, FOSTER & HARRIS

May 26, 1959 D. HALLIDAY 2,887,744

PATTERN FOR IMPELLER CORE

Filed Sept. 20, 1957 3 Sheets-Sheet 3

Fig. 5.

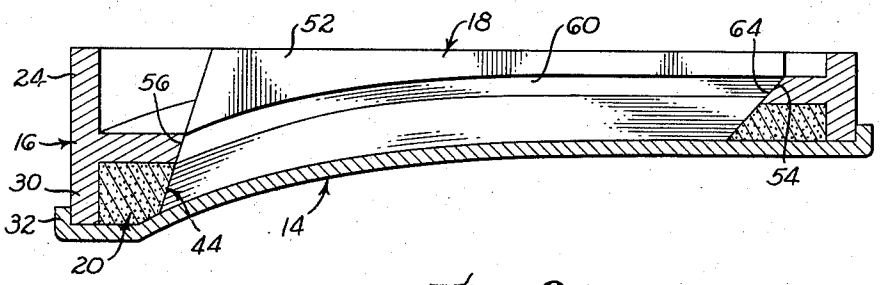


Fig. 6.

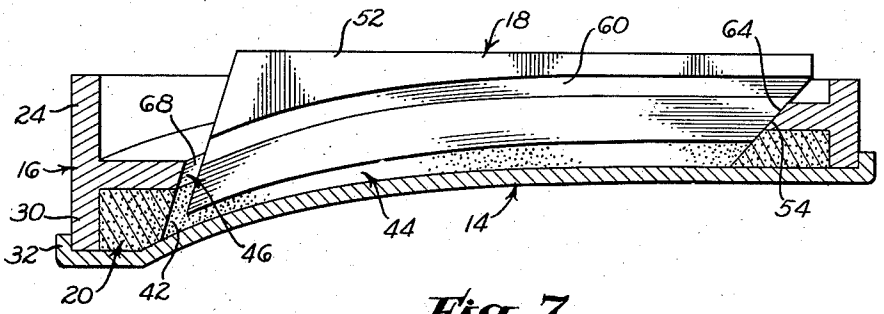
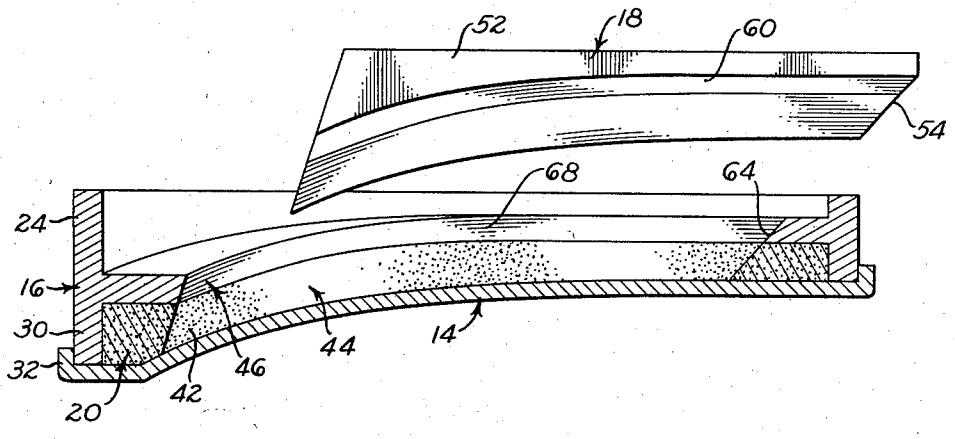


Fig. 7.



INVENTOR.
DAVID HALLIDAY

BY HIS ATTORNEYS.
HARRIS, KIECH, FOSTER & HARRIS

United States Patent Office 2,887,744 Patented May 26, 1959

2,887,744

PATTERN FOR IMPELLER CORE

David Halliday, Huntington Park, Calif., assignor, by mesne assignments, to Dresser Industries, Inc., a corporation of Delaware

Application September 20, 1957, Serial No. 685,781

4 Claims. (Cl. 22—158)

The present invention relates in general to patterns for making molds or cores and, more particularly, to a pattern for making a mold or core which is to be used in the casting of an article including components having complex configurations, or components arranged in complex fashion.

Since the present invention was initially embodied in and is particularly applicable to a pattern for making a core to be used in the casting of a centrifugal pump impeller having internal, outwardly spiralling passages, the invention will be considered herein in connection with such an impeller for convenience in effecting a disclosure thereof. However, it will be understood that the invention is applicable to patterns for making molds or cores utilized in the casting of other articles as well.

In a centrifugal pump impeller of the type under consideration herein, the internal, outwardly spiralling passages receive the fluid to be pumped through an axial inlet and discharge the fluid radially outwardly by centrifugal action. These internal passages are separated by integral, outwardly spiralling blades which are twisted from their inner ends toward their outer ends and which thus have complex curvatures. In making a core for use in casting such a centrifugal pump impeller, the core sand or other material of which the core is made must be provided with cavities conforming in configuration to the desired blade configuration and conforming in arrangement to the desired blade arrangement. Because of the intricate blade shapes and blade arrangements involved in impellers of this kind, the making of cores from which impellers with the proper blade configurations and arrangements may be cast presents difficult core-making problems, a primary object of the invention being to overcome such problems in a simple and straightforward manner.

One conventional way of making cores for use in the casting of centrifugal pump impellers involves making each core in a plurality of circumferentially arranged sections suitably secured together with gaps therebetween to form the blades. This procedure is open to objection because of the time and expense involved in making and piecing together a plurality of core sections.

Another conventional practice is to mount a plurality of blade patterns in a core box and fill the spaces therebetween with core sand. Subsequently, the blade patterns are removed from the core box manually one at a time to leave the desired blade cavities in the core. This practice requires extreme care and skill on the part of the core maker in twisting or threading the blade patterns out of the cavities in the core without damaging the core. This practice is time consuming and thus expensive, and is open to the additional disadvantage that the core may be damaged to such an extent that discarding thereof is necessary.

An important object of the invention is to provide a pattern capable of making a one-piece core, thereby avoiding the disadvantages of a sectional core, and capable of mechanically guiding the blade patterns out

of the cavities in the core accurately and positively in such a manner as to substantially eliminate any possibility of damage to the core, thereby avoiding the disadvantages of the aforementioned procedure which involves guiding the blade patterns out of the cavities manually.

More particularly, a basic object of the invention is to provide an impeller core pattern which includes a guide member and interengageable means solely on the guide member and the blade patterns for guiding the blade patterns out of engagement with the guide member along predetermined paths conforming to the configurations of the blade patterns, and thus conforming to the configurations of the cavities in the core.

Still more particularly, an important object of the invention is to provide interengageable means solely on the guide member and the blade patterns for twisting or threading the blade patterns out of engagement with the guide member along curved paths the curvatures of which conform to the curvatures of the blade patterns, and thus conform to the curvatures of the cavities in the core.

With the foregoing impeller core pattern of the invention, the guide member and the blade patterns cooperate to twist or thread the blade patterns out of the cavities in the core in such a manner as to minimize the possibility of damage to the core, which is an important feature.

Another object of the invention is to provide a guide member having curved guide slots therein which receive the curved blade patterns and through which the blade patterns extend from one side of the guide member to the other, the blade patterns being adapted to form the desired core on one side of the guide member and being provided on the other side of the guide member with heads or handles by means of which they may be removed from the cavities in the core through the guide slots in the guide member.

Another object is to provide guide slots and blade patterns the configurations of which are so related that the blade patterns can be removed from the cavities in the core only along paths the curvatures of which conform to the curvatures of the cavities in the core so that the possibility of damage to the core is minimized.

A further object of the invention is to provide a pattern wherein the interengageable means mentioned for guiding the blade patterns out of engagement with the guide member include interengageable cam surfaces respectively located at the edges of the guide slots and on the blade patterns. The related object is to provide such cam surfaces which comprise beveled edges of the guide slots and complementary beveled surfaces on the blade patterns.

The foregoing objects, advantages, features and results of the present invention, together with various other objects, advantages, features and results thereof which will be evident to those skilled in this art in the light of the present disclosure, may be attained with the exemplary embodiment of the invention described in detail hereinafter and illustrated in the accompanying drawings, wherein:

Fig. 1 is a perspective view of one side of an impeller core pattern of the invention;

Fig. 2 is a perspective view of the opposite side of the impeller core pattern;

Fig. 3 is a view, partially in longitudinal section and partially in elevation, of a core box incorporating the impeller core pattern, Fig. 3 being taken substantially along the irregular arrowed line 3—3 of Fig. 1 with respect to the impeller core pattern;

Fig. 4 is a view, partially in longitudinal section and partially in elevation, which is similar to Fig. 3, but which shows the core box inverted relative to the position there-

of shown in Fig. 3 and shows part of the core box housing removed; and

Figs. 5, 6, and 7 are partially sectional and partially perspective views illustrating the manner in which an impeller blade pattern of the invention is removed from a guide member thereof and from a cavity formed in an impeller core by the blade pattern, Figs. 5, 6, and 7 being somewhat diagrammatic and thus subject to some distortion.

In the drawings, the numeral **10** designates an impeller core box which includes two housing members **12** and **14** adapted to receive therebetween a guide member **16** and impeller blade patterns **18** of the invention. As will be described in more detail hereinafter, these components cooperate to make a core **20** for use in the casting of a centrifugal pump impeller having internal, radially outwardly spiralling passages.

Considering the core box **10** in more detail, the guide member **16** and the housing member **12** are spaced apart axially of the core by a central boss **22** on the housing member **12** and an annular rib **24** on the guide member. The housing and guide members **12** and **16** are adapted to be clamped together by a nut **26** seated against the housing member **12** and threaded on a stud **28** carried by the guide member **16**. The housing member **14** is adapted to seat on another annular rib **30** on the guide member **16** and is provided with a marginal flange **32** which telescopes over the annular rib **30**.

The housing and guide members **14** and **16** are provided with annular surfaces **34** and **36**, respectively, which are convex and concave, respectively, in cross section and which provide the core **20** with axially spaced surfaces **38** and **40**, respectively, corresponding to axially spaced walls of the outwardly spiralling internal passages through the centrifugal pump impeller ultimately to be formed by the core. The blade patterns **18** provide the core with surfaces **42** which correspond to radially spaced walls of the outwardly spiralling internal passages of the ultimate impeller, the surfaces **42** of the core being the walls of impeller blade cavities **44** formed in the core by the patterns **18**.

Considering generally the relationship between the guide member **16** and the blade patterns **18**, it will be noted that the blade patterns have rather complex configurations and may perhaps best be described as curving or spiralling generally radially outwardly away from the axis of the guide member to provide the surfaces **42** of the core **20** with the configurations necessary to form the corresponding walls of the internal passages of the centrifugal pump impeller with the requisite shapes. Because of the complex configurations of the blade patterns **18** and the cavities **44** in the core **20** formed thereby, it is necessary to guide the blade patterns out of the cavities **44** along curved paths the curvatures of which conform to the curvatures of the blade patterns and the cavities so as to prevent damage to the core **20**, the present invention providing interengageable means on the guide member and the blade patterns for guiding the blade patterns out of the cavities in the core in an accurate and positive manner.

More particularly, the guide member **16** is provided therethrough with a plurality of guide slots **46** which curve or spiral generally radially outwardly from the axis of the guide member and which are spaced apart circumferentially about such axis. The blade patterns **18** are insertable into the guide slots **46** and extend therethrough from one side of the guide member **16** to the other, the blade patterns having edges **48** which are engageable with the convex surface of the housing member **14**. Thus, the blade patterns **18** divide the core **20** into radially outwardly spiralling sections **50** corresponding in configurations to the configurations of the internal passages in the centrifugal pump impeller which is ultimately cast from the core **20**.

The blade patterns **18** are provided, on the side of the guide member **16** which is adjacent the housing member **12**, with enlarged heads **52** serving as handles by means of which the blade patterns **18** may be grasped manually to remove them from the guide slots **46** in the guide member **16** and from the cavities **44** in the core **20**. The heads **52** of the blade patterns **18** seat against the housing member **12** of the core box **10**, as shown in Fig. 3 of the drawings, when the core box is assembled, whereby the housing member **12** prevents inadvertent removal of the blade patterns **18** from the guide slots **46**.

The heads **52** of the blade patterns **18** are provided with beveled or tapered cam surfaces **54**, **56**, **58** and **60** which converge generally toward the edges **48** of the blade patterns and which are adapted to seat on complementary cam surfaces **64**, **66**, **68** and **70**, respectively, forming the edges of the guide slots **46**. As will become apparent, the relationships between the curvatures of the blade patterns and the guide slots **46** and the relationships between the configurations of the beveled surfaces **54**, **56**, **58** and **60** on the blade-pattern heads **52** and the beveled surfaces **64**, **66**, **68** and **70** on the guide member **16** are such that the blade patterns may be disengaged from the guide member only by movement of the blade patterns axially and generally radially outwardly out of the cavities **44** in the core **20** along curved paths conforming in curvature to the curvatures of the cavities **44**. Thus, damage to the core **20** as the blade patterns **18** are withdrawn from the cavities **44** therein is prevented, which is the important feature of the invention.

Considering the operation of the invention, the housing member **12**, the guide member **16** and the blade patterns **18** are assembled with the housing member **12** resting on a suitable supporting surface, the blade patterns **18** thus projecting upwardly through the guide member **16**. In other words, the housing member **12**, the guide member **16** and the blade patterns **18** are assembled and oriented in the manner shown in Fig. 3 of the drawings, with the housing member **14** removed.

Core sand of any suitable composition is then packed around the blade patterns **18** above the guide member **16** within the confines of the annular rib **30** on the guide member, this being accomplished by any suitable process. Thereafter, the housing member **14** is placed on the guide member **16** and the blade patterns **18** with the convex surface **34** of the housing member **14** in engagement with the edges **48** of the blade patterns **18** and in engagement with the rib **30** on the guide member, the marginal flange **32** of the housing member **14** being telescoped over the annular rib **30**. Subsequently, the interior of the housing member **14** is packed with core sand to the level **72** in any suitable manner, thereby completing the formation of the core **20**.

Before baking the core **20**, the blade patterns **18** are withdrawn from the cavities **44** which they form in the core. Considering how this is accomplished, the core box **10** is first inverted and the housing member **12** is removed, thereby leaving the heads **52** of the blade patterns exposed, as shown in Figs. 2 and 4 to 7. Then, the blade patterns **18** are withdrawn from the cavities **44** through the guide slots **46**, as will now be described.

Referring to Figs. 5 to 7, the operator grasps the head **52** of a blade pattern **18** and withdraws it from the corresponding guide slot **46** and core cavity **44** along a curved path which conforms in curvature to the curvature of the blade pattern, the path in question being determined by interengagement of portions of the blade pattern and the edges of the corresponding guide slot. As will be apparent from Fig. 6, the curvatures of the blade pattern **18** shown and the corresponding guide slot **46** require combined axial and generally radially outward movement of the blade pattern to achieve withdrawal of the blade pattern, it being impossible to withdraw the blade pattern by subjecting it to anything other than combined axial and generally radially outward movement. As clearly shown in Fig. 6, the beveled surfaces **54** and **64** in particular assist in guiding the blade pat-

tern shown out of the corresponding cavity **44** and guide slot **46** along the prescribed path.

The net result of the interaction of each blade pattern **18** and the guide member **16** in guiding the blade pattern axially and generally radially outwardly along a curved path which conforms in curvature to the curvature of the blade pattern and the corresponding guide slot in this fashion, is that the sides of the blade pattern move generally parallel to the surfaces **42** of the cavity **44** at all times. In effect, each blade pattern **18** is "unscrewed" from its cavity **44** in the core **20**. Thus, the possibility of damage to the core as the blade patterns **18** are withdrawn is minimized, and no particular skill in removing the blade patterns is required in view of the positive and accurate guiding action resulting from interengagement of the blade patterns and the guide member **16**, which are important features of the invention.

After the blade patterns **18** have been withdrawn in the foregoing manner, the guide member **16** is removed and the core **20** is baked in the usual manner. Thereafter the core **20** is utilized in the casting of a centrifugal pump impeller in accordance with conventional practices unnecessary to relate herein.

While the blade patterns **18** and the guide member **16** may be formed in various ways, it is convenient to make the blade patterns in wood first and then cast them in brass. Subsequently, the guide member **16** is cast around the blade patterns **18** in aluminum, which will not fuse to the brass. In this fashion, the guide slots **46** are formed automatically.

Although an exemplary embodiment of the invention has been disclosed herein for purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated in such embodiment without departing from the spirit of the invention as defined by the claims which follow.

I claim:

1. In an impeller mold pattern, the combination of: a guide member having an axis; a plurality of spirally curved blade patterns circumferentially spaced apart about said axis and engageable with said guide member, said blade patterns spiralling generally radially outwardly away from said axis; and a plurality of spirally curved interengageable means on said guide member and on said blade patterns, respectively, for guiding said blade patterns axially and generally radially outwardly out of engagement with said guide member along spirally curved paths the curvatures of which conform to the curvatures of said blade patterns.

2. In an impeller mold pattern, the combination of: a guide member having an axis and provided therethrough with a plurality of spirally curved guide slots which spiral generally radially outwardly from said axis and which are spaced apart circumferentially about said axis; a plurality of spirally curved blade patterns receivable in said guide slots, respectively, and adapted to extend therethrough from one side of said guide member to the other; and guide means including guide edges of said guide slots and complementary guide surfaces of said blade patterns, respectively, for guiding said blade patterns axially and generally radially outwardly out of said guide slots along spirally curved paths conforming in curvature to the curvature of said blade patterns.

3. In an impeller mold pattern, the combination of: a guide member having an axis and provided therethrough with a plurality of spirally curved guide slots which spiral generally radially outwardly from said axis and which are spaced apart circumferentially about said axis; a plurality of spirally curved blade patterns receivable in said guide slots, respectively, and adapted to extend therethrough from one side of said guide member to the other; and guide means, including guide edges of said guide slots and complementary guide surfaces of said blade patterns, respectively, for guiding said blade patterns axially and generally radially out of said guide slots along spirally curved paths conforming in curvature to the curvature of said blade patterns, said guide edges of each of said guide slots and said complementary guide surfaces of the corresponding blade pattern being beveled.

4. In a impeller mold pattern, the combination of: a guide member having an axis and provided therethrough with a plurality of spirally curved guide slots which spiral generally radially outwardly from said axis and which are spaced apart circumferentially about said axis; a plurality of spirally curved blade patterns receivable in said guide slots, respectively, and adapted to extend therethrough from one side of said guide member to the other; and guide means, including guide edges of said guide slots and complementary guide surfaces of said blade patterns, respectively, for guiding said blade patterns axially and generally radially out of said guide slots along spirally curved paths conforming in curvature to the curvature of said blade patterns, said guide edges of each of said guide slots and said complementary guide surfaces of the corresponding blade pattern being beveled and diverging in the direction of withdrawal of the blade pattern from the guide slot.

References Cited in the file of this patent

UNITED STATES PATENTS

165,237	Jones	July 6, 1875
416,333	Hogan	Dec. 3, 1889
1,443,341	Brown	Jan. 30, 1923
2,301,140	Pfeiffer	Nov. 3, 1942
2,611,161	Paul	Sept. 23, 1952
2,702,418	Miner	Feb. 22, 1955
2,741,817	Wilkins	Apr. 17, 1956
2,782,477	Bean	Feb. 26, 1957