Sept. 1, 1970 D. L. KIME 3,526,467

AGITATOR IMPELLER

Filed Aug. 23, 1968

FIG-1

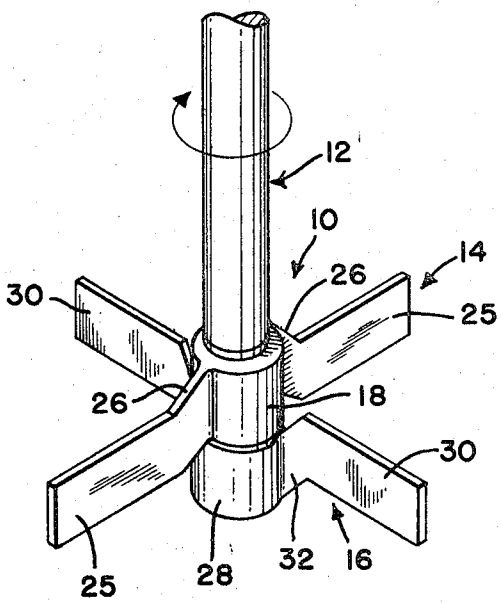


FIG-2

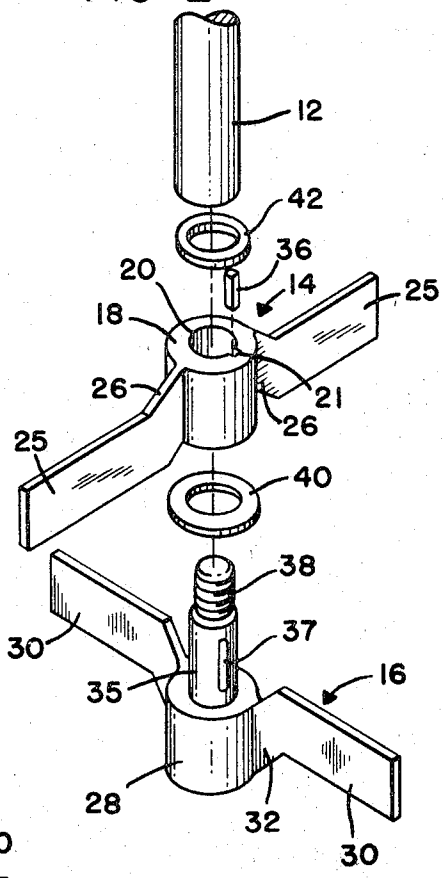


FIG-3

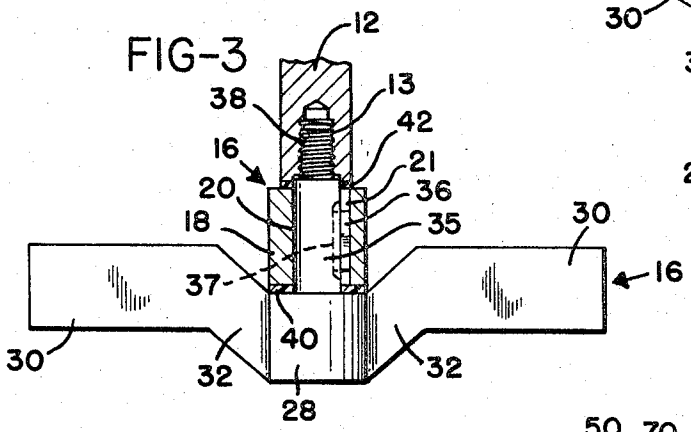


FIG-4

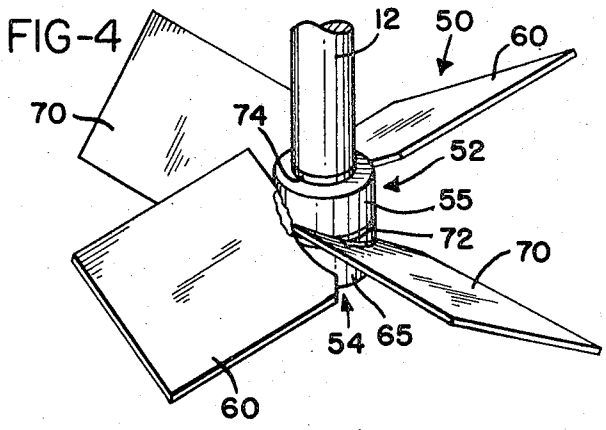
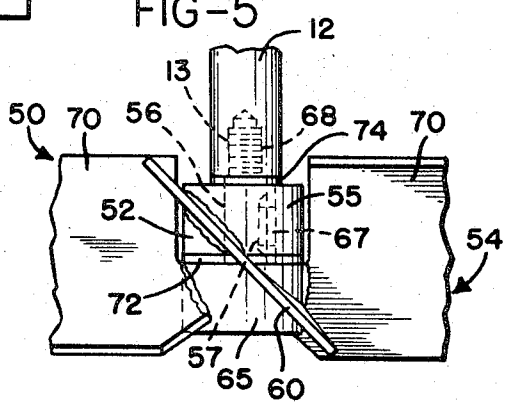


FIG-5



INVENTOR

DONALD L. KIME

BY

Marechal, Biebel, French & Bugg

ATTORNEYS

United States Patent Office 3,526,467
Patented Sept. 1, 1970

3,526,467

AGITATOR IMPELLER

Donald L. Kime, Dayton, Ohio, assignor to Chemineer, Inc., Dayton, Ohio, a corporation of Ohio

Filed Aug. 23, 1968, Ser. No. 754,770
Int. Cl. B44d 3/06
U.S. Cl. 416—200 4 Claims

ABSTRACT OF THE DISCLOSURE

An agitator impeller includes an upper section and a lower section each having a hub and outwardly projecting blades, and the blades of both sections are arranged to have substantially the same path. A shaft extension projects upwardly from the hub of the lower section through the hub of the upper section and is threadably connected to the lower end of a drive shaft to effect a self-tightening connection of the sections to the shaft.

BACKGROUND OF THE INVENTION

In an agitator including a prime mover connected to drive a shaft adapted to depend into a container or tank defining a mixing chamber, it is common to employ an impeller having a split hub formed in two mating sections each supporting a plurality of either curved or flat blades attached to the hub sections by threaded fasteners such as screws or bolts. The hub sections are clamped together on the drive shaft with transversely extending screws so that the impeller can be disassembled and inserted in sections into the mixing chamber through a cover opening which is substantially smaller in diameter than the overall diameter of the impeller. The sections of the impeller are re-assembled onto the drive shaft usually by inserting the hands through the opening and inserting the screws into the hub sections.

In some agitator installations, it is not only desirable to construct the impeller in sections for inserting into the mixing chamber through a small opening, but it is also desirable to eliminate all exposed fasteners. For example, when using such an impeller in a sanitary installation for mixing a food product, it is desirable to eliminate exposed fasteners and to minimize corner crevices so that the impeller does not collect and retain portions of the material being mixed and can be easily cleaned. As another example, when it is necessary to provide the impeller with a coating such as a plastic or rubber coating to prevent corrosion, exposed fasteners should be avoided to provide maximum corrosion resistance and a good bond of the coating to the impeller.

SUMMARY OF THE INVENTION

The present invention is directed to an improved impeller adapted for mounting on the drive shaft of an agitator and which provides the important features of sectional construction for inserting the impeller in sections through a small opening, the elimination of exposed fasteners and a simplified and economical construction which provides for a self-tightening connection of the impeller onto the drive shaft when the impeller is being driven. In accordance with one embodiment of the invention, the impeller includes an upper section and a lower section each having a generally cylindrical hub and a pair of diametrically opposed blades. A solid shaft extension projects upwardly from the hub of the lower section through the hub of the upper section and has an upper end portion which is threaded into a hole formed in the lower end of the drive shaft. The upper section of the impeller is keyed to the shaft extension to assure common rotation of the upper and lower sections in a fixed annular relation, and the blades are arranged so that they each have the same path.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of an impeller constructed in accordance with the invention;

FIG. 2 is a perspective exploded view of the impeller shown in FIG. 1;

FIG. 3 is an elevational view of the impeller shown in FIGS. 1 and 2 with a portion shown in axial section;

FIG. 4 is a perspective view of an impeller forming another embodiment of the invention; and

FIG. 5 is a fragmentary elevational view of the impeller shown in FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, FIGS. 1–3 show one embodiment of an impeller **10** which is mounted on the lower end of an agitator drive shaft **12** having a threaded axial hole **13**. The impeller **10** includes an upper section **14** and a lower section **16**. The upper section **14** has a cylindrical hub **18** with a central bore **20** interrupted by an axially extending keyway **21**. A pair of diametrically opposed flat blades **25** project outwardly from the hub **18** in an axial plane, and each blade **25** includes a downwardly and outwardly extending portion **26** located adjacent the hub **18** so that the outer radially extending portions of the blades **25** are offset downwardly in relation to the hub **18**.

The lower section **16** of the impeller **10** includes a cylindrical hub **28** having an outer diameter the same as that of the hub **18** of the upper section **14**. A pair of diametrically opposed flat blades **30** project outwardly from the hub **28** in an axial plane and are arranged at 90° in relation to the blades **25**. Each blade **30** includes an upwardly and outwardly projecting portion **32** adjacent the hub **28** so that the outer radially extending portions of the blades **30** are offset upwardly in relation to the hub **28** to have the same path as the outer portions of the blades **25**.

A cylindrical shaft extension **35** is formed integrally with the hub **28** of the lower section **16** and projects upwardly through the bore **20** of the hub **18**. A key **36** is mounted within a groove **37** formed within the shaft extension **35** and projects into the keyway **21** within the hub **18** so that the upper section **14** is rigidly connected to the lower section **16** with the blades **25** extending normally to the blades **30**.

The shaft extension **35** includes a threaded upper end portion **38** which is threaded into the hole **13** within the lower end of the drive shaft **12**. A resilient washer **40** is located between the hubs **18** and **28**, and a resilient washer **42** is located between the lower end of the drive shaft **12** and the upper end of the hub **18** to form fluid tight seals between the impeller sections **14** and **16** and between the drive shaft **12** and the upper impeller section **14**.

Referring to FIGS. 4 and 5 which show another embodiment of the invention, an impeller **50** is constructed similar to the impeller **10** and includes an upper section **52** and a lower section **54**. The upper section **52** has a cylindrical hub **55** constructed substantially the same as the hub **18** of the impeller **10**, that is, with a cylindrical bore **56** having an axially extending keyway **57**. A pair of diametrically oposed flat blades **60** are welded to the hub **55** and are pitched by an angle of approximately 45° in relation to the axis of the hub **55**.

The lower impeller section **54** includes a cylindrical hub **65** having an outer diameter the same as the hub **55**, and a shaft extension **66**, constructed substantially the same as the shaft extension **35**, projects upwardly through the bore **56** of the hub **55**. A key **67** secures the

hub **55** to the shaft extension **66** which has an upper end portion **68** threaded into the hole **13** within the lower end of the drive shaft **12**. A pair of diametrically opposed flat blades **70** are welded to the hub **65** of the lower section **54** and are pitched at the same angle as the blades **60** of the upper section **52**. Thus the outer configuration of the lower impeller section **54** is substantially identical to that of the upper section **52**.

As shown in FIG. 5, the blades **60** extend downwardly in relation to the hub **55**, and the blades **70** extend upwardly in relation to the hub **65** so that each of the blades **60** and **70** have the same path when the shaft **12** is rotated. Resilient washers **72** and **74** are mounted on the shaft extension **66** in the same manner as the washers **40** and **42** to form a fluid tight seal between the hubs **55** and **65** and between the lower end of the shaft **12** of the hub **55**.

From the drawing and the above description, it is apparent that an impeller constructed in accordance with the invention provides desirable features and advantages. For example, by forming the shaft extension **35** as part of the lower section **16** of the impeller **10** and by extending the shaft extension **35** upwardly through the hub of the upper section **14** for threading into the hole **13**, a self-tightening connection is formed between the impeller **10** and the drive shaft **12** when right hand threads are used and the shaft **12** is driven in the direction of the arrow shown in FIG. 1. The construction of the impeller **50** forms a similar self-tightening connection. Furthermore, the assembly of the impeller **10** or the impeller **50** onto the drive shaft **12** can be performed quickly and without the use of exposed fasteners, which is especially desirable when the upper and lower sections of the impeller are coated with a plastic or rubber coating or when the impeller is used in a sanitary installation for mixing a food product.

The impeller construction of the invention also provides for inserting and assembling of the impeller through a circular opening having a diameter substantially smaller than the overall diameter of the impeller. That is, each section of the impeller can be inserted separately through the opening and then be conveniently and quickly assembled onto the end of the drive shaft **12**. The impeller construction also provides for minimizing the outer diameter of the hub of the upper and lower sections which is desirable not only from an economical standpoint but also for obtaining optimum performance.

Another important advantage is provided by the offset relation of the blades **25** and **30** or the blades **60** and **70** in relation to their corresponding supporting hubs. That is, by extending the upper blades downwardly and the lower blades upwardly so that all blades have the same path, the impeller is provided with a balance construction which is important for eliminating any significant vibration within the agitator. Furthermore, the common path of all of the blades enables the use of performance charts for conventional impellers to predict the performance of an impeller constructed in accordance with the invention.

While the two impeller embodiments of the invention illustrated in the drawing each employ a set of flat blades, it is to be understood that it is within the scope of the invention to provide each impeller section with a set of curved blades according to the particular mixing action desired from impeller. It is also within the scope of the invention to form the stud shaft **35** as an integral portion of the drive shaft **12** and thread the shaft **35** into the hub **28** of the lower impeller section **16**. Furthermore, it is within the scope of the invention to extend the shaft **35** and to mount one or more intermediate impeller sections, similar to the section **14**, on the extended shaft to effect additional agitation.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. An improved impeller adapted for convenient mounting on an agitator drive shaft, comprising a lower section and an upper section each including a hub and blade means projecting outwardly from said hub, means defining an opening within said hub of said upper section, a shaft extension rigidly secured to said hub of said lower section and extending upwardly through said opening within said hub of said upper section, key means for rigidly connecting said hub of said upper section to said hub of said lower section to effect positive common rotation of said sections, said shaft extension including an upper end portion projecting above said hub of said upper section, and said upper end portion having external threads for engaging a threaded hole formed within the lower end of said drive shaft to effect a positive self-tightening connection of said sections to said drive shaft in response to relative rotation between said sections and said drive shaft.

2. An impeller as defined in claim **1** wherein said blade means of each said section comprise a pair of diametrically opposed substantially flat blades, said blades of said sections are offset axially of their corresponding said hubs and are disposed in interfitting relation causing all of said blades to have substantially the same path, and said hubs have a combined axial length substantially no greater than the width of said blades in an axial direction.

3. An impeller as defined in claim **1** wherein said blade means of each said section comprise a pair of diametrically opposite substantially coplanar blades.

4. An improved impeller adapted for convenient mounting on an agitator drive shaft, comprising a lower section and an upper section each including a generally cylindrical hub and at least one substantially flat blade projecting outwardly from said hub, said blades of said upper and lower sections being offset axially of their corresponding said hubs and being disposed in interfitting relation causing all of said blades to have substantially the same rotational path, said hubs having a combined axial length substantially no greater than the width of said blades in an axial direction. A shaft extension rigidly connected to said hub of said lower section and projecting upwardly therefrom, means defining an opening within said hub of said upper section for receiving said shaft extension, key means for rigidly connecting said hub of said upper section to said hub of said lower section to provide for positive common rotation of said upper and lower sections in fixed angular relation, said shaft extension including an upper end portion projecting above said hub of said upper section, and said upper end portion having external threads for engaging a threaded hole within the lower end of the drive shaft to effect a self-tightening connection of said sections to said shaft in response to relative rotation between said sections and said drive shaft.

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EVERETTE A. POWELL, JR., Primary Examiner