March 15, 1932. F. E. STELZER 1,849,557

CENTRIFUGAL PUMP

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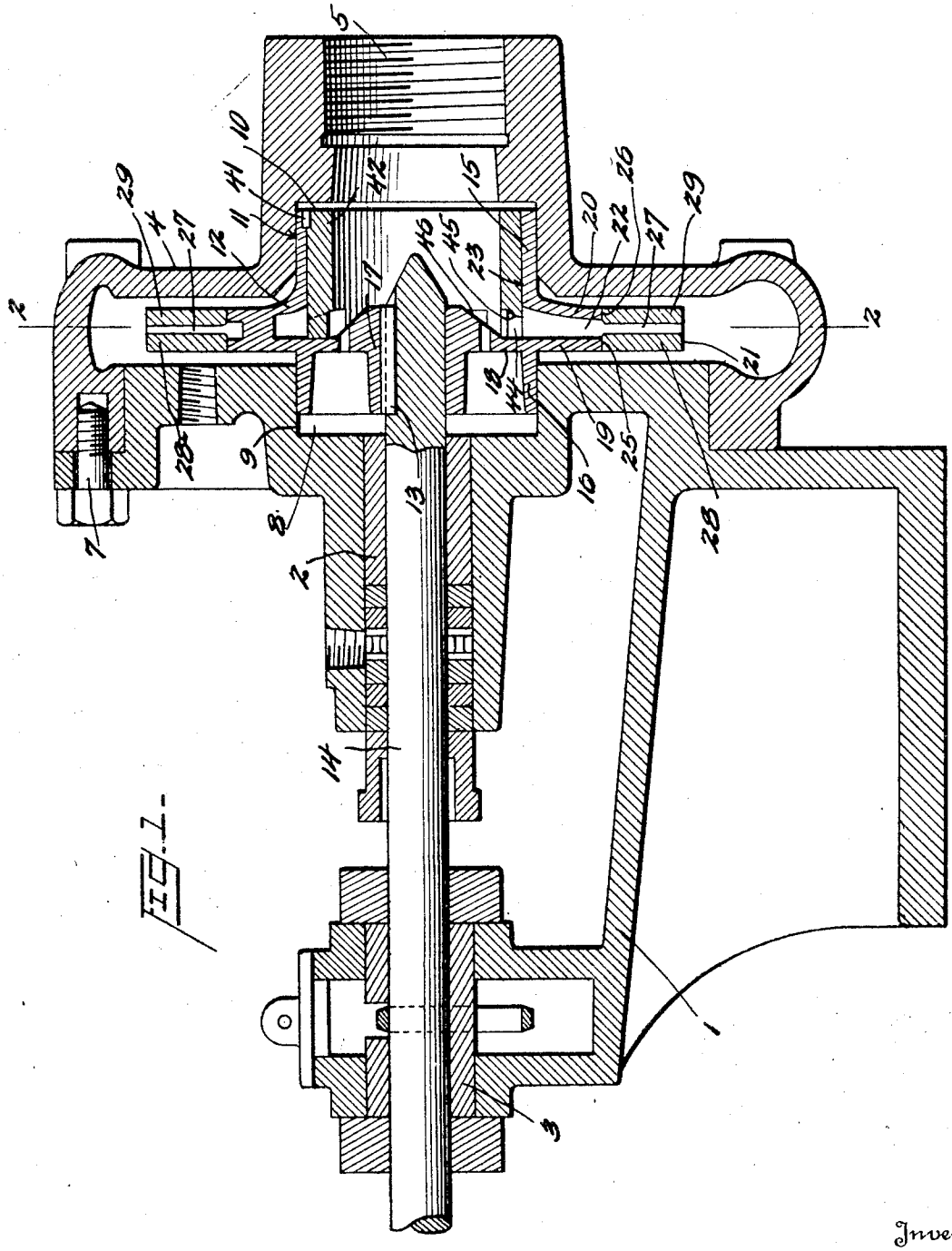


FIG. 1.

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CENTRIFUGAL PUMP

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FIG. 2.

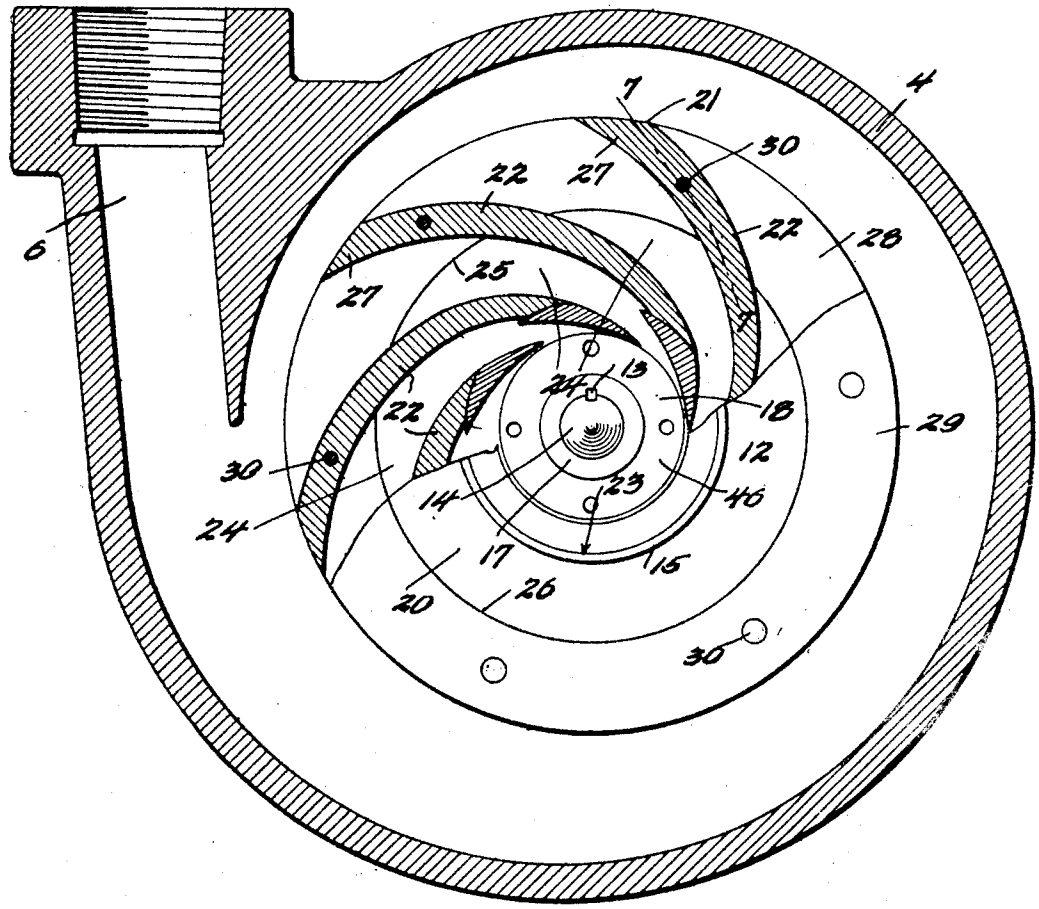


FIG. 3.

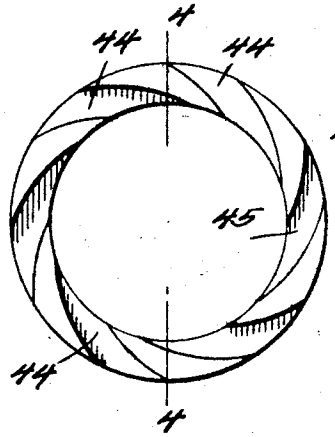
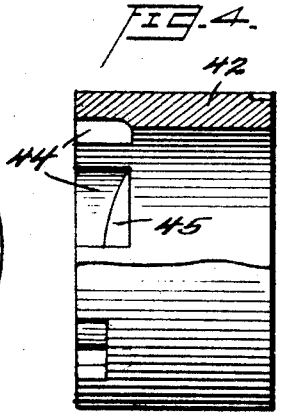


FIG. 4.



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CENTRIFUGAL PUMP

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FIG. 5.

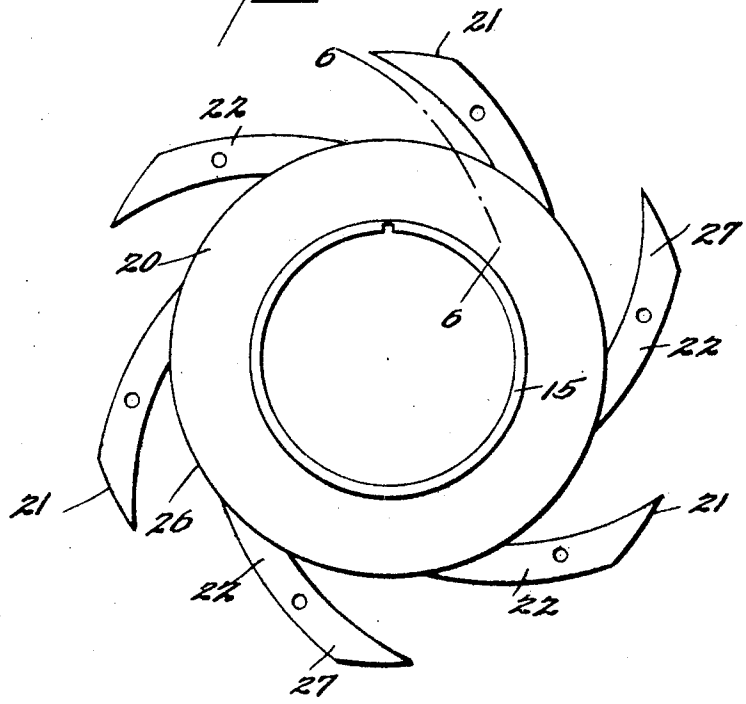


FIG. 6.

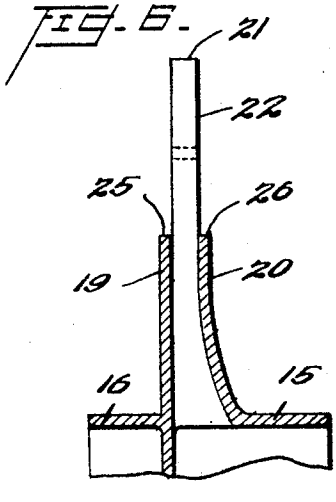


FIG. 6a.

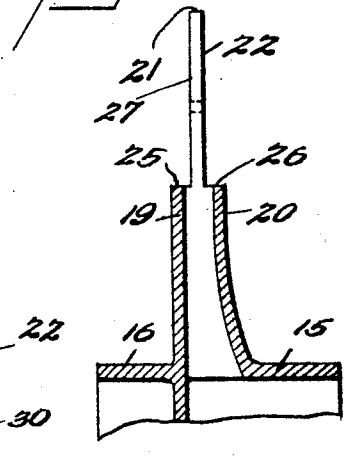
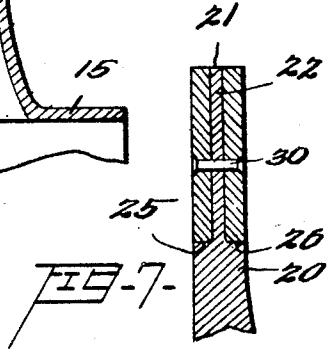


FIG. 7.



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CENTRIFUGAL PUMP

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FIG. 8.

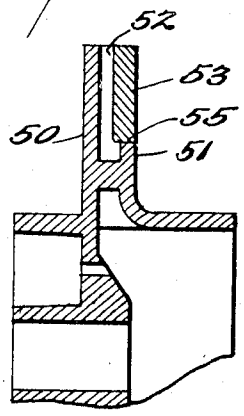
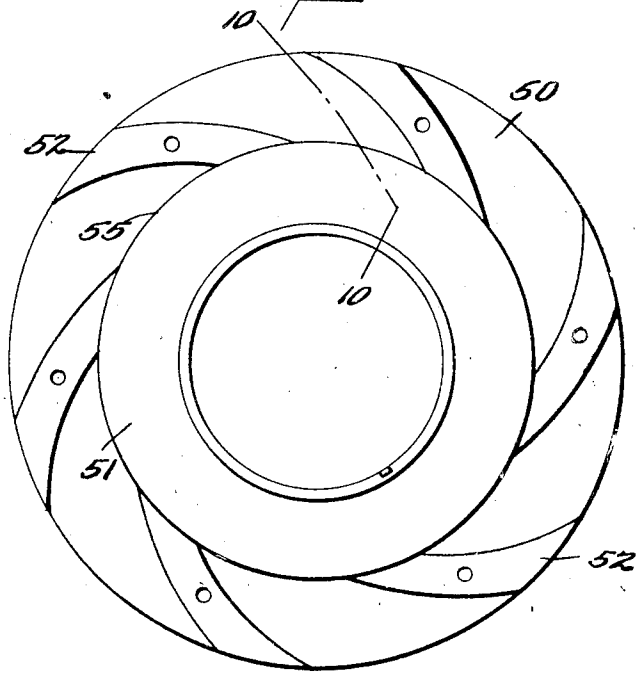


FIG. 9.



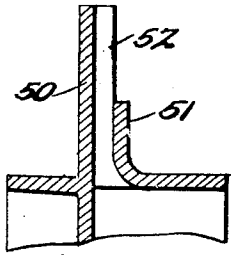


FIG. 10.

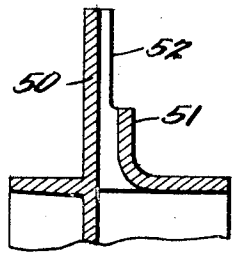


FIG. 10.

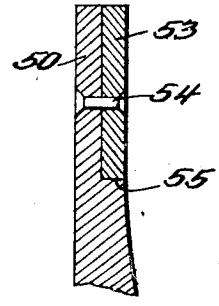


FIG. 11.

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UNITED STATES PATENT OFFICE

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CENTRIFUGAL PUMP

Application filed June 12, 1929. Serial No. 370,310.

This invention relates to impellers for centrifugal pumps.

The main object of this invention is to provide a high pressure centrifugal pump of low capacity and economical operation.

Another object of this invention is to provide an impeller for a centrifugal pump which will meet the above requirements, and at the same time be capable of being cheaply manufactured, and will consist mainly of an integral casting.

A still further object is to provide a centrifugal pump having interchangeable means for regulating the capacity of the pump.

It has previously been found impracticable to form enclosed type impellers for high pressure, low capacity centrifugal pumps by a casting process. This has been due to the fact that in order to obtain a high outlet pressure, the impellers must be made of relatively large diameter so as to give the water a higher peripheral speed as it leaves the vanes of the impeller. While it is possible to make castings of the required diameter, the mass of metal contained in such a casting is relatively large, and the weight and dimensions of the casting are such that cores of very small thickness, such as would be required to core out the narrow spaces between the impeller blades, will not withstand the strains set up in them as the casting cools. These phenomena are in accord with the usual experience that great difficulty is encountered in coring out small spaces in relatively large castings, and in casting thin sections integral with relatively large sections of metal of relatively large diameter.

In order to avoid these difficulties, a radically new type of enclosed impeller is made according to the present invention.

In the drawings:

Figure 1 is a vertical longitudinal section through a centrifugal pump showing the impeller of the present invention as it is applied to a pump;

Figure 2 is a sectional view taken along lines 2—2 of Figure 1 and showing the impeller of the present invention and the conventional surrounding casing;

Figure 3 is an end view of the interchangeable sleeve 42 which appears in Figure 1, but is shown in more detail in Figure 3;

Figure 4 is a sectional view of the same sleeve taken along the line 4—4 of Figure 3;

Figure 5 is a side view of the cast blank used in forming the impeller;

Figures 6 and 6*a* are fragmentary, sectional views taken along the line 6—6 of Figure 5, but at different steps in the process of treatment of the blank;

Figure 7 is a fragmentary view corresponding to Figures 6 and 6*a* and taken along the line 7—7 of Figure 2 and showing a portion of the impeller in its completed form;

Figure 8 is a fragmentary longitudinal sectional view of a modified form of impeller;

Figure 9 is a side view of the cast blank used in forming the modified form of impeller;

Figures 10 and 10*a* are fragmentary sectional views taken along the line 10—10 of Fig. 9 but at different steps in the process of treatment of the blank; and

Figure 11 is a fragmentary sectional view through a single blade of the modified form of impeller and corresponding to Fig. 7 of the preferred form.

The pump, illustrated in Figure 1, includes the main casting 1, the main bearing 2, the rear bearing 3 and the front cover casing 4 which is provided with the entrance channel 5, the conventional exit channel 6 and is fastened to the main casting by bolts, one of which is shown at 7.

Referring to Figure 1, the main casting is cut away to form a cavity 8 having the circular wall 9 and the front cover casting 4 is similarly cut away to form cavity 10 having the circular wall 11. The two cavities thus formed enclose a space for the impeller 12 which is fastened by a key 13 to the driving shaft 14 of the pump.

The impeller 12 consists of an outer hub portion comprising oppositely disposed integral cylindrical portions 15 and 16 which rotate in the cavities 10 and 8 respectively, and an integral inner portion 17 keyed to the driving shaft by the key 13 and joined to the

outer portion of the hub by the web 18. Forming part of and integral with the impeller are the two side wall portions 19 and 20 which terminate at about half the distance from the outer hub portion to the extreme periphery 21 of the impeller. Integral with and embraced by the side walls 19 and 20 are the impeller blades 22 which extend from a circle formed by the prolongation of the inner surface 23 of the outer hub portion 15 to the extreme periphery of the impeller. Referring to Figure 2, it will be seen that these blades 22 are spirally curved and increased slightly in width outwardly from the hub and define between them the spiral water impelling passages 24. As shown in Figure 1, the outer portions 27 of the blades are considerably thinner in an axial direction than the portions of the blades inside of the peripheries of the side walls 19 and 20. These thin outer portions 27 of the blades are embraced by two annular plates 28 and 29 which are shrunk onto the shoulders 25 and 26 formed partly by the peripheral surfaces of side walls 19 and 20 and partly by the reduction in thickness of blades 22. It is evident that the annular plates 28 and 29 could be shrunk on the peripheries of side walls 19 and 20 alone, but it is preferable to utilize the portions of the shoulders formed on blades 22 as well. In addition, the two anular plates 28 and 29 are joined to each other by any suitable fasteners 30, shown in Figure 2, such as rivets or screws.

Referring to Figures 1 and 2, it will be seen that the fluid is confined within the water impelling passages 24 by confining means coextensive with and cooperating with the blades 22 and comprising the inner side walls 19 and 20 and the outer annular plates 28 and 29. It will be seen that the outer portions of the blades 22 are of reduced thickness and that the corresponding outer portions (plates 28 and 29) of the confining means are of increased thickness. Furthermore, it is apparent from Fig. 1 that the over-all thickness of the impeller is substantially uniform from its periphery to near the hub. By means of this construction the outlet area of the impeller may be reduced to the most efficient area for the capacity desired, while enabling the main portion of the impeller to be cast, and in addition retaining substantially plane side surfaces on the impeller, and preventing undesirable variations in its over-all thickness.

In the modified form of impeller shown in Fig. 8, the two side wall portions of the casting instead of being of equal diameter, as in the preferred form, are of unequal diameter, side wall 50 extending to the outer periphery of the blades 52 and side wall 51 stopping considerably short of the outer periphery of the blades. In this modified form it is apparent that the blades 52 are integral with and embraced by the side walls 50 and 51 and extend radially beyond the periphery of side wall 51. In a manner similar to the preferred form, blades 52 are reduced in thickness from the periphery of side wall 51 outwardly. In this alternate form of construction a single annular side plate 53 is utilized, the annular side plate being shrunk on to the shoulders 55 which are formed partly by the peripheral surface of side wall 51 and partly by the reduction in thickness of blades 52. As in the preferred form the annular side plate is fastened to the blades by any suitable fasteners 54 shown in Fig. 11 such as rivets or screws. The alternate form of impeller described above provides a reduction in outlet area in the same manner as the preferred form, and likewise may be easily cast.

Inside of the outer hub portion 15 and fastened thereto by the key 41 is the cylindrical sleeve 42 illustrated in Figures 3 and 4. The end portion 43 of sleeve 42 is formed with a plurality of curved spiral slots 44 corresponding in number and position to the water impelling spaces 24 of the impeller. The curved spiral slots 44 form the only channels through which water flows into the impeller, and the total area available for a flow through the spaces 44 is designed to be considerably less than the total area of the entrances into the spiral water impelling passages 24. Thus it will be seen that the sleeve 42 constitutes a throttling device on the entrance side of the impeller.

Referring to Figures 1, 3 and 4, it will be seen that the grooves 44 have curved bottoms 45. The conical portion 46 of the central hub cooperates with the series of curved bottoms 45 of the grooves 44 to divert the incoming water from a path which is axial of the pump to one which is radial of the pump.

The sleeve 42 is intended to be interchangeable, so that the capacity of the pump may be regulated in steps by substituting various similar sleeves having larger or smaller grooves 44. This is of considerable advantage as it enables a single size of pump to be supplied for different capacity requirements and enables each capacity requirement to be economically met by merely selecting the proper sleeve and inserting it in the pump before fastening the front cover casting in place.

The operation of the pump and impeller is in general the same as that of the conventional enclosed impeller centrifugal pump, the water entering the casing in an axial direction at 5, being diverted to a radial direction, passing between the blades 22, being thrown radially outward by centrifugal force and finally being collected and discharged through the exit channel 6. The capacity of the pump is, as above described, throttled to varying degrees by the particular interchangeable throttling sleeve 42 which

is used, and the power required to drive the pump reduced accordingly.

It has been found as a result of tests that, when the capacity of the pump has been reduced by the use of the throttling sleeve 42, the outlet pressure and capacity of the pump may be maintained substantially constant, and the power requirement still further reduced by the use of the narrowed blades and the annular side plates described above. This is thought to be due to the reduction of the excess area exposed to the discharge column of water. It will be apparent that for the most advantageous operation where the throttling sleeve 42 and the annular side plates and narrowed blades are used in combination, the ideal width of the blades at their outer extremities will be dependent upon the area of spiral passages of the throttling sleeve.

However it is to be understood that the throttling sleeve and the annular plates are capable of separate use, and that each of these features has distinct advantages aside from those produced by their cooperative action. For example, either of these features of construction will facilitate the manufacture and assembly of a pump of the kind described.

In manufacturing the impeller described above, an integral casting is first made, comprising the entire hub with its inner and outer portions and connecting flange, the two side walls 19 and 20 and the curved blades 22. This casting forms the blank which is shown in Figure 5 of the drawings and in the partial sectional view of Figure 6. Referring to Figure 6 which, for the purpose of illustration, shows only one of the blades 22, it will be seen that blade 22 extends outwardly to its outer end or extreme periphery 21 of the blank with substantially the same width as the space between the outer portion of the side walls 19 and 20. This uniformity of width of the blades enables the blank to be cast in one piece without the outer projecting portions of the blades 22 being unduly stressed in cooling and also facilitates the molding process. It will be noticed that each of the blades 22 is considerably wider at the hub than at the periphery of the side walls 19 and 20, due to the slight convergence of the side walls 19 and 20 toward their peripheries. In Figure 6*a*, the said blank is shown after it has been subjected to the next step of the process which consists in machining a portion of the metal from each of the blades so as to decrease considerably its thickness. This machining operation, while decreasing the thickness of the extending portions of the blades, increases the width of the shoulders 25 and 26 originally formed by the peripheries of the side walls 19 and 20. The amount of metal cut off in this machining process determines the thickness of the outer portions of the blades, and hence the outlet area of the pump. By varying the amount of machining in this step of the process, various outlet areas corresponding to the desired area of sleeve 42 are obtained and hence pumps of various capacities and high efficiency may be obtained from a single size of cast blanks.

The two annular rings 28 and 29 are then shrunk on these respective shoulders. Fasteners 30 are inserted to hold rings 28 and 29 together and clamp the blades 22 therebetween, and the impeller is then complete, as shown in the fragmentary view of Figure 7. The desired sleeve 42 is then inserted.

In manufacturing the modified form of impeller the casting shown in Figures 9 and 10 is first made. This casting is similar to the blank shown in Fig. 6 from which the preferred form is made except that in the casting shown in Figures 9 and 10 the side wall 50 extends to the outer periphery of the blades 52 and hence the blades 52 extend beyond the periphery of only one of the side walls, side wall 51. In Fig. 10*a* the blank is shown after it has been subjected to a machining operation in which the thickness of the portions of blades 52 which extend beyond side wall 51 has been considerably reduced. In operating on this modified form of blank, metal is cut away from only one side of the blades instead of from both sides as in the preferred form. The annular side ring 53 is then shrunk onto the shoulders 55. The fasteners 54 are inserted and the impeller is then complete as shown in the fragmentary view of Fig. 11.

While the above invention has been described as embodied in a pump having a single entrance, it is obvious that it could also be applied to a pump having a double entrance.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a centrifugal pump, in combination, an impeller comprising a hollow hub portion forming an intake, a plurality of substantially radial impeller blades and shrouds cooperating therewith to provide a plurality of passageways having inlet portions opening from said hollow hub, and a separately formed throttling sleeve immovably secured within said hub and provided with circumferentially spaced substantially spirally formed notches cut in the inner end thereof each adapted to communicate with one of said inlet portions and having a smaller cross-sectional area than that of the corresponding inlet portion.

2. In a centrifugal pump, in combination, an impeller comprising a hollow hub portion forming an intake, a plurality of substantially radial impeller blades and shrouds cooperating therewith to provide a plurality of passageways having inlet portions opening from said hollow hub, and a separately formed throttling sleeve immovably secured within

said hub and provided with circumferentially spaced notches in the inner end thereof each adapted to communicate with one of said inlet portions and having a smaller cross-sectional area than that of the corresponding inlet portion, the construction of said pump being such as to permit the ready selective substitution of throttling sleeves having notches of different sizes after the installation of the pump at the place where it is to be used.

3. In a centrifugal pump, in combination, an impeller comprising a hollow hub portion forming an intake, a plurality of substantially radial impeller blades and shrouds cooperating therewith to provide a plurality of passageways having inlet portions opening from said hollow hub, and a separately formed throttling sleeve immovably secured within said hub and provided with circumferentially spaced notches in the inner end thereof, each adapted to communicate with one of said inlet portions and having a smaller cross-sectional area than that of the corresponding inlet portion, the axial depth of each notch being greater at its inner end than at its outer end.

In testimony whereof I hereunto affix my signature.

FRANK E. STELZER.