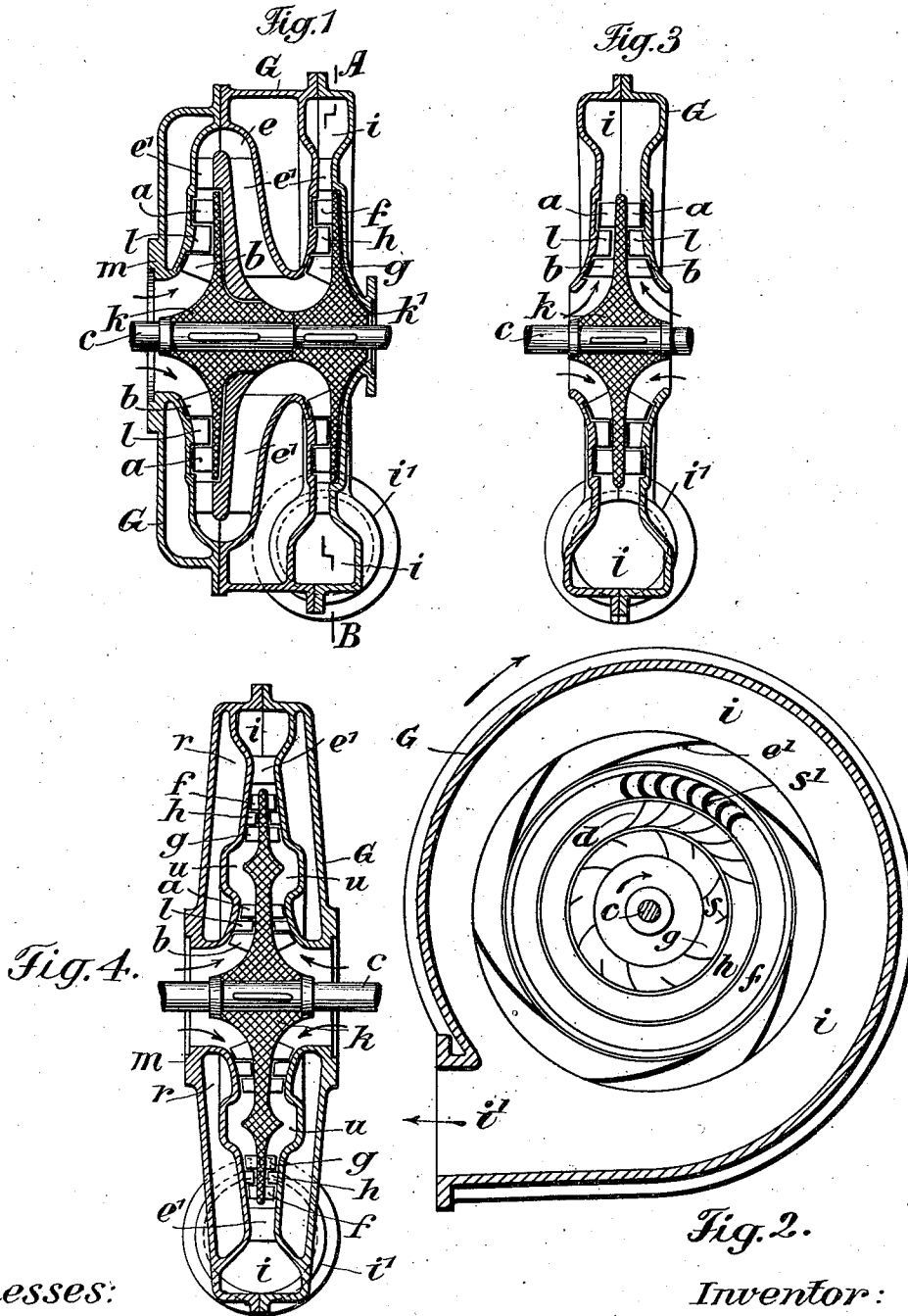


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 TURBINE PUMP, TURBINE BLOWER, AND PROPELLER.
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UNITED STATES PATENT OFFICE.

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TURBINE-PUMP, TURBINE-BLOWER, AND PROPELLER.

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To all whom it may concern:

Be it known that I, ALFRED BÜCHI, a citizen of the Republic of Switzerland, residing at Winterthur, Switzerland, have invented certain new and useful Improvements in Turbine-Pumps, Turbine-Blowers, and Propellers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

This invention relates to air and water pumps.

The main object of the present invention is to improve the construction of such pumps.

In water and air pumps the main object is to impart to the fluid moving through the pump a great velocity and to convert this velocity into pressure before the fluid leaves the pump with due consideration of the power expended, so as to make the operation of the device as economic as possible. It is a well known fact, that the efficiency of a pump or blower depends a great deal upon the shape of the blades of the wheels and accordingly it has already been proposed to curve the outer end of the blades backward, radially and forward relatively to their direction of travel. The results obtained with these different shaped blades vary within very large limits. The theory and an examination of the parallelogram of velocities show also the fact, that a considerable decrease of the dynamic pressure head has to take place, for increasing delivery quantity at a constant number of revolutions of the pump when the outer ends of the blades are curved backward relatively to their direction of travel, while under the same conditions a considerable increase in the dynamic pressure head takes place when the outer end of the blades is curved forward relatively to their direction of travel. From the theoretical point of view it would be, therefore, advisable to use only wheels

having blades, whose outer end is curved forward relatively to the direction of their travel, a higher pressure being then obtained in the delivery pipe of the pump or blower. The practice has, however, shown that these wheels have a low sucking power and that the delivery quantity of these wheels is smaller than that of those having blades with a backward bent outer end, so that the increase in pressure can only be obtained at the expense of the delivery quantity, the efficiency of the pump or blower being thus again impaired.

I have now discovered that the efficiency of the pumps or blowers can be very much increased by placing ahead of a wheel with blades having a forwardly bent outer end, the effect of which is mainly to impart to the fluid a high velocity, a wheel with blades having an outer end which is bent backward relatively to the direction of travel of the wheel, which has the effect to cause a greater volume of fluid to pass through the wheel with blades having a forward curved end than would otherwise be the case. The final effect of such an arrangement is that the pump has a high dynamic pressure head and at the same time a great sucking power and a great volume of delivery, whereby the latter does not impair the degree of the pressure head at which the delivery takes place.

In the accompanying drawings, in which like parts are similarly designated: Figure 1 is a view in vertical axial section, and Fig. 2 is a view of the same in vertical cross section on the broken line A—B of Fig. 1, of a two-wheeled radial or centrifugal type of a rotary pump or blower. Fig. 3 is a view in vertical axial section of a disk provided on opposite sides with vanes. Fig. 4 is a view in vertical axial section.

Referring to Figs. 1 and 2, G designates the casing of a radial flow centrifugal pump or blower. The rotary part of the pump comprises a shaft *c* on which two wheels *k* and *k*¹ in the form of disks are mounted. Each rotary disk *k* and *k*¹ is provided with two concentric circular series of vanes or blades *a b* and *f g*, which are attached to one side of the same. The outer ends of the

movable vanes or blades of the series b and g are bent backward relatively to the direction of travel of the disks k and k^1 , while the outer ends of the vanes or blades of the series a and f are bent forward relatively to the direction of travel of said disks. The casing G is provided with two series of stationary guide-blades l and h acting as nozzles (Fig. 2), arranged between the two series or rows of movable blades a b and f g , respectively, of the rotary disks k and k^1 and extending around the entire circuit, as shown in Fig. 2. Between the disk k and the disk k^1 a slowly divergent chamber or canal e in form of a diffuser is arranged, with fixed guide-vanes or blades e^1 . On the outside of the disk k^1 is provided a second diffuser i with guide-vanes or blades e^1 which is formed, in the present case as a slowly divergent spiral channel i , which is connected with the pressure pipe, not shown, by the flange i^1 . For the supply of the elastic or non-elastic fluid, a supply pipe, not shown, is connected to the flange m on the casing G .

The turbine pump, turbine compressor or blower constructed as hereinbefore described, operates as follows: Water, gas, or steam is admitted through the supply pipe into the first series b of blades s having a backwardly bent outer end, as indicated by arrow on Fig. 1. In this series b of blades, which have a great sucking power, a certain amount of mechanical energy of the rotary disk k is transformed into potential energy and kinetic energy and heat, these blades s being so shaped and proportioned that the potential and kinetic energy of the leaving medium are either equal, or that the potential energy is greater than the kinetic energy. After escaping the blades s of the series b the fluid enters into the stationary series l of guide-blades d , which act as nozzles, the kinetic energy of the fluid being either preserved or increased by transforming some of the potential energy into kinetic energy; the guide-blades d being so shaped and proportioned that the fluid is guided or expanded as it issues from the blades d , so that it receives a greater velocity, which will be spent by its impact against the blades s^1 (Fig. 2) of the series a .

In the radial flow, or centrifugal type of pump or blower illustrated in Figs. 1-2 the ends of the blades s^1 at their outer periphery are curved forward *i. e.* in the direction of rotation indicated by the arrow, as will be seen in Fig. 2. The mechanical work of the series a of vanes or blades s^1 is essentially transformed into kinetic energy, and the fluid escapes from the blades s^1 and enters the diffuser e at high velocity. In the diffuser-chamber e , which is provided with guide-vanes e^1 , the kinetic energy is gradu-

ally transformed into potential energy, owing to the gradual increase of the area of the cross-section of the chamber e and the decrease of the velocity. From the diffuser-chamber e the fluid enters into the next system or series g and f of movable blades s and s^1 respectively mounted on the disk k^1 , between which a series h of fixed blades d acting as nozzles are arranged around the entire circuit on the casing G . The mode of operation in this second system or series g , f and h of movable and fixed vanes or blades s , s^1 and d respectively is exactly the same as described hereinbefore with regard to the first system b a and l , the initial pressure being only augmented in proportion of the efficacy of the preceding system of bladings mounted on the disk k . The fluid escaping from the series f with blades s^1 having a forward bent outer end enters the diffuser chamber i and its kinetic energy or velocity is transformed in this chamber i and in the slowly divergent spiral channel i , into potential energy or pressure, as the increase in the cross-section area of the channel i has the effect to reduce the velocity and increase the pressure of the fluid in accordance with the general recognized theory of the diffusers.

Referring to Fig. 3, the rotary disk is provided on opposite sides with a system of movable blades, as hereinbefore described. This form of pump or compressor is balanced without special piston or other arrangements for the purpose.

Referring to Fig. 4, there are two concentric systems or series b , g and a f of movable blades or vanes having radially directed and forward bent outer ends respectively on opposite sides of the same disk with intermediate stationary series of blades l and h acting as nozzles and mounted on the casing G . Between the two systems or series of blades b , l , a and g , h f is provided a diffuser chamber u with guide vanes, to convert the kinetic energy from the first system b , l a into velocity and to conduct the fluid then to the second system g , h f of bladings. The casing G is provided with a chamber r for water cooling purposes.

In the several forms or modifications of the turbine pump, turbine blower or propeller herein shown and described, the principles involved and the mode of operation are essentially the same. In each case the fluid, like water, steam or gas, first enters into a blading system, having an outer end bent backward relatively to the direction of travel of the system, and is supplied from there to a series of stationary guide-blades acting as nozzles all around the entire circuit in which the velocity of the fluid is maintained or in which a certain amount of potential energy of the fluid is transformed into kinetic energy, which will be spent by

its impact in the vanes or blades of the next blading series having blades with a forward bent outer end and in which mechanical work is converted into kinetic energy without material change in the potential energy of the fluid. The kinetic energy of the escaping fluid is then transformed before leaving the pump into potential energy to the best advantage and with the greatest economy. It is understood that the different members follow one another in the above named succession as much as possible directly, and that one or several systems may be provided on the same wheel.

Various changes, other than those specifically mentioned herein, may be made in the details of construction and in the arrangement of parts of the turbine pump, turbine blower, or compressor and propeller, without materially affecting its operation, and without departing from the principles and intended scope of this invention.

I claim—

1. The combination with a casing and a rotor disk mounted therein, of a series of blades having their outer ends curved backward and a second series of blades having their outer ends curved forward relatively to their direction of travel, both series of blades being mounted on said rotor disk, and guide blades in the casing to which the fluid is delivered from the blades having backward curved outer ends and from which the fluid is delivered to the blades having forward curved outer ends.

2. The combination with a casing, and rotor disks mounted therein, of a series of blades having their outer ends curved backward, and a second series of blades having their outer ends curved forward relatively to their direction of travel, both series of blades being mounted on a rotor disk, and guide blades in the casing for each rotor disk, said guide blades receiving the fluid always from the blades having backward bent outer ends and delivering it to the corresponding blades having forward bent outer ends on the same rotor disk.

3. The combination with a casing, and a rotor disk mounted therein, of a series of blades having their outer ends curved backward relatively to their direction of travel to impart pressure and velocity to the moving fluid, and a second series of blades having their outer ends curved forward relatively to their direction of travel imparting velocity thereto, both series of blades being mounted on said rotor disk, guide blades in the casing between said series of blades to which the fluid is delivered from the blades having their outer ends curved backward in which guide blades the velocity imparted to the moving fluid is substantially unchanged and from which the fluid is delivered to the

series of blades having their outer ends curved forward, and a diffuser chamber to receive said fluid from said series of blades having their outer end curved forward.

4. The combination with a casing, and rotor disks mounted therein, of a series of blades having their outer ends curved backward relatively to their direction of travel to impart pressure and velocity to the moving fluid, and a second series of blades having their outer ends curved forward relatively to their direction of travel imparting velocity thereto, both series of blades being mounted on said rotor disks; guide blades in the casing for each rotor disk, to which the fluid is delivered from the series of blades having backward curved outer ends in which guide blades the velocity imparted to the moving fluid is substantially unchanged and from which guide blades the fluid is delivered to the corresponding series of blades having forwardly curved outer ends on the same rotor disk, and a diffuser chamber for each rotor disk to receive said fluid from the corresponding blades having forwardly curved outer ends.

5. The combination with a casing, and a rotor disk mounted therein, of a series of blades having their ends curved backward relatively to their direction of travel on each side of the disk near its center, sets of stationary guide blades in the casing to which said series of blades discharge, a second series of blades having their outer ends curved forward relatively to their direction of travel on each side of the disk receiving fluid from the guide blades, a diffuser chamber, and diffuser blades therein common to both series of blades having forwardly curved outer ends.

6. The combination with a casing, and rotor disks mounted therein, of a series of blades having their outer ends curved backward relatively to their direction of travel on each side of the disks near their centers, sets of stationary guide blades in the casing to which said series of blades discharge, a series of blades having their outer ends curved forward relatively to their direction of travel on each side of the disks receiving fluid from the guide blades, a diffuser chamber, and diffuser blades therein common to both series of blades having their outer ends curved forward.

7. The combination with a casing, and rotor disks mounted therein, of a series of blades having their outer ends curved backward relatively to their direction of travel on each side of the disks near their centers to impart pressure and velocity to the moving fluid, sets of stationary guide blades in which the casing to which said series of blades discharge and in which the velocity imparted to the moving fluid is substan-

tially unchanged, a series of blades having their outer ends curved forward relatively to their direction of travel on each side of the disks receiving fluid from the guide
5 blades and imparting velocity thereto, and a diffuser chamber to receive said fluid.

In testimony that I claim the foregoing

as my invention, I have signed my name in presence of two subscribing witnesses.

ALFRED BÜCHI.

Witnesses:

HERMANN GRAF,

JOSEPH SIMON.