Apr. 24, 1923. 1,453,055

F. PHELPS

CENTRIFUGAL FAN

Filed Aug. 9, 1915

Fig. 1.

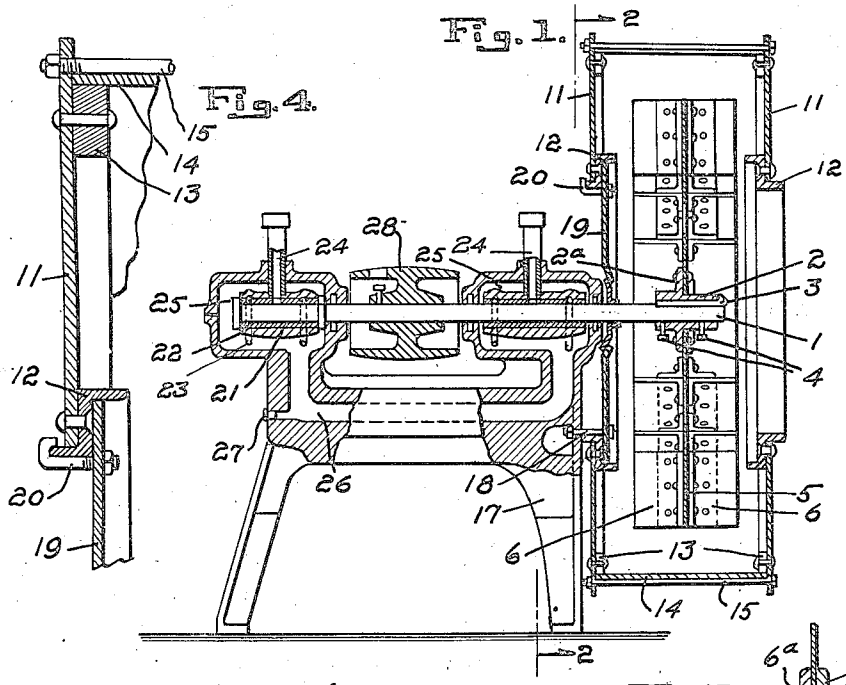


Fig. 4.

Fig. 2.

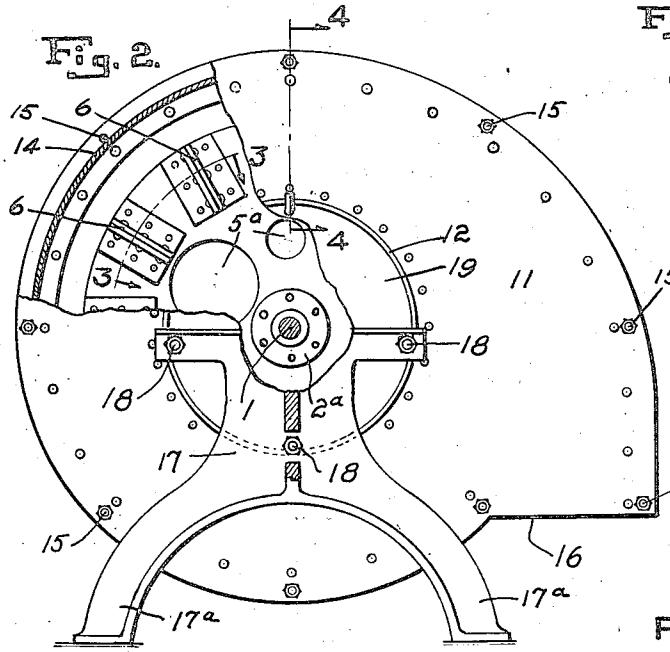
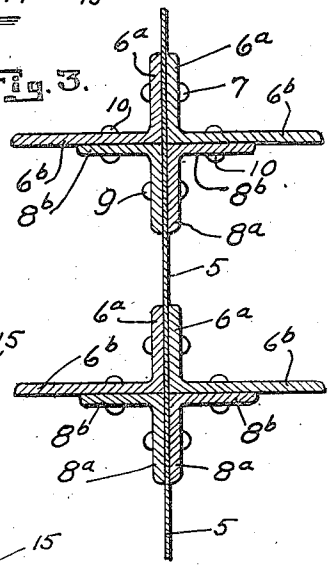


Fig. 3.



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Patented Apr. 24, 1923. 1,453,055

UNITED STATES PATENT OFFICE.

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CENTRIFUGAL FAN.

Application filed August 9, 1915. Serial No. 44,365.

To all whom it may concern:

Be it known that I, FRANK PHELPS, a citizen of the United States, residing at Little Rock, in the county of Pulaski and State of Arkansas, have invented new and useful Improvements in Centrifugal Fans, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide a simple and inexpensive type of construction for a centrifugal fan or blast wheel, such construction being especially designed to produce a wheel which when adjusted to a condition of still balance will also be found to be in satisfactory running balance. The usual practice in building blast wheels is to connect the blade with the shaft by means of a comparatively heavy web which is either formed as a casting or may be built up from standard forms of rolled steel, such as angles, plates, and the like. Whether this web be a casting or of such built-up construction its mass is not perfectly centered when first mounted upon the shaft, and the latter is therefore placed on temporary bearings, and the blast wheel is balanced by either adding weights to the light parts or by drilling out some of the metal in the heavier places until it will stand at rest at any point of rotative adjustment on its temporary bearings. In this condition the sum of the moments of all the individual masses which go to make up the wheel is equal to zero when such moments are taken with respect to the axis of the shaft. Likewise the algebraic sum of the centrifugal forces of these various individual masses will be zero; but with this usual class of construction the centers of mass of the various parts of the wheel will not all lie in exactly the same plane perpendicular to the axis of rotation,—and this is especially true if additional metal has been applied to the wheel at any point for balancing purposes. The result is that although the wheel will appear perfectly balanced so long as it stands at rest, the centrifugal forces set up when the wheel is revolved and acting effectively in different planes corresponding to the planes in which the centers of gravity of the individual parts happen to lie, will produce one or more couples tending to cause rotation of the wheel and its shaft in planes containing the shaft axis. Of course the shaft and the blast wheel are restrained against such movement by the bearings in which the shaft is mounted, but the unbalanced couples thus set up tend to cause excessive journal friction on said bearings, and if they succeed in causing even a very slight bending of the shaft during rotation the elastic re-action of the shaft to such bending will set up a vibration of the parts which may be transmitted throughout the entire machine, and which is nearly always detrimental to the latter. To overcome these difficulties the present invention provides details of construction hereinafter described and shown in the drawings and which are particularly set out in the appended claims.

In the drawings:

Figure 1 is an axial section of a blast wheel and its mounting embodying this invention.

Figure 2 is a side elevation of the same with a part of the casing broken away to reveal the construction of the wheel itself.

Figure 3 is an enlarged detail section taken as indicated at line 3—3 on Figure 2.

Figure 4 is an enlarged detail section taken as indicated at line 4—4 on Figure 2.

In the construction of this wheel the shaft, 1, is fitted with a hub, 2, secured by a key, 3, and set screws, 4, 4, and formed with a small flange, 2^a, to which there is secured a thin metal disk, 5, which constitutes the web of the wheel. The disk, 5, is cut exactly circular with a central opening to accommodate the hub, 2, and may be somewhat lightened by additional apertures, 5^a, punched out of its area immediately surrounding the hub, 2. Near the periphery of the disk, 5, are secured the fan blades, 6, and preferably these are arranged in symmetrical fashion projecting from both faces of the disk, as indicated in the detail section of Figure 3.

Each blade unit is shown as composed of four parts, namely, two angles disposed with their shorter length, 6^a, opposed and secured together by rivets, 7, fastened to the disk, 5, and with their longer lengths, 6^b, extending oppositely at right angles from the disk, 5. The blades thus formed of the angles, 6, are reinforced by additional angles whose opposing lengths, 8^a, are connected by rivets, 9, passing through the web, 5, while their other lengths, 8^b, are braced against and riveted to the respective parts, 6^b, of the other two angles, being firmly held

by rivets, 10. It will be understood that the angles of which the blades are thus composed may readily be formed as stamping of sheet metal so as to be absolutely uniform in shape and weight, so that with the web, 5, composed of a homogeneous sheet of metal there is little, if anything, in the construction to cause an imperfect balance in the wheel, and so that when it is first placed in temporary bearings it will be found to be very nearly in a condition of still balance. Slight inequalities in the heads of the rivets, 7, 9 and 10, or slight imperfections in the stock of which the blade is composed may, however, require that a little work be done on the wheel to bring it into perfectly balanced condition. Any such imperfections or other slight modifications of the parts to off-set them, is likely however to result in the distribution of mass centers into more than one transaxial plane, so that when the wheel is rotated rapidly there may be set up couples of forces tending to throw the shaft out of alignment as previously explained. Under this condition however slight, the mass centers of some of the elements composing the wheel are not quite in the mid-plane of the web, 5, but the centrifugal force acting at any one of these misplaced mass centers being opposed by the radial tension in the web, 5, produces a small resultant force acting transversely of said web and tending to move the individual mass center in such transverse direction to bring the centrifugal force and the opposing tension into a common line of action. Now the web, 5, being composed of sheet metal and being rendered especially flexible by virtue of the removal of a very considerable portion of the material at apertures, 5^a, is adapted to yield to this small transverse force to allow the misplaced mass to assume a position in a common plane with the majority of the individual mass centers of the wheel; in other words, any of the blade units whose mass is not quite symmetrically distributed with respect to the web, 5, is permitted to shift its position and thereby shift its center of mass in a direction transverse to the web, 5, and approximately parallel to the axis of the wheel,—such shifting being permitted by virtue of the flexibility of the disk, 5, by which the blades are carried. Thus while the wheel is revolving with great velocity the disk, 5, may be slightly bent or buckled out of its normal plane at certain parts, but the result will be an elimination of all couples tending to displace the shaft axis or to exert bending strains upon the shaft.

The casing for this wheel is quite simple in construction being composed of two side plates, 11, both centrally apertured and having their apertures reinforced by annular members, 12, which are Z-shaped in cross section. Near the peripheral outline of each plate, 11, but slightly set in from such edge there is riveted to the plate a strip, 13, which thus serves as a flange or shoulder for lodgment of the peripheral casing wall, 14, which is merely a strip of sheet metal of uniform width laid in position upon the flange members, 13, and held in place by the tie bolts, 15, which transversely connect the side plates, 11, and cross between them just outside the wall, 14. As indicated in Figure 2, the plates, 11, are cut to form the usual tangent discharge opening at 16, the peripheral wall, 14, terminating at opposite sides of said opening.

Journal bearings for the shaft, 1, are supported in a frame, 17, and the blast wheel casing is also supported on this frame, 17, partly by means of three bolts, 18, passing through a central plate, 19, which frictionally engages the web of the annular member, 12. An additional clamp is provided in the form of a hook bolt, 20, at the upper portion of said plate which also maintains frictional engagement between the plate and member, 12. The nut of this bolt, 20, is accessible by reaching through one of the apertures, 5^a, of the web, 5, it being understood that the central aperture in the side plate, 11, which is beyond the end of the shaft, 1, is left open to serve as an intake for the air supply to the blast wheel. Thus, by virtue of the wholly frictional engagement between the casing and the plate, 19, of frame, 17, the casing may be rotatively adjusted to bring its discharge mouth, 16, at any angle, upon merely loosening the bolts, 18 and 20.

Since the blade portions, 6^b, of the fan wheel are disposed in planes substantially radial to the axis of the wheel it will be seen that the wheel may be operated by rotation in either direction. The side plates, 11, of the casing are therefore exactly similar in construction so that by removing the bolts, 18 and 20, the friction plate, 19, may be completely disengaged from the Z-bar, 12, of the side wall, 11, permitting the casing to be taken apart and reassembled with the plate, 19, in the aperture of the other side wall, 11. Thus without any differences of construction the fans built according to this design are adapted to be operated either right-handed or left-handed. Furthermore, the design is so simple that the parts can be shipped in knock-down form and readily assembled by any ordinary mechanic. The first element to show signs of wear is usually the peripheral wall, 14, but this is very easily renewed by merely removing the bolts, 15, replacing the wall, 14, with a new strip of sheet metal and again clamping the bolts, 15, into position.

The journal bearings, 21, are shown as lined with the usual bearing metal, 22, and

provided with ring oilers 23, whose operation is well understood. Both journal boxes are provided with oil filler tubes, 24, and are formed with oil chambers, 25, surrounding the journal supports, 21. These chambers, however, are connected by a channel, 26, extending through the frame, 17, so that whenever oil is introduced in either of the filler tubes, 24, it is supplied to both bearings rising to the same level in both oil chambers, 25, by virtue of the connection, 26. The connection, 26, is provided with a discharge opening and a plug, 27, therefor, to be used for draining off the entire supply of oil if desired. A pulley, 28, is shown fixed to the shaft, 1, between the journal bearings, 21, but it will be understood that any suitable form of power transmission may be employed for driving the wheel.

I claim:

1. In a centrifugal fan, a casing comprising side plates having outwardly facing shoulders on their proximate sides, a peripheral wall member mounted upon said shoulders and spacing the side plates apart, and tie members extending from one side plate to the other just outside such peripheral wall and holding the latter in place on the said shouders.

2. In a centrifugal fan, a casing comprising side plates having outwardly facing shoulders on their proximate sides, a peripheral wall member mounted upon said shoulders and spacing the side plates apart, and removable tie bolts extending through said side plates just outside the peripheral wall for disengageably holding the plates in position.

3. In the combination of a fan wheel, a shaft and journal bearings therefor, together with a casing and a standard adapted to support said bearings and said casing, the casing wall having a central aperture, a plate in the casing overlapping the edge of said aperture, and clamping bolts extending from the standard through the plate and within said central aperture for frictionally holding the casing to the standard.

4. In the combination defined in claim 3, the aperture of the casing being reinforced by a circular member having a flange transverse to the casing wall, and the plate being fitted within said flange to center the casing for rotative adjustment on the standard.

In testimony whereof I have hereunto set my hand at Little Rock, Arkansas, this 5th day of August, 1915.

FRANK PHELPS.

Witnesses:

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