Nov. 14, 1944. W. L. UPSON 2,362,868

BLOWER WHEEL BLADE CONSTRUCTION

Filed May 18, 1943

FIG. 1.

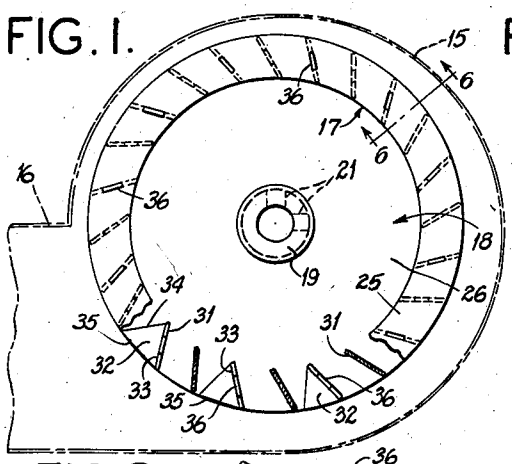


FIG. 2.

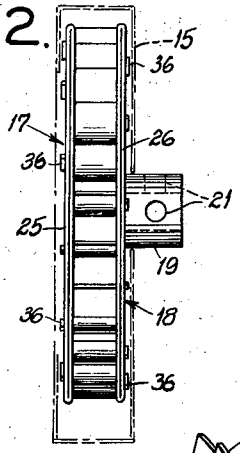


FIG. 4.



FIG. 3.

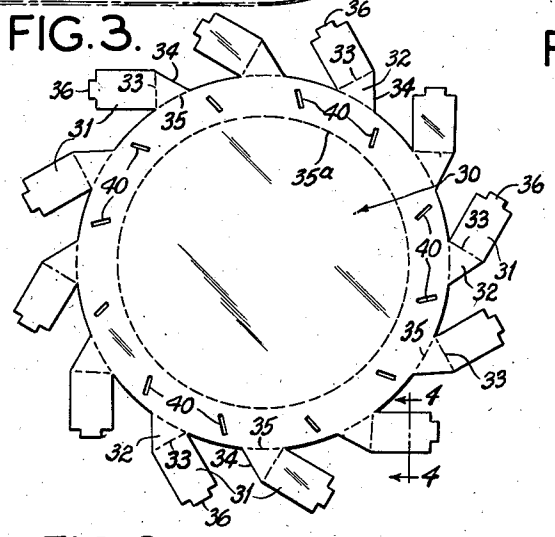


FIG. 5.

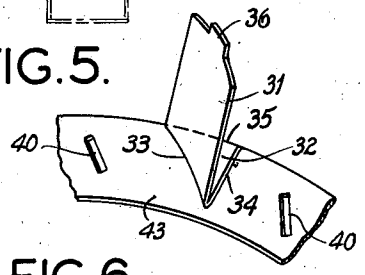


FIG. 6.

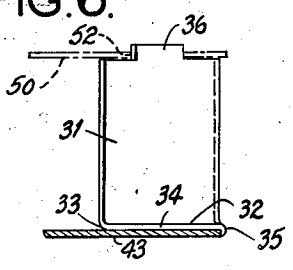


FIG. 8.

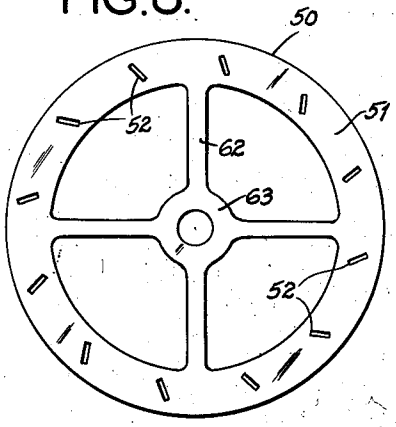


FIG. 9.

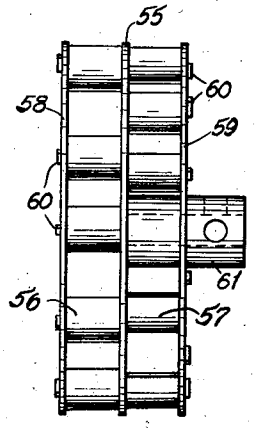
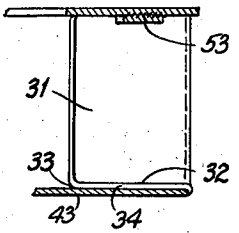


FIG. 7.



INVENTOR;
WALTER L. UPSON,
BY Robert B. Terry
ATTORNEY.

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BLOWER WHEEL BLADE CONSTRUCTION

Walter L. Upson, Litchfield, Conn., assignor to The Torrington Manufacturing Co., Torrington, Conn., a corporation of Connecticut

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10 Claims. (Cl. 230—134)

This invention relates to improvements in blower wheel blade construction, and more particularly to an improved blower wheel assembly in which the blade-forming elements, or some thereof, are integral with, and constituted from the original stock of one or more plate elements of the wheel.

Various types of sheet metal centrifugal rotors are currently and conveniently utilized in commercial production. One long-established practice consists in forming the blade elements separately from either of the ring or plate elements, and riveting the blades at their ends in assembled bridging relation to the plates.

Still another more recently favored type of centrifugal rotor, involves a one-piece body secured as a unit, as by crimping or the like to a pair of end rings or end plates. While the latter type of construction has numerous advantages, wheels or rotors of either of the types noted, may be considerably simplified as to number of parts, tooling requirement and overall costs, by producing the blade-forming elements from individual, integral projections on at least one of the plate or ring elements of the wheel. It is accordingly, to this general objective that the invention is particularly directed.

Somewhat differently stated, a major object of the present invention is attained in a reduction in the number of necessary parts or elements of a complete blower wheel, which simplification may be carried, if desired, to a reduction in number of wheel parts as low as two.

A further important object of the present invention is attained in a marked economy of centrifugal rotor construction by the provision of making blades integral with one or a pair of wheel plate elements.

Further and important objects of the invention include an increased adaptability, with given tooling equipment, to various minor design changes of such character as differing angle or pitch of blades; the formation of blades either of planar or curved form, and if the latter, of different radii of curvature or of different width, and an unusual facility for variation in number of blades of the rotor.

The invention is adapted generally to fluid reaction wheels or rotors operating according to centrifugal principles, or in fact any rotary fluid reaction structure in which a plurality of blades are mounted in substantially parallel relation, parallel to the axis of revolution of the wheel and carried between two end ring or plate members. In the ensuing description the term "plate" and "ring" are at times used interchangeably, inasmuch as it is well known practice in the art selectively to employ at times either an imperforate back plate, or a more truly annular element as one of the blade-carrying members of the wheel. It is considered for purposes of present description that a ring, in this sense, is only an incomplete plate.

The objects above expressly stated and others implied, will become more readily apparent from the following description in detail of a preferred embodiment and certain minor modifications thereof, particularly when the description is considered in connection with the accompanying drawing, in which:

Fig. 1 illustrates a blower wheel embodying present improvements, as mounted in a scroll housing, a portion being broken away for clearness to illustrate certain detail;

Fig. 2 is a sectional view of the assembly of Fig. 1, taken in an axial plane, but showing the wheel in marginal elevation.

Fig. 3 is a plan of one form of plate and blade blank, as same may be pre-cut prior to folding up the blade-forming projections of the blank;

Fig. 4 is an enlarged section through one of the blades, when produced in curved or cambered form, as taken along line 4—4 of Fig. 3;

Fig. 5 is a fragmentary isometric view of a portion of an end ring, showing one of the blades in partly folded condition, but prior to assembly of the wheel;

Fig. 6 is a fragmentary elevation showing one of the blades and portions of a pair of end plates or rings associated therewith and bridged by the blade, as taken along line 6—6 of Fig. 1;

Fig. 7 is a view similar in purpose and scope to Fig. 6, but showing an alternate arrangement for assembling one of the wheel plates to the ends of the blades;

Fig. 8 is a plan view of a spoke-type end plate or ring, and which is of circular aspect, not provided with projections or blade-forming portions, but shown as provided with apertures for blade assembly, and

Fig. 9 is an edge or marginal elevation of a centrifugal rotor or blower wheel of double inlet type embodying three plates and intervening blades.

Referring now by characters of reference to the drawing, Fig. 1 shows, principally for completeness, a scroll housing 15 provided with a tangential outlet 16, and provided at one or both of its sides with a suitable inlet, not specifically indicated. Operatively disposed within the scroll

housing 15 is a centrifugal rotor or blower wheel generally indicated at 17, and embodying a back plate 18, which may be imperforate in assembled form, and a shaft mounting hub 19. A set screw (not shown), located in one of the openings 21, conveniently serves in well known manner to secure the wheel to the shaft (not shown) for rotation thereby.

A preferred construction of single inlet wheel consists, as indicated by Fig. 2, of a pair of end plates 25 and 26. Each of the plates 25 and 26 is formed of a blade and plate blank 30 which is shown as a circular disc, but may consist of a ring of sheet metal of suitable gauge, and which may be die-punched or otherwise formed to include a peripherally extending series of individual blade forming extensions 31. In the form in which the element 30 is initially blanked out, the blade forming portions 31, per se, are of substantially rectangular outline as shown, and each element 31 is integrally joined to the circular periphery of the disc 30 as by a triangular or quasi-triangular connecting neck portion 32. A real or imaginary fold line 33 bounds one end of the blade forming element 31, and constitutes one side of the triangular neck 32. A free margin 34 of each of the quasi-triangular portions 32, along with a clearly defined arcuate line 35 completes the bounds of each portion 32, according to the preferred arrangement. In case a ring is desired, instead of a back plate, the blank may be cut away along the smaller circle, shown in dotted lines at 35A (Fig. 3).

According to the preferred construction the outermost or free end of each of the blade forming projections 31, is provided with a securement or anchorage tongue 36 for an assembly purpose hereinafter better appearing.

As the time of or as a sequential step to blanking out the element 30 and projections, the blade-forming portions 31 may either be left flat or planar if a flat blade is desired, or may be given the desired camber or curvature as suggested by the somewhat enlarged sectional showing of Fig. 4.

The preferred construction of wheel, and hence of the blank 30 further embodies an annular series of seats for the several tongues 36 of a companion blank. These are shown in Fig. 3 as consisting of slots 40 each biased so as to present its major dimension or axis located substantially on a tangent to a circle on the axis of rotation of the wheel.

Referring now to the manner of folding up the several blade-forming projections 31, so as to dispose the several blades in their proper assembly relation and in the desired pitch, the projections including portions 31 and 32 may first be folded along the several lines 35 so as to bring the quasi-triangular portions 32 downwardly upon and in close parallel adjacence to the peripheral portion of the body substantially as shown by Fig. 5. The blade-forming portion proper, being part 31, is thereafter folded at substantially a right angle to portion 32 as shown by Fig. 5, so as to bring the blade proper at a right angle to the plane of the ring 43 or of the plate 25 or 26. When all of the blades have thus been formed and located by the folding operations described (the order of such operations being a matter of choice and production convenience), there will obviously result a unit formed of a single piece of metal and which is ready to constitute the major part, or one thereof, of the rotor.

In what is probably structurally the most simple form of the several present wheel assemblies, the plate element with formed blades thereon may now be completed, but for the hub, by the addition to such bladed unit of an unbladed end plate such as indicated at 50 (Fig. 8). As shown in this figure, the plate or ring 50 includes a rim portion 51 provided at equal angular intervals with a series of biased rectangular slots 52 in a number which corresponds to the number of blades, hence the number of tongues 36 on the previously formed-up plate and blade unit. It now appears obvious that by so applying the ring 50 to the blade and plate unit, that the slots 52 are occupied by the tongues 36, the tongues preferably being of a length to extend through and somewhat beyond the slots, the tongues are by pressure or impact bent over in such manner that the heretofore free ends of the several blades are staked firmly in place in the slots. Addition of a suitable hub member, which is or may be similar to the hub 19, serves to complete one form of the wheel which, as will be apparent, results in a single inlet assembly. It will of course be understood that if desired, the disc 30 may be provided with the usual central hub opening and secured by projecting a formed portion of the hub through such opening and by swaging, welding or by any customary mode of assembly, firmly securing the hub to the plate.

Optionally, not only in the particular assembly of wheel just described, but in any of the other several forms herein referred to and to be described, instead of providing the apertures such as slots 40 or 52, the tongue element of each of the blades may be seated in close adjacence to the inner surface of one of the rings or plates, and spot-welded as indicated at 53 (Fig. 7). In Fig. 6 is shown a somewhat enlarged detail indicating the manner of extending the tongue 36 of each of the blades through an opening therefor, such as 52, following which the portion of the tongue projecting beyond the plate or ring element, is firmly and sharply bent or swaged over to complete the staking operation earlier described.

The advantages provided by the present structures for producing wheels of a great variety of types, sizes, number of blades and varying capacities, will still further appear from the mode of assembly according to which a pair of the bladed units, each formed up of a blank such as shown by Fig. 3, or a corresponding ring, are utilized in a wheel provided with a relatively greater number of blades, such as shown, for example, by Fig. 2. In this form of rotor a pair of the units, in which the blades have been folded to right angular relation to the plate to which they are integrally joined, are brought in facing relation and in register, with the blades of each unit intervening those of the other unit, and further with the blades of each unit interfitted, through their tongue portions 36, with the tongue apertures of the opposite unit. Assembly is now obviously completed by folding or upsetting the projecting extremities of the several tongues 36, thereby staking the two units together in such manner that alternate blades are integrally carried by opposite plates, and alternate blades staked in assembly with opposite plates or rings. As before noted, the tongues 36 may be welded to the internal surfaces of the plates or rings instead of staking, as may be desired. It will now appear that the assembly, described as formed up of a pair of blade and plate units, will result in a wheel having twice the number of

blades as one formed, as first above described, from a single bladed plate or ring, and an unbladed ring.

A still further example of the many possibilities for varying form, capacity and other characteristics of the number of different wheels possible to be attained, is illustrated by the center plate wheel of Fig. 9. In this construction, in folding the blades out of the plane of the plate by which the blades are integrally carried, alternate blade-forming projections are bent to extend in opposite directions from their initial plane. In Fig. 9, a three-plate wheel is illustrated including a center blade-carrying plate **55**, with which is initially integrally formed a series of peripheral projections. These are bent or folded for example, as above described in connection with the formation of disc **30**, but in such manner that alternate blades, for example **56** and **57**, extend on opposite sides of the center plate **55**. If the staked construction be utilized, a pair of end rings such as shown by Fig. 8 for example, may be employed to constitute the end plates **58** and **59** of the center plate wheel, and tongues **60** projecting through the suitable number of slots provided therefor in plates **58** and **59** will, when upset to overlie the rings, serve to complete the assembly of the wheel. The addition of a hub such as **61** for shaft-mounting the wheel, will now complete the assembly of this form of rotor. As desired, the center plate **55** may be either of open construction provided with spokes such as indicated at **62** and a hub eye as shown at **63** in Fig. 8, or may be of imperforate plate type in a center plate wheel of this type. Both of the end rings **58** and **59** will usually be of either fully open or of spoked construction.

To those skilled in the art it will now have appeared from the ease of producing a variety of wheels of this type, that the arrangement described lends itself to ready adaptability without expensive production changes to an unusual variety of types and specifications of centrifugal rotors. Now obviously, it will appear that it is relatively simple to increase within reasonable limits as desired, the length of the individual blade-forming projections on the flat blank as shown by Fig. 3 and thereby to increase as desired, the axial dimension or depth of the wheel. It will also have appeared that the number, hence the angular spacing of the several blade-forming and securement portions such as **31** and **32** may be easily and readily varied so as to result in a greater or less number of blades than suggested by the original example of Fig. 3. There is further provided, as noted, the facility for quickly doubling the number of blades by opposing and assembling paired units formed by the blanks of Fig. 3. It also appears now to require no more than a notation of the fact that the blades in any of the described forms, may be either left flat, or cambered as shown by Fig. 4 to provide the desired curvature.

In the course of description of the manner of folding up the blade-forming extensions **31** and **32** it will have appeared that by varying the angularity of the fold lines **33**, the pitch of the blades may be varied quite readily to fit particular requirements of use, and in variance of wheel specifications. It will also now be apparent that either by utilizing the blade-plate blank as shown by Fig. 3, or by extending incisions from the periphery of disc **30** a distance equal to the width of blades desired, the blades may each be formed up from the blank by a single fold, instead of the somewhat preferred double fold along lines **33** and **35**. For example, a fully operative wheel may be formed by folding the blade extensions of the blank solely along lines **33**. Since the blades will then be outside the circle of the disc, a slightly larger ring element, such as **50**, will serve to complete the wheel.

It will now have appeared that the described embodiments of the invention appear fully to attain each of the objects hereinabove expressly set out, and that others will be implied or suggested from the detail of description of the several assembly embodiments.

Although the present improvements have been described by making detailed reference to but a few of the many possibilities of embodiment, such detail of description is to be understood entirely in an instructive and not in a limiting sense, inasmuch as many changes may be made within the scope of the appended claims.

I claim as my invention:

1. In a centrifugal wheel of the general type described, a plate provided with a plurality of integral, peripherally projecting strips, each of said strips being folded along a line substantially corresponding to the outer margin of the plate and further folded along a line lying substantially at an acute angle to the margin of the plate, with each of said strips, when formed, projecting at substantially a right angle to the plane of the plate, and a further wheel element assembled in supporting relation to the free ends of the strips, whereby the strips serve as blades bridging said element and the plate.

2. In a centrifugal rotor, a blade supporting disc provided with a peripheral series of blade-forming extensions, each extension including an anchoring end folded to lie adjacent the face of the disc, and further folded to project at substantially a right angle from the anchoring end to constitute the active portion of the blade, and means for rotatively mounting the disc with its extensions in substantially parallel relation to each other and to the axis of rotation.

3. In a centrifugal rotor, a blade-supporting disc provided with a peripheral series of blade-forming extensions, each extension including a substantially triangular portion nearest the body of the disc, and lying substantially parallel to the disc, the extension beyond the triangular portion being of a substantially rectangular outline, and constituting the reaction area of the blade, projecting at substantially a right angle from the triangular portion but at an angle to the radius of the rotor to result in the desired blade pitch, and means for rotatively mounting the disc with its blade forming extensions assembled fixedly in substantially parallel relation to each other and to the axis of rotation of the rotor.

4. In a bladed fluid-reaction wheel, a plate, a plurality of blades integrally carried by the plate, each of said blades including an end anchorage portion lying in close parallel adjacence to the plate, and an active portion pitched and extended at substantially a right angle to the anchorage portion, and means coacting with the plate and anchorage portions for rotatively supporting the blades in spaced parallel relation.

5. In a bladed fluid-reaction wheel, a plate, a plurality of blades integrally carried by the plate, each of said blades including an end anchorage portion lying in close parallel adjacence to the plate, and an active portion pitched and extended at substantially a right angle to the anchorage

portion, and means including an annulus secured to the several blades beyond their active portions coacting with the plate and anchorage portions for rotatively supporting the blades in spaced parallel relation.

6. A centrifugal rotor including a center plate, a series of blades formed integrally with the center plate, the blades being folded from extensions of the body of the plate, so as to lie in pitched positions laterally of the plate, with a number of the blades evenly angularly spaced, lying at one side of the plate, and the remainder, evenly angularly spaced, lying on the opposite side of the plate, and means for rotatively mounting the plate with its blades maintained in substantially parallel, pitched relation to each other.

7. A centrifugal blower wheel adapted for double inlet operation, and comprising three plates, one centrally and one at each end of the wheel, a series of blades formed integrally with the center plate, the blades being folded from the center plate to lie on opposite sides thereof in pitched relation between the adjacent plates, and alternate blades being secured at their otherwise free ends, to the opposite end plates of the wheel.

8. In a centrifugal blower wheel, a circular plate provided with a plurality of integral, peripherally projecting strips, each of said strips being folded along a line corresponding substantially to the outer margin of the plate and further folded along a line lying approximately at an acute angle to the margin of the plate, in such manner that each of the strips when fully formed, projects at substantially a right angle to the plane of the plate, and a ring element serving to support the otherwise free ends of the several strips, and acting to maintain said strips in mutually parallel relation with the strips bridging the ring and the plate, each of the strips having a staked connection with the ring.

9. In a centrifugal rotor, a blade-supporting disc provided with a peripheral series of blade-forming extensions, each extension including an anchoring end folded to lie adjacent the face of the disc, and further folded to project at substantially a right angle from the anchoring end to constitute the active portion of the blade, a ring for supporting the otherwise free ends of the several extensions, the ring being provided with a series of spaced slotted apertures for receiving, in assembly, said ends of the extensions, and means for rotatively mounting the disc with its extensions in substantially parallel relation to each other and to the axis of rotation.

10. A centrifugal blower wheel adapted for double inlet operation, and comprising a center plate element and a pair of ring elements at each end of the wheel, a series of blades formed integrally with the center plate, the blades being folded from the center plate so that alternate blades extend on opposite sides of the plate in pitched, mutually parallel relation, between the center plate and the end rings, the alternate blades being secured at their otherwise free ends, to opposite end rings, the end rings being provided with a series of slotted, angularly disposed, evenly spaced apertures each adapted to receive in assembly, an end portion of one of the blades supported thereby.

WALTER L. UPSON.