This invention has to do with a fan having detachable blades and is a general object of the invention to provide a fan of this type which is of simple, practical and improved construction.

Fans such as are provided for the handling or circulating of air when of appreciable size are, in many instances, cumbersome and present difficulties in handling, as for instance, in the course of transporting, storing, etc. Fans of this general character have been heretofore provided with blades separable from hub constructions. However, mechanisms of this type are generally rather complicated of construction and not altogether convenient to assemble or disassemble when assembled.

It is an object of this invention to provide a fan construction characterized by a hub with a holder thereon and having blades with arms releasably secured to the hub, the whole construction being such as to involve but few simple parts and being such that the parts can be easily and quickly assembled to be dependably and securely connected when the construction is completely assembled.

Another object of this invention is to provide a structure of the general character referred to including an improved hub and holder construction which involves few parts that are simple and inexpensive of manufacture and which are permanently joined or assembled to form a structure ready for the reception of arms provided on fan blades.

Another object of the invention is to provide a structure of the general character referred to in which the fan blades are equipped with arms with projecting parts that are secured to the hub and which are provided with stiffening portions in effect overlapping the portions of the holder that hold the arms and serving to render the arms rigid and highly satisfactory.

The fan construction provided by the invention involves a hub, tubular in form and having a reduced projection at one end, which projection has a terminal lip portion. A holder is carried on the hub, being engaged over or on the reduced projecting portion, and is held thereon by the lip of the hub and shaped to overlie the holder. The holder involves but three parts, namely, two like plates and a spacer between the plates. The plates have central openings that receive the reduced portion of the hub and they have peripheral notches which divide their peripheral portions into flange-like parts that are circumferentially spaced. The plates are assembled with their flange-like parts in register or opposed, and the spacer is between the plates separating the plates at the central portion of the holder or where the holder is engaged on the reduced portion of the hub. The blades are preferably alike and in a preferred form each has a main portion formed of sheet metal or the like, and having the desired shape and form. An arm is provided on each blade and is preferably a part formed separate from the main portion of the blade, in which case it has a base fixed to the main portion of the blade, as by welding or riveting, and has an inwardly projecting portion, the terminal end of which enters between the plates of the holder. The several arms of the blades enter between the opposed flanges of the holder and the projecting portions of the arms have their edges turned or deflected to form stiffening parts, and these stiffening parts continue from the bases of the blades into the notches provided in the holder. The projecting portions of the arms not only enter between the opposed flanges of the holder, but continue inward from the flanges toward the center of the holder, and suitable releasable fasteners are provided, securing the arms in the desired position in the holder. In practice screw fasteners such as bolts preferably serve to retain the arms engaged in the holder.

The various objects and features of my invention will be fully understood from the following detailed description of a typical, preferred form and application of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a front elevation of a fan embodying the present invention, showing the several parts fully assembled so that the fan is complete and in working condition. Fig. 2 is a view similar to Fig. 1, showing the parts exploded or separated, so that the arms of the blades are separated from the holder on the hub. Fig. 3 is an enlarged longitudinal sectional view of the structure taken as indicated by line 3—3 on Fig. 1. Fig. 4 is a transverse section taken as indicated by line 4—4 on Fig. 3. Fig. 5 is a perspective view of the hub showing the central portion of the holder in place thereon ready to be secured. Fig. 6 is a view similar to Fig. 5, showing the holder secured on the hub, and Fig. 7 is a reduced sectional view taken as indicated by line 5—5 on Fig. 4.

The construction provided by the present invention involves, generally, a hub A, means B for locking the hub on a shaft S or the like, a holder C mounted on or carried by the hub, blades D and mounting means E releasably mounting the blades on the hub A through or by means of the holder C.

The hub A is an elongate tubular element and has a central longitudinal opening 10 that is round or in the form of a bore designed to receive a shaft S, or the like. The means B provided for locking the hub on the shaft S may be any suitable means. In the drawings I have illustrated the means B as involving set screws 11 carried in threaded openings 12 provided in the hub, the screws being operable from the exterior of the hub and being engageable with the shaft for setting the hub against displacement from the shaft.

In accordance with the invention the hub has a holder retaining means provided thereon or combined therewith. In the preferred form of the invention the hub has a portion 20 of reduced diameter at one end forming a part on which the holder is held. The part 20 is smaller in outside diameter than the adjoining portion of the hub, so there is a shoulder 21 against which the holder is engaged. The shoulder 21 is preferably flat and in a plane normal to the longitudinal axis of the hub. The portion of reduced diameter is substantially longer than is necessary to hold the hub and a counterbore 22 is provided in the projecting portion from its outer or terminal end, establishing the projection with a thin projecting lip 23. As the hub is initially formed the projecting portion 20, with its lip 23, has its exterior turned so that it is uniform in diameter throughout the length of the projection and is such as to slidably receive the holder.

The holder C, which is an assembly of parts as will be hereinafter described, is engaged on the projecting portion 20 to abut the shoulder 21, and when this is in place the lip 23 is deformed, for instance, pressed to project outwardly and into engagement with the end of the hub opposite to that engaging the shoulder 21, as clearly shown in Fig. 5 of the drawings. Through this construction the
holder retaining means, which is provided on or which is a part of the hub, serves to positively and dependably retain the holder C on the projecting end portion 20 of the hub with the holder in a plane normal to the longitudinal axis of the hub.

The holder C provided by the present invention is formed by an assembly of three parts, namely, two like plates 30 and a spacer 31 between the plates. The plates 30 are preferably flat disc shaped elements that are all the same number of flanges 36 may be varied, or being provided, respectively, to provide a spacer so that each plate has the same number of flanges as there are blades involved in the structure. In the case illustrated the fan illustrated has four blades and consequently there are four notches 34 providing four like flanges 36.

In accordance with the present invention the spacer 31 is provided between the plates 30 and is preferably concentric to the central portion of the holder, that is, to that portion of the holder which is engaged with the hub. In the case illustrated the spacer 31 is in the form of a simple, anular plate or washer with a central opening corresponding in size with the openings 32 provided through the plates, and the washer is of limited extent radially, or in outside diameter, so that the plates have annular portions projecting outward beyond the spacer and on which the flanges 36 occur or are provided, as shown throughout the drawings. In accordance with the invention the several parts of the holder just described, namely, the plates and the spacer, are arranged together as a unit with the flanges 36 of the two plates in register or opposite each other. It is preferred, in practice, that the holder be secured or locked on the hub against rotation relative thereto and for this purpose the plate 30 engaged by the lip 23 has one or more recesses 38 provided in the opening 32 and the portion of the lip 23 formed to retain the holder on the hub is indented or shaped to project into one or more of the recesses. In the case illustrated in the drawings there are four recesses 38 and the lip 23 is indented at the four points 39 shown in the views. The result of this is that the holder is effectually locked on the hub against rotation relative thereto.

The blades D are preferably alike and the desired number of blades is provided about hub A and is held by the holder C through the mounting means E. Each blade D involves a main portion 40 formed of sheet metal, or the like, and so far as the present invention is concerned the main portion 40 may be of any suitable size, shape, or formation. In the particular case illustrated the main portion 40 is substantially round in shape and the edge portion 41 that faces inwardly toward the hub is made somewhat concave, as shown in Figs. 1 and 2 of the drawings. It will be readily understood that in practice the high portion 40 may be shaped or formed so that it is other than flat and so that it has the desired air handling action, and furthermore, if desired, it can be provided with various features such as stiffening ribs 42 and the like.

The mounting means E provided for or in connection with each blade serves to securely the blade to the holder C and, in accordance with the present invention, it involves an element that I will term an arm 50, which arm has a base portion 51 fixed to the main portion 40 of the blade and a projecting portion 52 that projects radially inward from the main portion of the blade, and has a flat terminal end portion 55 engaged by the holder C. In the preferred construction the base portion of the arm is substantially flat or is formed to seat against one side of the main portion 40 of the blade, and it is of substantial size or extent so that there is engagement between the portion 40 of the blade and the base of the arm. In the case illustrated the base of the arm is permanently and rigidly fixed to the main portion 40 of the blade, as by rivets 60. With the construction that I have provided the middle or central portion of the arm is substantially flat or is formed to seat against one side of the main portion 55 and the base portion 51 may be twisted or shaped so that the main portion 40 of the blade is supported relative to the plane in which the holder occurs at any suitable angle, as circumstances may require. The twisted or deflected central portion of the arm can, in practice, be shaped so that the fan has a substantial pitch or a slight pitch, as may be desired.

In accordance with the present invention the longitudinal edge portions 65 of the projecting portions 52 of the arms are bent or turned somewhat from the planes of the arm portions to which they are secured and as a result, transform stiffening elements that continue from the base portion of the arm to the inner terminal end portion 65. In practice the stiffening flanges or edge portions 65 of the arms materially stiffen the sheet metal arm members and serve to effectively maintain the arms against bending or flexure.

In accordance with the present invention the flat terminal end portions 55 of the several arms project between the opposed flanges 36 of the holder and these parts of the arms continue inwardly from the flanges 36 to the spacer 31 or to points close to the spacer. The manner in which the flat terminal end portions 55 of the arms enter between the plates of the holder is clearly illustrated in Figs. 3 and 4 of the drawings. Where the parts are proportioned as shown in the drawings the inner corners 70 of the arm portions 55 are bevelled or cut away as shown in Fig. 4, so that these portions of the arms may be entered between the plates of the holder in the desired manner and without interfering with each other, as would be the case if they were not bevelled or dressed away.

In accordance with the present invention the projecting portions 52 of the arms are wider than the flanges 36 of the holder in a direction circumferentially of the holder, with the result that the reinforcing or stiffening edge portions 65 of the arms are clear of the flanges 36 and extend inwardly into the notches 34 provided in the holder, as clearly illustrated in Fig. 4 of the drawings. By thus notchting the holder so that the stiffening ribs or flanges of the arms enter into the holder, the arms are held in position which the arms are held, in effect overlap the reinforced portions of the arms, with the result that there is no flexibility or weakness in the structure where the arms connect to or are held by the holder.

The mounting means further includes releasable fasteners 75 preferably screw fasteners such as bolts that retain the flat terminal end portions 55 of the arms engaged between the plates of the holder in the manner illustrated in Figs. 3, 4 and 7 of the drawings. When bolt type fasteners are employed, as shown in the drawings, registering holes 76 are provided in the arms portions 55 and the flanges 36 of the holder, and the desired bolts are passed through these registering openings. It will be apparent that in practice any desired number of bolts can be employed in connection with or to hold each of the arms, a typical bolt arrangement being shown throughout the drawings.

With the construction provided by the present invention the hub 50, with the holder C permanently fixed thereto, can be provided and a suitable number of blades D, with arms 50 thereon, can be provided. These parts can be packed in a limited space, the blades being superimposed and nested together and the structure can be so designed that the blades are held in this packed or knocked down position. When the fan is desired for use the flat terminal end portions 55 of the arms occurring on the
blades are inserted between the flanges 36 of the holder to project inward beyond the flanges, as shown in Fig. 4, and when in working position the fasteners or bolts 75 are applied. When the bolts 75 are made fast or tight the flanges 36 of the two plates at each arm can be flexed or clamped tightly toward each other to solidly grip the arm and because of the presence of the notches 34 the flanges 36 at the arms are somewhat independent of each other, so that each arm can be effectively and securely gripped by suitable tightening of the fasteners related thereto. The terminal end portions 55 of the arms being extended inward from the flanges 36 have substantial engagement with and between the plates of the holder, so that the arms are effectively and dependably maintained in the desired relationship to the holder. From the foregoing description it will be apparent that the holder, in turn, is effectively and dependably secured on the hub, and with the means D illustrated the hub can be suitably fixed on a shaft S, or the like, provided for operating the fan.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art and fall within the scope of the following claims.

Having described my invention, I claim:

1. A fan including, an elongate hub with a central longitudinal shaft opening therein, a holder permanently fixed on the hub and including, a pair of like longitudinally spaced disc-shaped plates with circumferentially spaced radially outwardly opening notches in the peripheries thereof, blades, elongate arms on the blades extending inwardly therefrom and between the plates, and releasable screw fasteners securing the arms in tight clamped engagement between the plates, the arms having base portions fixed to the blades, portions projecting from the base portions toward the hub and flat terminal end portions between the plates, the arms having stiffening parts at the edges thereof and projecting laterally therefrom and entering the notches in the plates and adapted to prevent shifting of the blades relative to the hub.

2. A fan including an elongate hub with a central longitudinal shaft opening therein, a holder on the hub, and blades with arms releasably held engaged with the holder, the holder comprising three parts, one being an annular spacer and the other two being like apertured plates held apart by the spacer and having radially projecting parts between which the arms are entered, the hub having a shoulder at one end, a cylindrical portion of reduced diameter projecting longitudinally from the shoulder to slidably engage and carry the plates and spacer, and a radially outwardly projecting lip on the outer terminal end of the said cylindrical portion and permanently enga
gaged with the holder and holding it tight against the shoulder, the plates having recesses therein adjacent the said cylindrical portion of the hub and the lip having a longitudinally offset part engaged in a recess in one of the plates.

3. A fan including, an elongate cylindrical hub with a central longitudinal shaft opening and having a shoulder at one end, a portion of reduced diameter projecting from the shoulder and a radially outwardly projecting lip on said portion and spaced from the shoulder, a holder including two like apertured disc-shaped plates and an annular spacer between the plates, the holder being slidably engaged on said portion of the hub between the said shoulder and lip and permanently held against the shoulder by the lip, the plates having circumferentially spaced notches in the peripheries thereof establishing circumferentially spaced flanges at the periphery of the plates, blades, arms on the blades projecting therefrom toward the hub and having flat end portions between flanges of the plates, and screw fasteners releasably securing the end portions of the arms in tight clamped engagement between the flanges, the arms having turned and offset edge projections extending longitudinally thereof and into the notches.

4. A fan including, an elongate cylindrical hub with a central longitudinal shaft opening and having a shoulder at one end, a portion of reduced diameter projecting longitudinally from the shoulder and a radially outwardly projecting lip on said portion and spaced from the shoulder, a holder including two like disc-shaped plates with central openings and an annular spacer between the plates, the holder being slidably engaged on said portion of the hub and permanently held against the shoulder by the lip, the plates having circumferentially spaced notches in the peripheries thereof establishing circumferentially spaced flanges at the periphery of the plates, blades, arms on the blades projecting therefrom toward the hub and having flat end portions between flanges of the plates and extending between the plates inward of the flanges, and screw fasteners extending through the plates and through the said end portions of the arms and releasably securing the end portions of the arms in tight clamped engagement between the flanges.

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