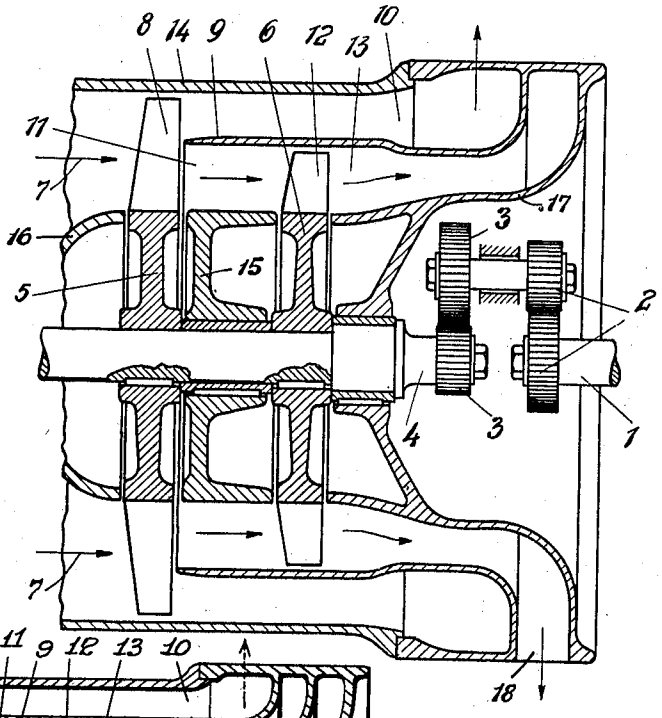
July 7, 1936. F. GOSSLAU 2,046,737

MULTIPLE STAGE BLOWER

Filed Oct. 26, 1934

Fig. 1.



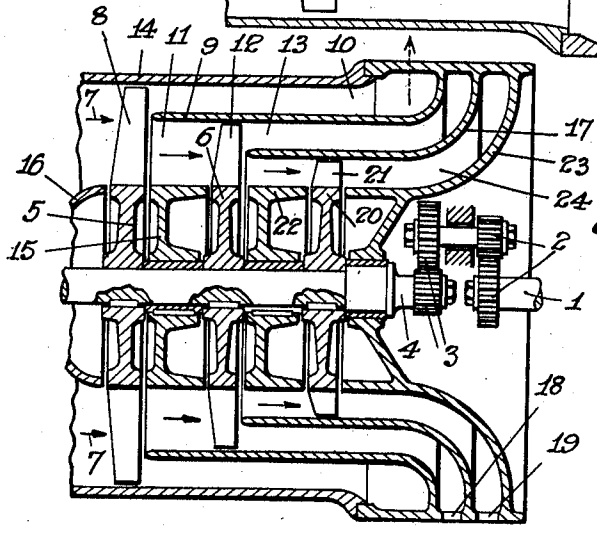


Fig. 2.

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MULTIPLE STAGE BLOWER

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In Germany October 30, 1933

3 Claims. (Cl. 230—122)

This invention relates to improvements in multiple stage blowers.

It is necessary in many installations to supply a plurality of currents of air at different pressures, for example currents of cooling air and scavenging air for internal combustion engines, and to simplify the blower installation, it has been proposed to construct blowers to produce two separate air currents of different pressures. With centrifugal blowers it has been customary to sub-divide the blading so that each subdivision thereof produces one of the air currents but it is found with such an arrangement that any marked alteration in consumption of air in one of the currents reacts adversely on the pressure conditions and quantity of air in the second current.

It has therefore been proposed to construct a blower in which the fan blading impels the air current in the axial direction of the fan shaft and to provide two co-axial fan blade systems of different diameter on the same shaft so that the two blade systems produce two air currents of different pressure, one in each system. Whilst this form of blower is more satisfactory in operation than the centrifugal type, it is relatively expensive to manufacture.

It is an object of this invention to provide a multiple stage blower of the type in which the fan blading impels the air in the axial direction of the fan shaft, which is relatively simple in construction and cheap to manufacture whilst ensuring complete segregation of the several air currents of different pressure produced by the blower.

In a preferred construction according to the invention, a blower of the type referred to for producing two distinct air currents of different pressures, comprises at least two co-axially mounted fans of different diameter, of which the larger is spaced axially from the smaller in the direction of the blower intake. The fans are each closely surrounded by one of two concentrically disposed cylindrical jackets or casings, which are arranged to provide two concentric air conduits, the entry end of the inner conduit terminating adjacent to the delivery face of the fan of larger diameter so as to subdivide the air delivered therefrom into two concentric currents, of which the inner is delivered into the inner conduit as the air supply to the fan of smaller diameter. The pitch of the blading of the smaller fan is such as to act effectively in series with the inner blading portion of the larger fan from which that air supply is delivered, to produce an increase in pressure of the air so delivered.

In order that the invention may be fully understood, reference is directed to the accompanying drawing, which in Fig. 1 shows a multiple stage blower in central sectional elevation constructed in accordance with the invention, only that portion of the blower being shown which is necessary for clear understanding of the invention. Fig. 2 shows in similar view a modification of Fig. 1.

The blower shown in the drawing, is constructed for use with internal combustion engines and is arranged to supply two air currents of different pressure, one for cooling the engine and the other for scavenging purposes, the engine, for example, being used as the driving motor of a vehicle or aircraft.

Referring to Fig. 1, the blower is arranged to be driven from the crank shaft of the engine, a portion of which is indicated at 1, the blower shaft 4 being geared to the shaft 1 by two sets of transmission gear wheels 2 and 3, this gear transmission being represented somewhat diagrammatically in the drawing. Two fans 5 and 6 are keyed upon the shaft 4, the fan 5 being of larger diameter than the fan 6 and displaced axially with respect thereto towards the air inlet of the blower. Preferably the blower is mounted so that the air current produced by the travelling speed of the vehicle or aircraft enters the inlet of the blower in the direction of the arrows 7 thus producing an initial air pressure at the inlet. The blading 8 of the fan 5 is of greater radial length than the blading 12 of the fan 6, but is of the same root diameter, the fans 5 and 6 being provided with hubs of equal diameter. A cylindrical spacer 15 of the same diameter as the hubs of the fans is interposed between the two fans as shown in the drawing and is likewise keyed to the shaft 4. At the intake side of the fan a domed member 16 is provided and directed towards the incoming air stream and is of a stream line configuration adapted to conduct the air smoothly into the fan blading, the domed member terminating adjacent to the fan 5 with a diameter equal to the diameter of the hub of the said fan.

An outer cylindrical jacket or casing 14 surrounds the blading 8 of the fan 5 close to the periphery thereof and an inner cylindrical jacket or casing 9 is similarly arranged around the blading 12 of the fan 6 and is concentrically disposed within the casing 14 so as to provide an outer annular conduit 10 between the casings 9 and

14 and an inner annular conduit 13 between the casing 9 and the peripheries of spacer 15 and the hub of the fan 6; the forwardly continuing portion of the conduit 13 is formed by the provision of an inner cylindrical wall 17 following more or less the contour of casing 9 as shown in the drawing. The casing 9 terminates at the inlet end 11 of the inner conduit 13 adjacent to the delivery side of the blading 8 and acts as a partition which in the operation of the blower divides the air current delivered by the blading 8 into two annular streams, the outer one of which is conveyed by the conduit 10 to an outlet, not shown in the drawing but is represented diagrammatically by a broken arrow, and is conducted therefrom to the cooling system of the internal combustion engine. The inner annular current of air delivered by the blading 8 is further compressed by the blading 12 of the fan 6, this blading being given a suitable pitch for this purpose. The air delivered by blading 12 is conveyed by the conduit 13 to an outlet 18, shown at the bottom right-hand portion of the drawing, from which it is conducted to the scanvenging ports of the engine cylinders.

If it is desired to supply supercharging air to the engine the blower shown in Fig. 1 is modified as illustrated in Fig. 2. In all of its essential elements and arrangements this blower is similar to that shown in Fig. 1, and corresponding elements are denoted with similar reference numerals. It will be noted, however, that in addition to bladings 8 and 12, a third fan 20 with blading 21, smaller in diameter than blading 12, is fixed on the blower shaft 4 and spaced, in the direction of air flow, from blading 12 by spacing cylinder 22 which, the same as cylinder 15, is also keyed to shaft 4. Blading 21 is closely surrounded by a cylindrical wall 17 which follows in substance the contour of wall 9 and extends closely to the delivery side of blading 12. Further, an inner cylindrical wall 23 is provided which at its left hand end approaches closely hub 20, and has the same diameter as this hub. It flares toward the delivery end of the blower, following in substance the contour of wall 17. Thereby, an innermost annular duct 24 is formed, which is concentric with duct 13, and into which the inner portion of blading 12 delivers air of the second pressure stage, and the pressure of which is further increased to a third pressure stage by blading 21. Thus the total amount of air delivered by blading 12 is divided into two parts. Air of the second pressure stage for scavenging purposes—as in Fig. 1—is delivered directly through duct 13 into exhaust port 18. The air for the third stage—for supercharging purposes above-mentioned—is delivered by blading 12 directly into duct 24, and after its pressure is increased by blading 21, passes through the remainder of this duct into exhaust port 19. The same is in Fig. 1, the exhaust port for the first pressure stage is indicated in Fig. 2 only by a dotted arrow.

The invention is not limited to the specific examples above described, but may be modified to suit particular requirements within the terms of the appended claims.

What I claim and desire to secure by Letters Patent of the United States is:—

1. A multi-stage blower comprising in combination a plurality of axially spaced rotatable fans having blading of progressively different radial length, and pitched to impel air in the direction of their rotary axis, and concentric cylindrical casings, each closely surrounding one of the fans to form between the casings delivery chambers for separate air currents, each casing for a smaller diameter fan extending beyond that fan and closely to the blading of the next preceding larger diameter fan, whereby the air stream deivered by the larger fan is divided into two individual concentric streams, of which the inner stream constitutes the air supply for the next smaller diameter fan, and the outer stream is directy discharged into the chamber surrounding the inner stream, and means for separately discharging the air from each chamber to obtain a plurality of separate air streams of different pressure stages.

2. A multi-stage blower comprising in combination a plurality of axially spaced rotatable fans having blading of progressively different radial length, and pitched to impel air in the direction of their rotary axis, and concentric cylindrical casings, each closely surrounding one of the fans to form between the casings delivery chambers for separate air currents, each casing for a smaller diameter fan extending beyond that fan and closely to the blading of the next preceding larger diameter fan, whereby the air stream delivered by the larger fan is divided into two individual concentric streams, of which the inner stream constitutes the air supply for the next smaller diameter fan, the blade pitch of each smaller diameter fan being suitaby dimensioned with respect to the pitch of the blading portion of the next preceding larger fan which supplies the air to the smaller fan, whereby the pressure of the air delivered to it by the preceding fan is increased, and each fan delivers into its larger appertaining chamber directly an air current of different pressure, and means for separately discharging the different pressure currents from said chambers.

3. A multi-stage blower comprising in combination a plurality of axially spaced rotatable fans having blading of progressively different radial length, and pitched to impel air in the direction of their rotary axis, and concentric cylindrical casings, each closely surrounding one of the fans to form between the casings delivery chambers for separate air currents, each casing for a smaller diameter fan extending beyond that fan and closely to the blading of the next preceding larger diameter fan, whereby the air stream delivered by the larger fan is divided into two individual concentric streams, of which the inner stream constitutes the air supply for the next smaller diameter fan, and a cylindrical spacing element between each two adjacent fans, equal to the diameter of the root diameters of the fan bladings and forming the inner wall of the delivery chamber portion between the two fans.

FRITZ GOSSLAU.