

Feb. 9, 1926.

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S. S. CRAMER

PNEUMATIC POWER GENERATOR

Filed June 5, 1920

3 Sheets-Sheet 1

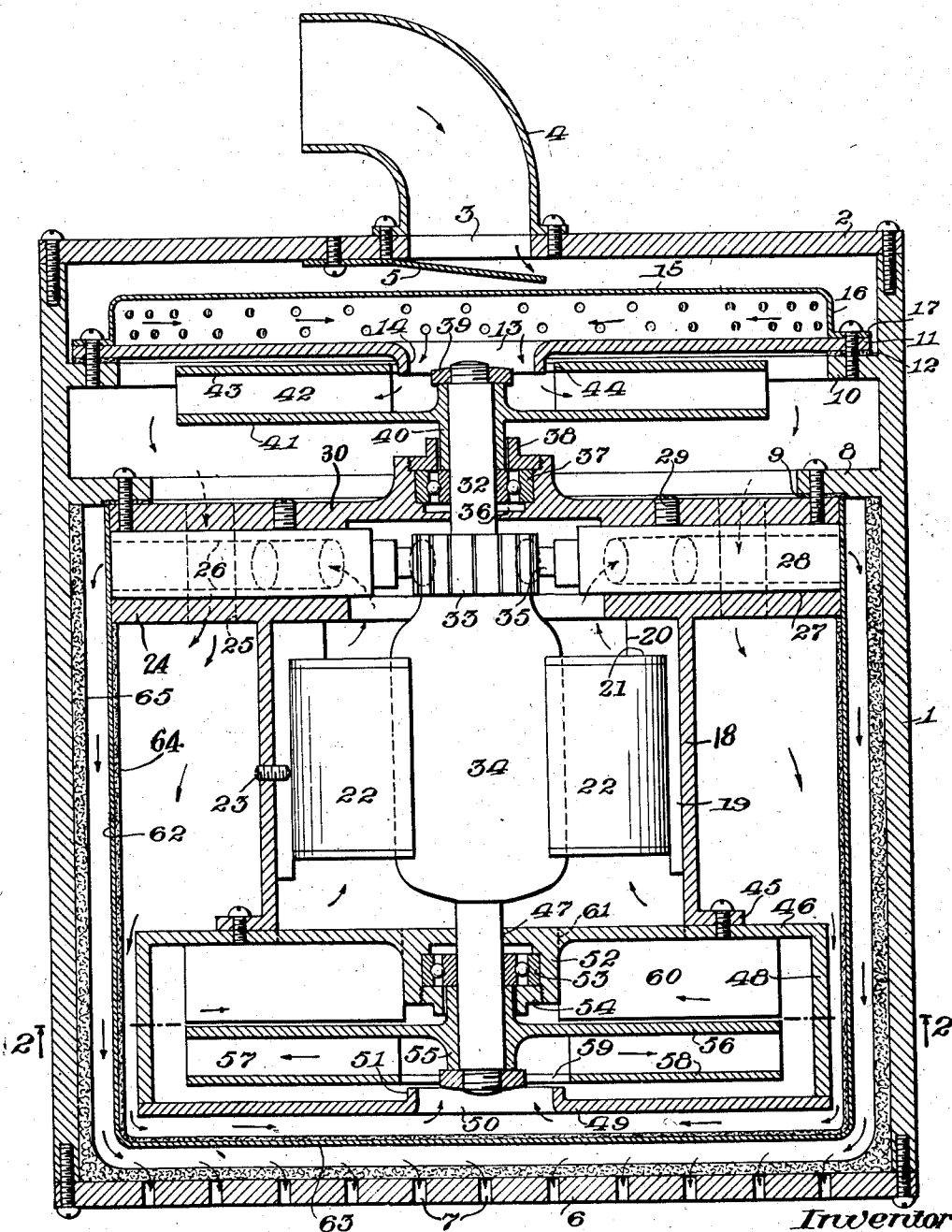


Fig. 1.

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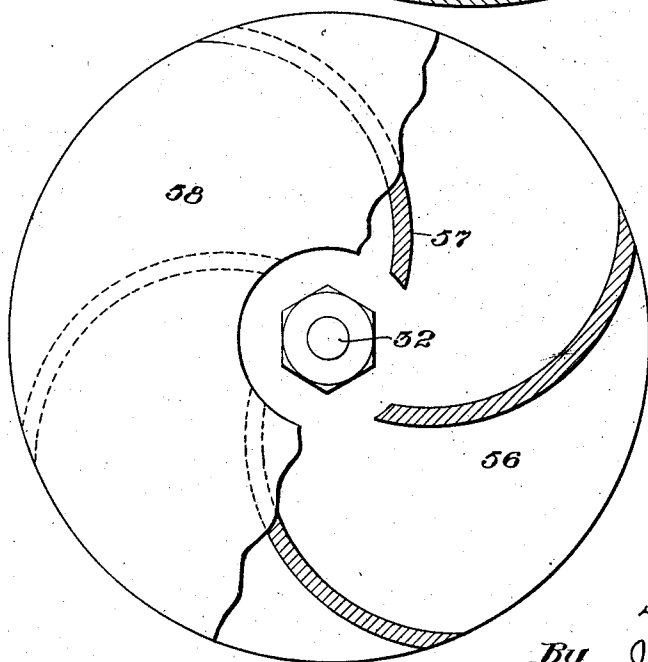
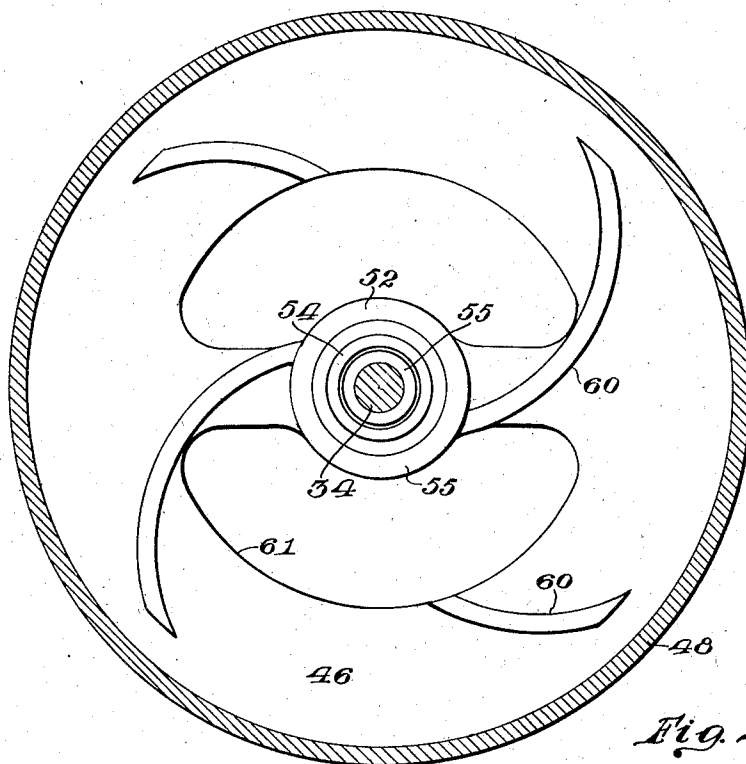
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3 Sheets-Sheet 2



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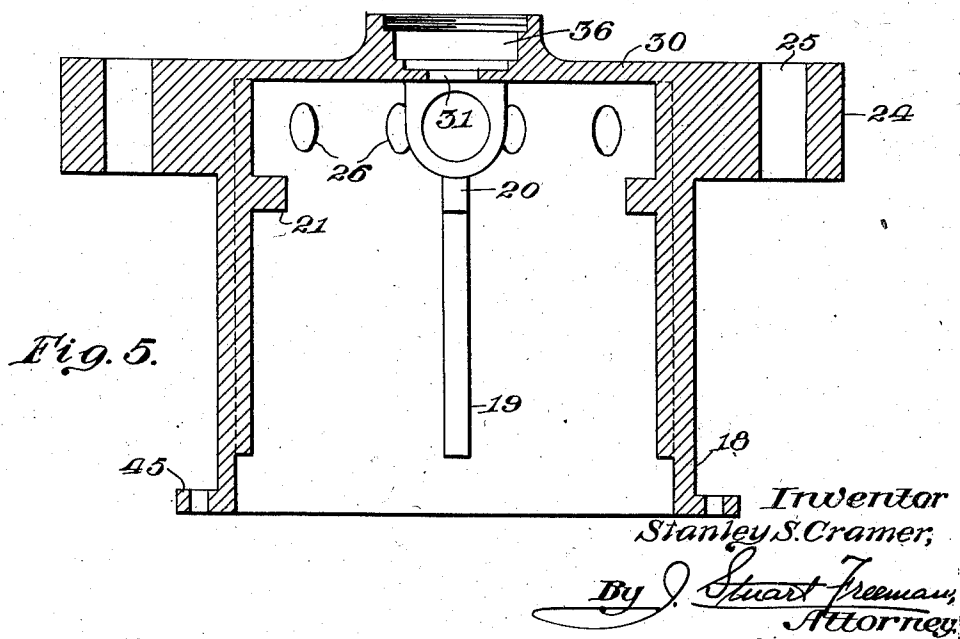
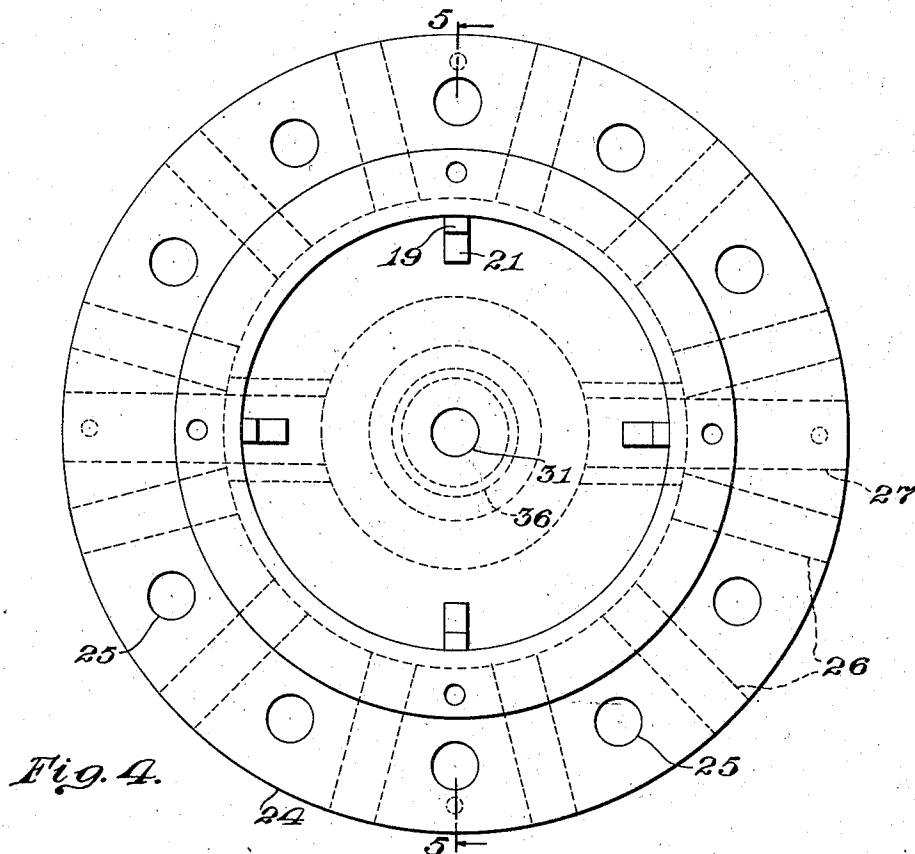
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PNEUMATIC POWER GENERATOR

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Patented Feb. 9, 1926.

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UNITED STATES PATENT OFFICE.

STANLEY S. CRAMER, OF CAMDEN, NEW JERSEY, ASSIGNOR TO MOTORA HOLDING COMPANY, OF CAMDEN, NEW JERSEY, A CORPORATION OF DELAWARE.

PNEUMATIC POWER GENERATOR.

Application filed June 5, 1920. Serial No. 386,872.

To all whom it may concern:

Be it known that I, STANLEY S. CRAMER, a citizen of the United States, residing at Camden, in the county of Camden and State of New Jersey, have invented certain new and useful Improvements in Pneumatic Power Generators, of which the following is a specification.

This invention relates to electric motor driven pneumatic power generators, whether for creating and maintaining partial vacuums, or for producing compressed air, and the mechanical application hereinafter described has proved to be very efficient as a means for effecting the vacuum required in the operation of pneumatic player pianos by means of the ordinary perforated web and tracker-bar combination.

In the application of electrically driven high speed vacuum producing devices, the centrifugal fan principle has been found to be most efficient and is generally operated with a plurality of fan stages operating in a continuous series, or two or more of such stages operating in series but with a gap between and separating the same for various purposes. This centrifugal fan principle has therefore been incorporated in the present device.

As in the case of all electric motor construction designed to run for extended periods of time, the usual tendency to heat up has to be recognized, provided for and controlled, or limited, by suitable means. Likewise, the high speed at which such apparatus must run in order to be efficient, creates an unavoidable hum or whirl with a tone pitch and intensity dependent upon the speed of the motor and the physical characteristics of the neighboring mechanism, thus demanding in a machine of this class a construction designed to completely muffle this sound.

Certain other factors also enter into the design of a well balanced machine, as for instance it has been found very advantageous to employ a centrally positioned motor together with either single or multiple unit centrifugal fans of substantially equal power of displacement mounted upon the opposite ends of the motor shaft, and so arranged that the usual central points for taking in the air face in the opposite directions, and each fan as a result operating to counteract the tendency of the other to cause

an axial thrust of the shaft in its direction.

The objects of this invention therefore include broadly the provision of an improved vacuum producing mechanism, means and a method of directing the air currents to cool the internal elements of the apparatus, means and a method of directing the air currents to completely muffle the sounds arising from the operation of the device, an arrangement to insure the greatest degree of balance of the parts of the device, both when stationary and in operation, in accordance with the weight and function of the individual parts of the device, and to provide further details of construction and operation, as brought out in the following description, when read in conjunction with the accompanying drawings, in which Fig. 1 is a diametrical longitudinal section through one embodiment of the invention; Fig. 2 is a horizontal section on the line 2—2 of Fig. 1; Fig. 3 is a plan view of one of the fan units with a fragment of its shroud broken away; Fig. 4 is a bottom plan view of the motor frame; and Fig. 5 is a longitudinal diametrical section of the same on the line 5—5 of Fig. 4.

Referring to the drawings, a preferably cylindrical member 1 is provided, the same being closed at one end by a removable disc 2 provided with an aperture 3, in axial alignment with which is secured any suitable form of hose connection 4, while the inner surface of said disc is provided with any suitable type of flapper-valve 5, adapted to close the aperture 3 when the air pressure within the member 1 is greater than that within the coupling 4. The opposite end portion of said member is normally closed by means of a disc 6 provided with any suitable number and arrangement of apertures 7, which unite to form outlets for air after having passed through said member following its entrance therein by means of the said aperture 3, and the member 1 together with the end closure discs 2 and 6 obviously unite to form an outer shell or container.

The member 1 is provided towards one end with an integral radially extending flange 8, to which is removably secured a frame member hereinafter described in detail, and illustrated in Figs. 4 and 5, said frame member being separated from said flange by a suitable vibration insulating

medium 9. The said cylindrical member is furthermore provided with a second radially inwardly extending flange 10, positioned between said first flange and the inclosing discs 2, and having secured thereto a disc 11 separated from its supporting flange by means of a vibration insulating medium 12, and provided centrally with an aperture 13 surrounded by an inwardly extending flange 14.

Secured to the outer edge portion of said last-named disc 11 is a baffle, comprising a plane disc 15 provided with a cylindrical section 16 terminating in an outwardly extending radial flange 17, which co-operates directly with the edge portion of the said supporting disc. Secured by suitable means to the opposite side of the flange 8 from the end closure 2, the said frame member above referred to comprises a substantially cylindrical portion 18, upon its inner surface being provided with longitudinally extending ribs 19 and offsets 20 having shoulders 21, against which the field coils 22 of the electric motor are secured by means of set screws 23.

Said frame member also comprises an annular radially outwardly extending flange portion 24 provided with circumferentially alternately positioned apertures 25 extending parallel with the axis of symmetry of the said member itself and with radially extending apertures 26, both sets of said apertures being adapted to permit and direct the passage of air currents in predetermined paths through the device as hereinafter described, said flange portion being furthermore provided with diametrically opposed and aligned apertures 27 adapted to receive suitable brush holders 28, which same are removably positioned by means of set-screws 29.

The end portion of the said frame member nearest to the flange 8 is closed by substantially a plane section 30 provided with a central bore 31, through which extends one end portion of the armature-shaft 32, to which in turn is secured the usual commutator 33 and armature 34, said armature being revolvably positioned substantially central with respect to the motor field coils 22, and the said commutator being in alignment and slidingly contacting with brushes 35 supported by brush-holders 28.

The said plane section 30 of the frame member is furthermore provided upon its outer portion with a stepped recess 36, adapted to receive any suitable type of ball-bearing 37 and adapted to be secured in position by means of a collar 38, which is arranged to be removably secured within the said aperture 36. Secured upon the neighboring end of the armature-shaft 32, by means of a suitable lock-nut 39, is a centrifugal fan unit comprising a sleeve 40

abutting directly against the shaft-supporting portion of the ball-bearing 37, and a plane disc section 41, provided at intervals upon its outer face with preferably curved fan-blades 42, having their corresponding otherwise free edge portions connected by means of a shroud 43 having a central aperture 44, through which extends the annular flange 14 of the disc 11.

The said motor supporting frame member at its other end comprises a radially extending flange 45, to which is removably secured a fan chamber comprising a plane wall section 46, centrally apertured at 47 to permit the extension therethrough of the armature-shaft 32, and at its outer free edge portion provided with a cylindrical section 48, closed in turn at its opposite end by means of a disc-like closure 49, having a central aperture 50 surrounded by an inwardly extending cylindrical flange 52. This fan chamber, together with the frame member above described, constitutes an inner casing surrounded by the outer shell 1, 2, 6.

The wall 46 is furthermore provided adjacent to the aperture 47 with an inwardly extending cylindrical portion 52, adapted to receive and position a ball-bearing 53, rotatably supporting the said armature-shaft and removably secured in place by means of a plug 54, which in turn has a central aperture larger than the said shaft and receives one end portion of the sleeve 55 of a centrifugal fan unit, said unit additionally comprising a radially extending plane disc portion 56, provided upon the surface facing towards the closure 49 with curved fan-blades 57, connected at their otherwise free radially extending edge portions by means of a shroud 58 having a central aperture 59, into which the flange 51 is adapted to direct air currents. The said fan unit terminates considerably short of the cylindrical portion 48 and is adapted to force air outwardly against the said cylindrical section, and thence towards the armature shaft between radially inwardly extending stationary vanes 60, and through the wall 46 by way of spaced apertures 61.

Secured to the outer peripheral surface of the motor supporting frame member is the free edge portion of a cylindrical member 62, closed at its opposite end by means of an imperforate wall 63 to form a cup-shaped baffle member, and lined throughout its full extent by suitable sound-insulating media 64, said baffle member being spaced from the adjacent portions of the side and end walls of the said outer shell to provide an annular air passage between the same, while said shell is lined by a sound-insulating medium 65, extending from the flange 8 to and covering the inner surface of the shell closure 6, said last-named medium being sufficiently porous to permit the passage

of air through the same and thence through the closure aperture 7.

The course followed by the air currents through this improved device is as follows:—From the usual pneumatics of a player-piano, or other pneumatically-operated musical instrument, the air is drawn through the coupling 4, past the flapper-valve 5, and thence through the apertures in the baffle 15 towards the centre of the disc 11 through the aperture 13 therein, whence the said currents are flung outwardly by means of the fan-blades 42, and thence through the apertures 25 in the motor supporting member. Thence said currents pass between the cylindrical portion 48 of the closure for the fan 56 and the inner surface of the cup-shaped baffle 62, around the outer surface of the wall 49 and through the aperture 50 into the second fan unit, whence said currents are flung radially outwardly by the fan-blades 57, and immediately thereafter are directed inwardly by the stationary blades 60 toward and through the aperture 61 in the wall 46. At this point the air currents pass between the field and armature windings 22 and 34 to cool the same, and thence over the surface of the commutator 33, whence they pass radially outwardly through the apertures 26 in the motor supporting frame, and thence between the cylindrical portions of the outer shell and the cup-shaped baffle 1 and 62 toward and through the outlet apertures 7 in the closure 6.

It is to be noted that that portion of the movable parts of this mechanism, likely to create the greatest sound by reason of their high speed of rotation and action upon the air currents, is surrounded not only by sound insulating mediums 64 and 65, but also by a circumferentially unbroken continuously flowing jacket of air, which is operative to prevent the otherwise free passage of sound waves from the interior to the exterior of the device. An additional marked advantage derived from the present arrangement is that the thrust of the fan-blades 42 upon the armature-shaft 32 in one direction is equally counter-acted by the thrust of the fan-blades 57 upon the said shaft in the opposite direction, thus insuring a substantially thrust-balanced bearing for the said armature-shaft and preventing otherwise uneven wear between contacting surfaces. Additionally, further advantage is derived from the fact that the air currents reverse their direction twice in passing by the elements of the electric driving motor, and thus in effect providing three moving air jackets, which have been hereinbefore described in detail.

Having thus described my invention, what I claim and desire to protect by Letters Patent of the United States is:—

1. A pneumatic power producing device, comprising an outer shell, an inner casing, and a combined motor and fan unit within said casing and operative to cause a jacket of fluid to flow continuously between said shell and said casing throughout the longitudinal extent of said casing while said unit is in operation.

2. A pneumatic power producing device, comprising a shell having an opening in one end portion, a transverse apertured partition within said shell, a fan unit between said partition and said end portion, a casing within and spaced away from said shell and apertured adjacent to said partition, and a fan unit within said casing, to impel air currents through said partition and between said shell and said casing towards an opening in the opposite end portion of said shell.

3. A pneumatic power producing device, comprising a shell having an opening in one end portion, a transverse apertured partition within said shell, a fan unit between said partition and said end portion, a casing supported by said partition within and spaced away from said shell and apertured adjacent to said partition, a fan unit within said casing, and means within said shell to actuate both of said fan units, to impel air currents through said partition and between said shell and said casing towards an opening in the opposite end portion of said shell.

4. A pneumatic power producing device, comprising a shell having an opening in one end portion, a transverse apertured partition within said shell, a second apertured partition between said first partition and said end portion, baffle means covering the aperture in said second partition, a fan unit between said partitions, a casing within and spaced away from said shell and apertured adjacent to said first partition, and a fan unit within said casing to impel air currents through said first partition and between said shell and said casing towards an outlet opening in the opposite end portion of said shell.

5. A pneumatic power producing device, comprising a shell having an opening in one end portion, a transverse apertured partition within said shell, a second apertured partition between said first partition and said end portion, baffle means covering the aperture in said second partition, a fan unit between said partitions, a casing supported by one of said partitions within and spaced away from said shell and apertured adjacent to the supporting partition, a fan unit within said casing to impel air currents through said first partition and between said shell and said casing towards an outlet opening in the opposite end portion of said shell, and means within said shell to actuate said units.

6. A pneumatic power producing device, comprising a shell having an opening in one end portion, an apertured casing covering said opening and positioned within and spaced away from said shell, said casing being supported by the said end portion of said shell and provided with an aperture adjacent to said end portion, a fan unit within said casing and operative to impel air currents through the aperture in said casing and throughout the extent of said casing in the space between said casing and said shell.

7. The combination of a container having an inlet and an outlet, a centrally apertured transversely extending wall within said container, a baffle-plate positioned between said inlet and the aperture of the said wall, a fan upon the opposite side of said wall, a second fan spaced away from said first fan, means to drive said fans, a channel to convey air from said first fan to the opposite side of said second fan, a channel to convey air from the nearer side of said second fan through said means to cool the latter, and a substantially cylindrical channel surrounding said means to lead the air from said means towards said outlet, and operative to provide a moving jacket of sound- and heat-insulating media.

8. The combination of a container having an inlet and an outlet, a fan adjacent to said inlet, means interposed between said fan and said inlet to retard the passage of sound from said fan through said inlet, a second fan spaced away from said first fan, common means positioned between and operative to drive said fans, a channel to convey air from said first fan into the opposite side of said second fan, said air passing by said driving means to cool the same, and a channel to lead the air from said second fan towards said outlet.

9. The combination of a container having an inlet and an outlet, a fan adjacent to said inlet, means interposed between said fan and said inlet to retard the passage of sound from said fan through said inlet, a second fan spaced away from said first fan, common means positioned between and operative to drive said fans, a channel to convey

air from said first fan into the opposite side of said second fan, said air passing by said driving means to cool the same, and a substantially cylindrical channel surrounding said driving means, to lead air from said last-named means towards said outlet, and operative to provide a moving sound- and heat-insulating media between said driving means and said container.

10. The combination of a container having an inlet and an outlet, a fan adjacent to said inlet, means interposed between said fan and said inlet to retard the passage of sound through said inlet, a second fan spaced away from said first fan, a motor surrounded by a cylindrical wall and positioned between and operative to drive said fans, the air passing from said first fan around said motor wall and into the opposite side of said second fan, thence through said motor within said wall to cool the motor, and through said outlet.

11. The combination of a container having an inlet and an outlet, a fan adjacent to said inlet, means interposed between said fan and said inlet to retard the passage of sound through said inlet, a second fan spaced away from said first fan, a motor surrounded by a cylindrical wall and positioned between and operative to drive said fans, a casing surrounding said second fan and said motor and spaced away from said container, the air passing from said first fan and thence into the opposite side of said second fan to equalize the axial thrust upon the motor, thence past said motor to cool the same, and around said casing towards said outlet, to heat- and sound-insulate said motor from said container.

12. A pneumatic power producing device, comprising an outer shell, an inner casing wholly surrounded by and having a portion spaced away from said shell, a motor and a fan unit within said casing operative to cause an encircling jacket of air to flow between said shell and the longitudinal extent of that portion of said casing containing said fan unit.

In testimony whereof I have affixed my signature.

STANLEY S. CRAMER.