S. S. CRAMER.

PNEUMATIC POWER GENERATOR.

APPLICATION FILED AUG. 21, 1919.

1,431,907.

Patented Oct. 10, 1922.

3 SHEETS—SHEET 1.

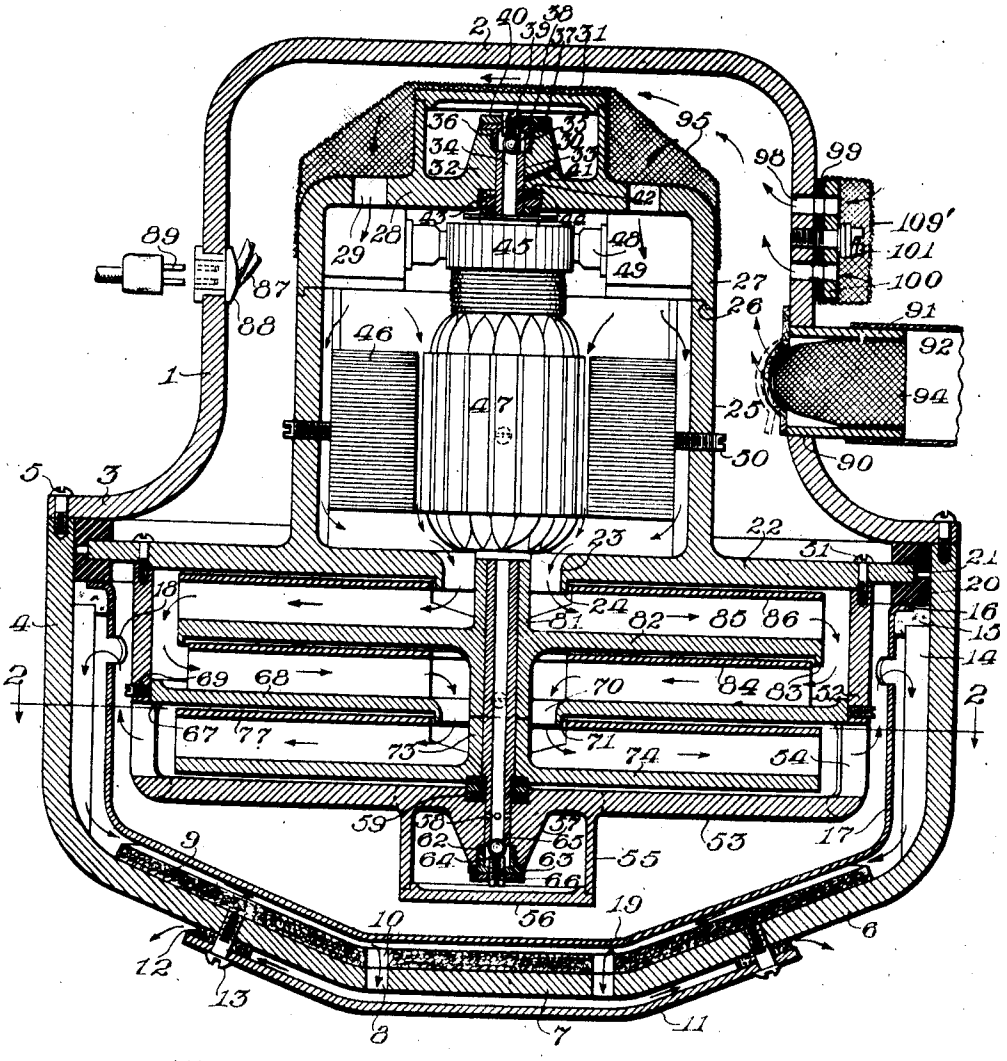

FIG. 1.

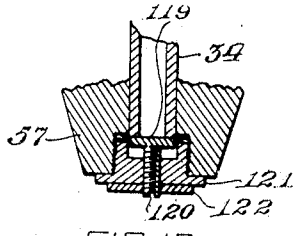

FIG. 13.

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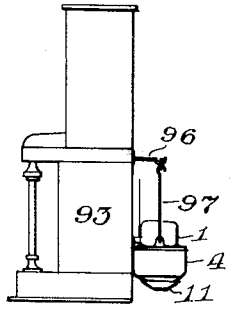

FIG. 3.

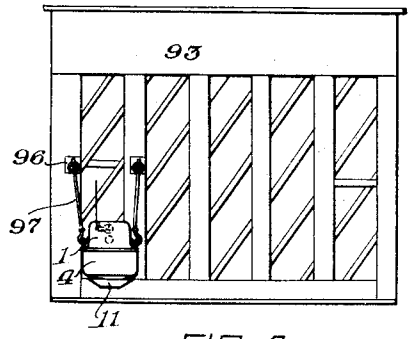

FIG. 4.

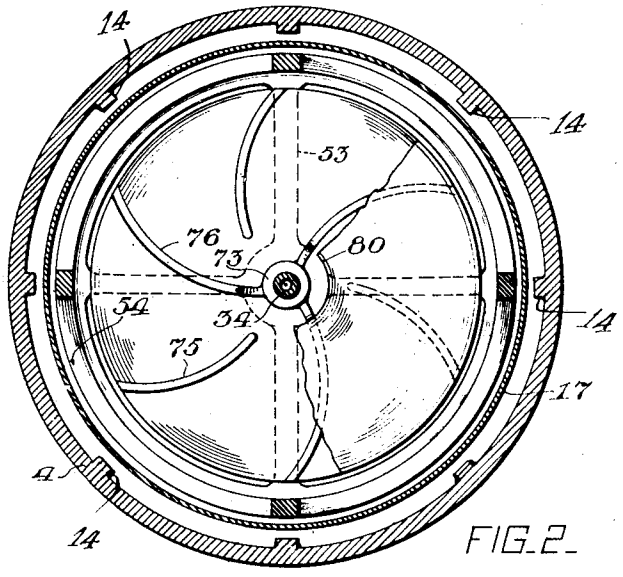

FIG. 2.

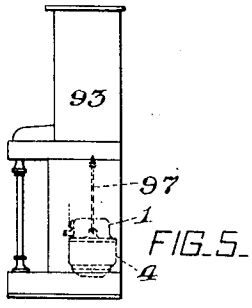

FIG. 5.

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3 SHEETS--SHEET 3.

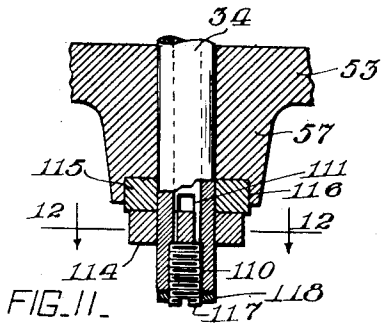

FIG. 11.

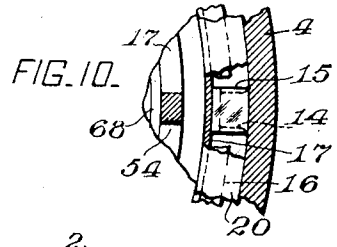

FIG. 10.

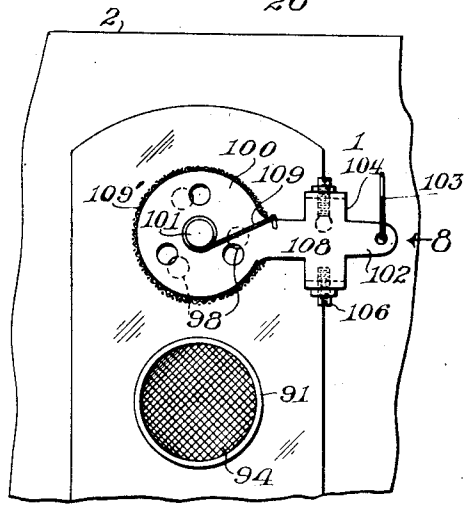

FIG. 7.

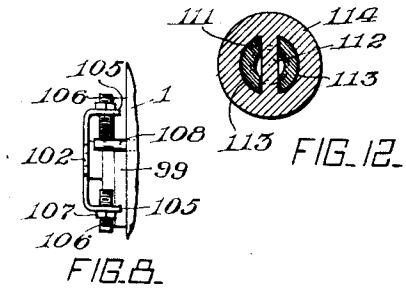

FIG. 12.

FIG. 8.

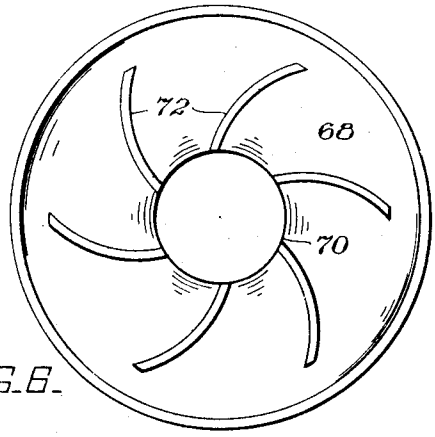

FIG. 6.

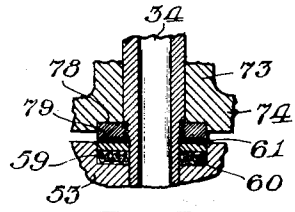

FIG. 9.

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Patented Oct. 10, 1922. 1,431,907

UNITED STATES PATENT OFFICE.

STANLEY S. CRAMER, OF CAMDEN, NEW JERSEY.

PNEUMATIC POWER GENERATOR.

Application filed August 21, 1919. Serial No. 318,886.

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 pneumatic power generators, and particularly to rotary mechanisms for creating a vacuum such as is used in automatic or player-pianos.

Heretofore, it has been quite generally the practice to employ in player-pianos pedal-operated bellows for the purpose of creating the vacuum necessary to actuate the various hammers, expression devices, winding and re-winding mechanisms, etc., but with this type of generator the effective vacuum usually obtained is sufficient to support only a twelve-inch column of water. With the relatively limited possibilities incident to such a low vacuum equivalent, the scope of the musical reproducing powers of the instrument is greatly restricted.

Therefore, in order to materially improve the quality of reproduction of a given instrument, and in order to make such reproduction as nearly identical in tone qualities with the original creation by a master pianist, it has been found absolutely essential to provide a source of much higher power than has heretofore been attainable, thus making it possible to strike the chords with greater force, to bring into play the desired notes more instantaneously, and numerous other achievements which are only attainable with a relatively high pneumatic power at one's instantaneous command.

In addition to the foregoing, in order to obtain the results mentioned, it has been found necessary to have a more continuous power than that created by any known form of intermittent bellows mechanism, wherefore, it has been found that the only means which will produce the desired result is a high-speed electric motor running preferably at from 8,000 to 12,000 revolutions per minute, and so constructed as to maintain a vacuum equivalent to a twenty-four to thirty-inch water column.

However, although various types of electric motors have been used as blowers, and to a certain extent as vacuum-creating means in various other devices such, for instance, as vacuum-cleaners, ventilating systems, and the like, extensive experiment has proved that nothing previously perfected in any other art is capable of fulfilling the extremely exacting requirements of the automatic or player-piano industry.

One of the main details which it has been necessary to work out and perfect to the highest possible degree is that of insuring an absolutely noiseless operation of such a motor, entirely free from even the slightest degree of vibration, as such vibration transmitted to any of the neighboring parts of a music instrument as, for instance, a piano, will set up audible vibrations of the latter which will be highly detrimental and injurious to the instrument, if not entirely fatal to the reproduction of music by the given instrument in the perfect manner which is obviously the desire and aim of every musician and manufacturer. To obtain this result, the improved generator, hereinafter described, is essentially encased within means adapted to inclose all operating noises and to effectively prevent the passage of sound from the motor outwardly through either the intake or the exhaust opening of the generator.

Possibly only secondary to the necessity for absolutely damping all vibration set up by the motor of the vacuum-generator is the great desirability of providing for the automatic compensation by the vacuum-generator for rapid and widely varying rates, at which the constantly changing cross-sectional area of the total number of exposed apertures in the tracker-board, permit a widely varying flow of air to relieve the vacuum which must be constantly maintained, with as little variation in degree as may be possible.

To accomplish this result, it has been found that a series-wound motor is admirably suited to the work, with the result that when the flow of air through the tracker-board increases, thus increasing the load upon the motor, the latter automatically decreases its speed in accordance with certain electro-magneto characteristics which such a motor possesses, whereby, there is undoubtedly a decrease in the rate at which the vacuum is generated, and with the result that a constant pressure for all intents and purposes is maintained.

Still another advantage gained by the use

of a series-wound electric motor resides in the fact that, if properly constructed, it is substantially equally well adapted to run on either direct or alternating current without dangerous sparking at the brushes, heating of the field or armature-winding, or variations in the average speed acquired, thus eliminating the necessity of the manufacturer and dealer carrying both A. C. and D. C. motors in stock.

In addition to the foregoing objects sought for and obtained by the perfection of the improved generator hereinafter described, there are additionally provided various details of construction, all of which co-operate in attaining the desired result, among these details there being that of a multiple fan unit operative to repeatedly act upon the air passing through its blades; a careful shaping of the air passage-ways in order to offer to the air-currents the least possible obstruction to their free passage through the disc; flanges over-lapping the fan-blades and adapted to thus seal against air leakage in the spaces between the relatively movable and stationary parts; channels so arranged as to permit a portion of the air to pass between the armature and field-magnets in order to maintain a low temperature of the same; certain details in the design of the electric wound-motor employed to produce the power for driving the vacuum-creating fans, readily assembled and disassembled; means to strain all dust and other foreign particles from the air passing into the device; improved automatically lubricated anti-friction bearings for supporting an improved tubular shaft; a vacuum bleed valve operative to constantly permit a predetermined minimum flow of air through the machine for maintaining a low temperature of the motor, and to permit rapid yet delicate degrees of alteration in the air-pulling power of the device without depending for variations of different speeds of the motor; to provide a mechanically simple method of manufacturing the device; and to provide numerous other details in the construction and operation of the generator as hereinafter fully described in the following specification, when read in conjunction with the accompanying drawings, in which Fig. 1 is a vertical diametrical section through the preferred embodiment of the invention; Fig. 2 is a horizontal section on the line 2—2 of Fig. 1; Fig. 3 is an end elevation of an upright piano showing one of the improved power plants attached to and supported by the rear side thereof; Fig. 4 is a rear elevation of the same; Fig. 5 is a similar view to Fig. 3 showing by dotted lines the position of the power plant when operated within a piano; Fig. 6 is a plan view of the interior of the fan casing, showing the stationary blades; Fig. 7 is an enlarged fragmentary elevational view of the upper part of the casing of the device, showing the vacuum bleed valve; Fig. 8 is a rear elevation of the said valve in the direction of the arrow "8" on Fig. 7; Fig. 9 is an enlarged fragmentary sectional view of the revolving fan bearing; Fig. 10 is an enlarged fragmentary sectional view showing the sound-insulating supports of the motor and fan casings; Fig. 11 is an enlarged detail sectional view of a modification of the lower shaft bearing; Fig. 12 is a section on the line 12—12 of Fig. 11; and Fig. 13 is a detail of a modified thrust bearing for the shaft.

Referring to the drawings, there is provided an upper cylindrical casing section 1, closed at its upper limit by means of a horizontally extending imperforate wall 2, and at its lower portion provided with a radially outwardly directed peripheral flange 3. The lower portion of the inclosing casing comprises a cylindrical section 4, which is normally secured by any suitable means 5 to the flange 3 of the section 1, while the sides of said lower section are at their lower extent directed diagonally inwardly at 6, and centrally closed by means of a horizontally extending wall 7, said wall, however, being provided with spaced apertures 8. The inner surfaces of the sections 6 and 7 are covered by a relatively thick layer of fibrous material 9, which is also provided with spaced apertures 10 registering with the apertures 8 and the wall 7. Partially covering the lower outer surfaces of the wall sections 6 and 7 is a baffle-plate 11, spaced from the section 6 by means of suitable sound-insulating walls 12, yet secured against accidental removal therefrom by suitable attaching means 13.

The inner surface of the cylindrical portion 4 is provided with spaced longitudinally extending ribs 14, upon the upper portion of which are mounted an equal number of yielding sound-insulating bushings 15, and between and upon which is positioned the upper flanged portion 16 of an inner cylindrical sheet-metal shell 17, which, adjacent to its uppermost limits, is provided with spaced apertures 18, and at its lower limits is closed by a frusto-conical section 19, conforming in general to the shape of the adjacent portions 6 and 7 of the surrounding casing and spaced equi-distant therefrom.

Resting directly upon the bushings 15 and shell flanges 16 are spaced sound-insulating sections of yielding material 20, upon which directly rests the reduced radially extending peripheral flange portion 21 of a substantially plain casting 22, centrally apertured at 23 and surrounding the lower edge portion of said aperture provided with a depending annular flange 24, while integral with the portion 22 and surrounding said aperture is an upwardly extending cylindrical section

25, provided at its peripheral edge portion with an outwardly directed cylindrical shoulder 26.

Supported by the cylindrical portion 25 of the casting just described and surrounding the shoulder 26 is a cylindrical casting 27, closed at its upper portion by a transversely extending wall 28, which in turn is provided with spaced apertures 29 adjacent to the periphery of said wall, while the latter is provided with a centrally positioned upwardly extending integral cylindrical portion 30, adapted to serve as an oil reservoir and normally closed at its upper end by means of a removable cap or plug 31.

The wall 28 is furthermore centrally provided with an upwardly extending integral boss 32 provided with a central axially extending bore 33, forming a bearing for the tubular shaft 34 extending revolvably therethrough. The bore 33 is enlarged and internally threaded at 35 to receive a plug 36 shaped as an inverted cup and housing a ball 37, which is larger than the bore of the shaft 34 and is seated within the end of said last-named bore. The plug 36 is provided centrally with a tapped bore 38, through which extends a flat-ended set-screw 39, which in turn is surrounded adjacent to its outer end portion by means of a lock-nut 40. The boss 32 is also provided with a capillary diagonally extending bore 41, adapted to convey a predetermined amount of lubricant from the oil-cup 30 into the bore 33 for lubricating the shaft 34 in its bearing.

The wall 28 is furthermore provided upon its under surface and concentric with the bore 33 with a centrally disposed recess 42, in which is forced a washer 43, loosely surrounding the shaft 34 but conforming within the recess, thus inclosing a suitable section of fibrous absorbent material 44 adapted to prevent the lubricant from passing in any substantial amount down the shaft to the commutator 45 of the electric motor, which comprises field-coils 46, within which is revolvably mounted an armature 47, while suitable brushes 48 are supported by brush-holders 49, and said field-coils are axially positioned with respect to the rotating armature by means of radially directed set-screws 50 extending through the cylindrical portion 25 of the casting 22.

Suspended beneath the casting 22, and secured thereto by any suitable means 51, is a cylinder 52, which co-operates with a shoulder at the base of the flange 21 in order to position said cylinder exactly concentric with the said casting 22. The lowermost portion of said last-named cylinder is spanned by means of ribs 53 in order to provide spaced laterally directed openings 54, while depending from the center of said ribs is an inverted cup-shaped lubricant reservoir 55 normally closed by means of a plug 56, while disposed within said reservoir and forming an integral extension of said ribs is a depending boss 57 provided with an axially positioned bore 58, which forms a bearing for the lower end portion of the tubular shaft 34.

At its upper extent, the bore 58 is enlarged to provide an annular recess 59, in which is placed a section of fibrous absorbent material 60, retained in position by means of a washer 61 secured by a forced fit into the said last-named aperture. Downwardly, the bore 58 is enlarged and internally threaded at 62 to receive an internal cup-plug 63, which is centrally drilled and tapped to support a set-screw 64 having a flat upper end and supporting a ball 65, similar to the ball 37, and against which the tubular shaft directly co-operates. The set-screw 64 is furthermore surrounded at its lower end portion by a lock-nut 66, in order to prevent the set-screw from accidental dislodgment.

The cylinder 52, immediately above the laterally directed apertures 64, is provided preferably with an annular shoulder 67, upon which rests a transversely extending annular partition 68, which is maintained in normal fixed position by means of radially directed set-screws 69, and is provided centrally with an aperture 70, surrounded at its immediate lower peripheral edge portion by a depending flange 71. This partition 68 is provided with a plurality of upwardly extending stationary blades 72, each starting from the aperture 70, and as it progresses radially outwardly being curved in a clockwise direction, for a purpose hereinafter described.

Mounted upon the lower portion of the tubular shaft 34 is a hub 73, provided with a radially extending plane flange 74, upon the upper surface of which are secured spaced vanes or ribs 75 and 76, said vanes being preferably designed so that the latter extend downwardly from said hub to the periphery of said flange, while the former vanes extend to the periphery of said flange from points spaced from said hub. This construction, together with the disc 77, forming a shroud and connecting the upper free edge portions of said vanes, comprises a centrifugal fan or blower unit, which upon its under side is preferably provided with an axially positioned recess 78, into which extends a nut 79, operative to secure the said fan units upon the shaft 34, and positioned opposite to though normally spaced from the washer 61. The shroud 77 is centrally apertured at 80 to admit air into the spaces between the vanes 75 and 76 from the region above the horizontally extending partitions 68, as it passes through the aperture 70 in said partitions.

A second blower unit is likewise secured to said shaft in any suitable manner, and is

positioned between the unit first described and the armature of the driving-motor, said unit comprising a hub 81, which extends and contacts with the hub 73 up to the armature above referred to, and is provided substantially mid-way its longitudinal measurement with a radially extending plane flange 82, which latter terminates at its outer periphery in a depending cylindrical flange 83, operative to direct air-currents passing thereby over the peripheral edge portion of a shroud 84 which covers the three upper edge portions of the vanes 72 of the partition 68. The flange 82 is provided with upwardly extending vanes 85 preferably exactly similar in number, position and shape with those hereinbefore described as comprising portions of the first fan unit, and these vanes 85 are connected at their upper free edges by means of a shroud 86.

This device, as before stated, is preferably driven by the series-wound electric motor hereinbefore described, and to which current may be led in any suitable manner as by means of wires 87, which pass through the outer casing of the device in any suitable manner as by means of the insulating bushing 88, with which is adapted to be removably connected the terminal 89 of an electric-conductor leading from any suitable source of electric current, either alternating or direct in character.

The upper casing section 1 is furthermore provided with a relatively large aperture 90, in which is fixed in any suitable manner a short tube 91, to which is coupled a preferably flexible section of hose 92, adapted to convey air from the operating parts of the piano 93 to the improved vacuum-creating device forming the invention. The tube 91 has removably secured in it a suitable section of mesh 94, operative to strain the air entering the device and prevent dust and other foreign particles from being conveyed to the finely machined mechanisms thereof. Supplementing this strainer, there is preferably provided a mesh section 95 in the form of a cap adapted to surround and yieldingly engage the outer surface of the cylindrical portion 27 of the motor-casing, and again strain the incoming air before it passes into the motor and lower mechanisms by way of the apertures 29. As to the position that this device occupies in practice, the same may be upon suitable brackets 96 and flexible supports 97, extending outwardly and downwardly from the back wall of a piano as shown in Figs. 3 and 4, or the device may be supported within the piano as shown by the dotted lines in Fig. 5 and by means of the same type of flexible members 97.

The motor in this device is necessarily of that type which comprises a very high-speed as one of its characteristics. This feature secondarily implies a tendency of the motor to heat-up when run for a prolonged period unless provided with enough circulating air to maintain a low temperature of the same. To this end, the upper portion of the casing 1 is provided with spaced apertures 98, in registry with which is positioned a similarly apertured section 99 of air insulating material such as leather, which device to separate from said casing a similarly apertured circular disc 100 is revolvably mounted with respect to the apertures 98, and in a plane transverse to the axis of said aperture about a pivot 101, which is secured to the casing and passes revolvably through said disc, which latter is provided upon one side of its periphery with a laterally extending lever 102, to which is connected a flexible operating member 103, while intermediate of the limits of said lever the same is provided with oppositely extending ears 104, bent downwardly at their end portions to form parallel shoulders 105, through which are adjustably mounted screws 106, held in fixed position by means of lock-nuts 107. These screws, being directed towards each other, co-operate with a suitable pin 108 positioned between them and extending outwardly from the casing member 1, and said pin and adjustable screws operating to limit the movement of the valve-disc 100 in opposite directions, said disc being maintained in a predetermined position by means of a suitable spring 109 applied thereto in any feasible manner.

It will be noted that in the position of the disc, as shown in Fig. 7, there is always a predetermined amount of air being admitted through the bleed-apertures 98 in order to maintain the necessary air circulation for cooling the motor, even when the greatest amount of vacuum is desired to be maintained for the heaviest work in operating a reproducing musical instrument to which the device is attached. This arrangement also affords a simple efficient and quick-acting means for varying the degree of vacuum effective upon the pneumatics of the musical instrument, without varying the speed of the motor, for upon applying tension to the operating member 103 the disc is shifted as far as desired, and possibly until the apertures of the disc and casing are in complete register, in which position air is admitted freely to the interior of the casing of the device, and thus indirectly decreases the degree of vacuum to such an extent that a relatively low pressure is available through the pneumatics of the musical instrument, thereby producing reproduced sounds of as low intensity as may be desired. And, further, for this condition of soft music, the bleed valve just described may be suddenly closed, thus effecting a rapid increase in the vacuum to the maximum degree, or as near

thereto as may be desired, which has the effect of creating the so-called "crash" music, that is, the loudest and suddenly struck chords, when desired.

The phrase "pneumatics of the musical instrument" hereinbefore referred to, as well as the single concise term "instrument" employed in the claims, refer to the operating parts of an instrument, whether the pneumatics are arranged to actuate the usual hammers to produce sound, or are so designed as to control and influence the quality of the sound produced, but do not refer to inoperative parts such as the usual bottom and top air chests or equalizers which merely comprise portions of the air conduit between the pneumatics and the power device, or more specifically the air propelling means thereof.

In order to strain the air entering this bleed-valve, it will be noted that a guaze cap 109′ is provided, the same being adapted to be removably secured over the top of the major portion of the disc 100 and the apertures extending therethrough.

The modified form of the lower bearing for supporting the tubular shaft 34 is illustrated in Figs. 11 and 12, and differs from the bearing hereinbefore described in that the lowermost end portion of said shaft is internally threaded at 110 and is bifurcated by means of parallel slots 111, into which slides longitudinally the bridge portion 112 separating two segmental apertures 113 in a disc 114, as shown in Fig. 12. A tool-steel washer 115 is forced into a recess 116 in the lowermost portion of the boss 57, and against this washer thus held stationary, revolves in slidable contact the hardened tool-steel washer 114, it being obvious that the pressure between said washers is adjustable by means of the set-screws 117, extending into the end portion of the shaft 34, and locked in position by means of a nut 118.

And referring to Fig. 13, the hollow shaft 34 is shown as resting substantially vertically upon a hard metallic disc 119, adjustably supported by a set-screw 120, carried centrally by a plug 121 and fixed in position by means of a lock-nut 122. The said plug is cupped to preferably partially surround and position the said disc, and is removably threaded in the lower portion of the boss 57 hereinbefore described, and through which boss is also journalled the shaft 34.

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

1. The combination of an electric motor-operated vacuum generating device, and a conduit adapted to connect said device with a pneumatically operated musical instrument, with a positively actuated valve operative to relieve at will the vacuum of said device other than through said musical instrument.

2. The combination of an electric motor-operated vacuum generating device, and a conduit adapted to connect said device with a pneumatically operated musical instrument, with a manually actuated valve operative to relieve the vacuum of said device by a path other than through said musical instrument.

3. The combination of an electric motor-operated vacuum generating device, and a conduit adapted to connect said device with a pneumatically operated musical instrument, with a spring-operated valve, manually operable against the tension of said spring, to relieve the vacuum created by said device other than through said musical instrument.

4. The combination of an electric motor-operated vacuum generating device, and a conduit adapted to connect said device with a pneumatically operated musical instrument, with a spring-operated valve having adjustable limits of movement, manually operable against the tension of said spring, to relieve the vacuum created by said device other than through said musical instrument at variable rates.

5. The combination of an electric motor-operated vacuum generating device, and a conduit adapted to connect said device with a pneumatically operated mechanism, with a spring-operated valve having adjustable limits of movement, manually operable against the tension of said spring, to relieve the vacuum created by said device other than through said conduit at variable rates, said valve being set at its minimum limit to pass a definite amount of air to cool the motor of said device.

6. The combination of a pneumatically operated music reproducing instrument with an electric motor-operated vacuum generating device, and means connected with said device and operative to constantly pass a fixed minimum amount of air to cool the motor of said device, and said means being adpated to relieve the vacuum created by said device at variable rates above said fixed minimum.

7. The combination of a pneumatically operated music reproducing instrument with an electric motor-operated vacuum generating device, and means connected with said device and operative to constanly pass a fixed minimum amount of air to cool the motor of said device, and said means being manually actuated to relieve the vacuum created by said device at variable rates above said fixed minimum, and automatically operative to return when released towards and to the said fixed minimum.

8. A vacuum generator for pneumatic music-producing instruments, comprising a container, motor and fan units within and separated from said container by sound-in-

sulating material, a port in said container adjacent to said fan unit, and a baffle member between said container port and said fan unit, operative to decrease the sound escaping through said port, and sound-insulating means to position said baffle member in spaced relation from both said container and said fan unit.

9. A vacuum generator for pneumatic music-producing instruments, comprising a container, a motor and a fan unit within and separated from said container by sound-insulating material, a port in said container, a baffle member spaced from and positioned between said container port and said fan unit, and a baffle-plate outside of and spaced from said container, said baffle-plate and said baffle member co-operating with that portion of the container provided with a port to provide a circuitous path for air passing through said port, to decrease to a minimum the sound escaping through said port.

10. A pneumatic power generator, comprising a container having inlet and outlet ports, a baffle member covering the outlet port and spaced away from the adjacent side of said container, and a baffle-plate covering said outlet port outside of and spaced from said container.

11. The combination of an electric motor-operated vacuum-generating device, and a conduit adapted to connect said device with a pneumatically-operated mechanism, with a valve having adjustable limits of movement and operative to relieve the vacuum created by the device, resilient means tending to maintain said valve in one limit of its movement and manually operable against said resilient means towards its other limit of movement.

12. The combination of an electric motor-operated vacuum-generating device, and a conduit adapted to connect said device with a pneumatically-operated mechanism, with a valve having adjustable limits of movement and operative to relieve the vacuum created by the device, resilient means tending to maintain said valve at one limit of its movement, and manually operable against said resilient means towards its other limit of movement, and said valve at one limit of its movement admitting to the device a predetermined amount of air, to cool the internal mechanism.

13. The combination of an electric motor-operated pneumatic power generator, and a conduit adapted to connect said generator with a pneumatically-operated mechanism, with a valve having adjustable predetermined limits of movement, and operative to relieve the vacuum created by the generator independently of the said mechanism.

14. The combination of a pneumatically operated music instrument; means for generating the power to actuate the sound producing parts of said instrument, and a conduit connecting said parts to said means and provided with an aperture, with means adjustable independently of the air pressure to vary the effective area of said aperture to permit air to pass through said first means in varying quantities without also passing through said parts.

15. The combination of a pneumatically operated music instrument, means for generating the power to actuate the sound producing parts of said instrument, and a conduit connecting said parts to said means, with an aperture in said conduit, and an adjustably positioned valve operative to by-pass air through said first means without also passing through said parts.

16. The combination of a pneumatically operated player-piano, means for generating the power to actuate the said sound producing parts of said piano, and a conduit to conduct air between said piano and said means, with means in said conduit to admit a predetermined minimum flow of air through said first means without passing through said parts.

17. The combination of a pneumatically operated player-piano, means for generating the power to actuate the sound producing parts of said piano, and means interposed between said parts and said first means for allowing a predetermined flow of air to pass through said first means without also passing through the said sound producing parts of said piano.

18. The combination of a pneumatically operated player-piano, means for generating the power to actuate the sound producing parts of said piano, and a valve manually opened and closed and interposed between said parts and said first means for allowing air to pass through said first means without also passing through the said sound producing parts of said piano.

19. The combination of a pneumatically operated player-piano, means for generating the power to actuate the sound producing parts of said piano, and a manually operated valve, adjustable at will to permit air to pass through said first means without also passing through the said sound producing parts of said piano, and said valve also being operative to permit a constant minimum amount of air to pass through said first means to cool the same.

20. The combination of a pneumatically operated music instrument, means for generating the power to actuate the sound producing parts of said instrument, and a conduit connecting said instrument to said means, with manually actuated means operative independently of the operation of said first means to permit air to pass through

said first means without also passing through said parts.

21. The combination of a pneumatically operated music instrument, means for generating the power to actuate the sound producing parts of said instrument, and a conduit connecting said sound producing parts to said means, with a valve manually adjustable at will to position intermediate of its limits of movement and operative to bypass air in varying degrees through said first means without also passing through said sound producing parts.

22. The combination of a pneumatically operated player-piano, means for generating the power to actuate the sound-producing parts of said piano, and a conduit to conduct air between said piano and said means, with means direct manually actuated and instantly adjustable to positions between its limits of movement and independently of the speed of operation of said first means, to admit air in varying quantities through said first means without passing through said sound producing parts.

23. The combination of a pneumatically operated player-piano, means for generating the power to actuate the sound producing parts of said piano, and a valve directly actuated manually between open and closed positions for allowing air to pass through said first means without also passing through the said sound producing parts of said piano.

24. The combination of a pneumatically operated music player instrument, and means to generate the power to operate the sound producing parts of said instrument, with manually actuated means to instantly vary between maximum and minimum the effective operating power supplied to said sound producing parts independently of the power generated.

25. The combination of a pneumatic power generator, comprising a motor, air propelling means actuated by said motor, and a casing provided with an inlet and an outlet and surrounding said motor and said means, with means to maintain a predetermined minimum rate of flow of air constantly through said casing by a course other than through said inlet.

26. The combination of a pneumatic power generator, comprising a motor, air propelling means actuated by said motor, and a casing provided with an inlet and an outlet and surrounding said motor and said means, with means to maintain a minimum flow of air constantly past the motor within said casing by a course other than through said inlet.

27. The combination of a pneumatic power generator, comprising a motor, air propelling means actuated by said motor, and a casing provided with an inlet and an outlet and surrounding said motor and said means, with a spring-pressed valve to automatically maintain a predetermined minimum rate of constant flow of air through said casing by a course other than through said inlet.

28. The combination of a pneumatically operated musical instrument, with a pneumatic power generating mechanism, comprising an air propelling means, a motor to drive said means, a container common to said means and said motor, a conduit connecting said air propelling means to said instrument, and means to adjustably relieve the vacuum of said mechanism in degrees varying at will other than through said instrument.

29. The combination of a pneumatically operated musical instrument, with a vacuum generating mechanism, comprising an air propelling means, a motor to drive said means, a container common to said means and said motor, a conduit connecting said air propellig means to said instrument, and manually actuated means to permit a quantity of air variable at will to pass through said mechanism other than through said instrument.

30. The combination of a pneumatically operated musical instrument, with a vacuum generating mechanism, comprising an air propelling means, a motor to drive said means, and a container common to said means and said motor, a conduit connecting said air propelling means to said instrument, and means having adjustable limits to relieve the vacuum of said mechanism other than through said instrument.

31. The combination of a pneumatically operated musical instrument, with a pneumatic power generating mechanism, comprising an air propelling means, a motor to drive said means, a container common to said means and said motor, a conduit connecting said air propelling means to said instrument, and resiliently controlled means to automatically maintain a minimum quantity of air passing through said mechanism without its passing through said instrument, to cool said motor.

32. The combination of a pneumatically operated musical instrument, with a pneumatic power generating mechanism, comprising an air propelling means, a motor to drive said means, a container common to said means and said motor, a conduit connecting said air propelling means to said instrument, and resiliently controlled means having an adjustable limit of movement to automatically pass a predetermined minimum quantity of air through said mechanism without its passing through said instrument.

33. The combination of a pneumatically operated musical instrument, with a pneumatic power generating mechanism, comprising an air propelling means, a motor to

drive said means, a container common to said means and said motor, a conduit connecting said air propelling means to said instrument, resiliently controlled means having an adjustable limit of movement to automatically pass a predetermined minimum quantity of air through said mechanism without its passing through said instrument, and means to actuate said last-named means to permit more than said minimum quantity of air to pass through said mechanism.

34. A suction-producing apparatus which comprises in combination, a container inclosed at the top and open at the bottom, an air inlet in the upper portion of the container, a casing within the container, the outer walls of which are spaced apart from the inner walls of the container, an apertured baffle plate between the lower portion of the container and the lower portion of the casing, a compressible gasket interposed between the baffle plate and the lower portion of the casing which forms an air chamber between the baffle and the lower portion of the casing, a plurality of rotary fan blades within the lower portion of the casing, a plurality of vanes also within the lower portion of the casing, an electric motor within the upper portion of the casing, which rotates the fan blades, and cushioning devices interposed between the inner walls of the container and the outer walls of the casing.

35. A suction-producing apparatus of the class recited, in which are combined, a container inclosed at the top and open at the bottom, an air inlet in the top of the container, a casing within the container, the outer walls of which are spaced apart from the inner walls of the container, a plurality of fan blades within the lower portion of the casing, a plurality of vanes also within the lower portion of the said casing, an electric motor within the upper portion of the casing, which rotates the fan blades, supporting devices within the container upon which the casing rests, cushioning devices interposed between the inner walls of the container and the outer walls of the casing, and cushioning devices between the supporting devices and both the inner walls of the container and the outer walls of the casing.

36. An air propelling mechanism, comprising a container having an inlet and an outlet, a unitary casing removably supported within said container, and having an inlet and an outlet, an air propelling means within said casing, a motor also within said casing to drive said means and so situated that the said means creates a draft of fresh air passing over the parts of said motor to cool the same before being acted upon by said means.

37. An air propelling mechanism comprising a container having an inlet and an outlet, a casing within said container, and having an inlet and an outlet, sound insulating means to support the weight of said casing with respect to said container and operative to divide the interior of said container outside of said casing into a plurality of compartments containing air at different pressures.

38. The combination of an electric motor-operated pneumatic power generator, and a conduit adapted to connect said generator with a pneumatically-operated mechanism, with a valve having a normally fixed range of movement, and means to adjustably alter the limits fixing said normal range, said valve being operative to relieve the air pressure created by the said generator independently of the said mechanism.

39. A pump, comprising a casing, a surrounding container spaced away from direct contact with said casing, and an air-tight partition of flexible vibration-absorbing material yieldingly gripping and surrounding a portion of said casing and extending from said casing to said container to divide the intervening space into a plurality of chambers adapted to contain air at different pressures.

40. The combination of a casing, with a surrounding container having a supporting surface, and a gasket resting upon said surface and also resiliently engaging a portion of the radially outer surface of said casing to form an air tight partition to divide the space between said casing and said container into a plurality of chambers.

41. The combination of a casing and a fan and motor to drive said fan inclosed within said casing, with a surrounding container having a supporting surface, and a gasket resting upon said surface and also co-operating with said casing to form an air-tight partition to divide the space between said casing and said container into a plurality of chambers adapted to contain air at different pressures.

42. The combination of a unit pump casing, with a unit sectional container independent of said casing, and a yielding gasket contacting with and extending from said casing into contact with and secured in position by the union of the sections of said container.

43. The combination of a unit pump casing, with a unit sectional container independent of said casing, and a vibration-insulating gasket having one portion in air-tight relation with said casing and having another portion in air-tight relation with a section of said container and operatively compressed against said casing by the union of said sections.

44. The combination of a pump casing,

with a container, and a vibration-insulating gasket having one portion in direct co-operation with said casing and having another portion in direct co-operation with said container to form an air-tight partition dividing the space between said casing and said container into a plurality of chambers adapted to contain air at different pressures.

45. The combination of a pump casing, with a sectional container, one of said sections having a longitudinally facing substantially radially extending surface, and a gasket comprising a pair of annular members, one of which bears against said surface and connects the adjacent container section with said casing, and the other of which members bears against and extends between the other container section and said casing.

46. The combination of a pump casing, with a sectional container, one of said sections having a longitudinally facing substantially radially extending surface, and a gasket comprising a pair of annular members, one of which bears against said surface and connects the adjacent container section with said casing, and the other of which members bears against and extends between the other container section and said casing, said gasket member uniting to form a yielding vibration-insulating air-tight partition between said casing and container, and operatively positioned by the union of said container sections.

47. A pump, comprising a casing having an inlet and an outlet, a fan and motor unit mounted within and surrounded by said casing, a surrounding container also having an inlet and an outlet, and a gasket operative to support said casing within said container and to divide the intervening space into a plurality of chambers, said fan within said casing being operative to force air into said container upon one side of said gasket, within the space between said casing and said container, thence through said casing, and then outwardly into the space between said casing and said container upon the other side of said gasket.

48. A vacuum generator for pneumatic music-producing instruments, comprising a container, motor and fan units within and separated from said container by sound-insulating material, said container being provided with a port adjacent to said fan unit, and a cup-shaped baffle member between said container port and said fan unit, operative to decrease the sound escaping through said port, and sound-insulating means to position said baffle member in spaced relation from both said container and said fan unit.

49. A vacuum generator for pneumatic music-producing instruments, comprising a container, motor and fan units within and separated from said container by sound insulating material, said container being provided with a port adjacent to said fan unit, and a cup-shaped baffle member between said container port and said fan unit, said cup-shaped baffle member partly surrounding said fan unit, and operative to decrease the sound escaping through said port, and sound-insulating means to position said baffle member in spaced relation from both said container and said fan unit.

50. The combination of a pneumatic power generator, comprising a motor, air-impelling means actuated by said motor, and a casing provided with an inlet and an outlet and surrounding said motor and said air-impelling means, said casing being provided with an aperture to permit a flow of air through said casing by a course other than that between said inlet and said outlet.

51. A suction producing apparatus which comprises in combination, a container having an inlet and an outlet, a casing within the said container, the outer walls of which are spaced apart from the inner walls of the said container, a baffle member between the lower portion of the container and the lower portion of the casing, a plurality of rotary fan blades within the lower portion of the casing, a plurality of vanes also within the lower portion of the casing, an electric motor within the upper portion of the casing which rotates the fan blades to draw the incoming air past said motor to cool the same, and cushioning means interposed between the inner walls of the container and the outer walls of the casing.

52. A suction-producing apparatus of the class recited, in which are combined, a container having an inlet and an outlet, a casing within the container, the outer walls of which are spaced apart from the inner walls of the container, a plurality of fan blades within the lower portion of the casing, an electric motor within the upper portion of the casing which rotates the fan blades to draw air past said motor, supporting means within the container upon which the casing rests, cushioning means interposed between the inner walls of the container and the outer walls of the casing, and cushioning means between the supporting means and both the inner walls of the container and the outer walls of the casing.

53. In a device for operating the pneumatics of a player piano, the combination with a container, a motor and fan suction unit within said container for drawing air through the pneumatics of a piano, said motor and fan being mounted upon the same shaft, and a pneumatic expression mechanism for varying the pressure of air passing through the fan element.

54. An air propelling mechanism for pneumatically operated pianos, comprising a container having a main inlet and an out-

let, a unitary casing entirely within the container and supported by sound deadening material, and having a main inlet and an outlet, air propelling means within said casing, and a motor also within said casing to drive said means and so situated that the current of air set up by said means passes through the main inlets of said container and said casing over the parts of said motor to cool the same before coming into contact with said air propelling means.

55. An air propelling mechanism for pneumatically operated pianos comprising a container having a plurality of inlets and an outlet, a unitary casing entirely within the container and supported by sound deadening material, and having an inlet and an outlet, a fan and motor within said casing, and means to maintain a current of air flowing over the parts of said motor to cool the same, said current of air passing through the motor before it passes into said fan to be acted upon thereby.

In testimony whereof I have affixed my signature.

STANLEY S. CRAMER.