April 14, 1925. 1,534,016

J. P. NORTHEY

SOUND PRODUCING DEVICE

Original Filed June 5, 1922

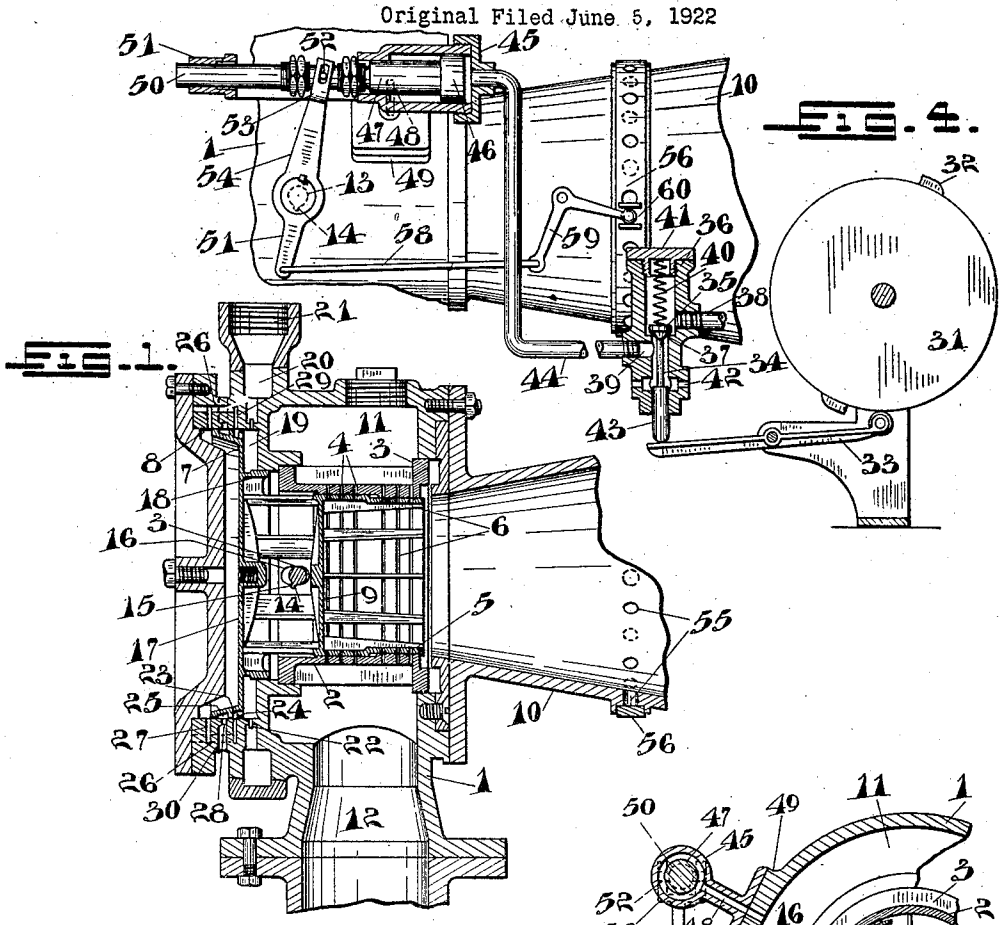


FIG. 1.

FIG. 4.

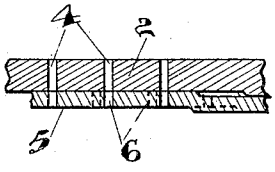


FIG. 3.

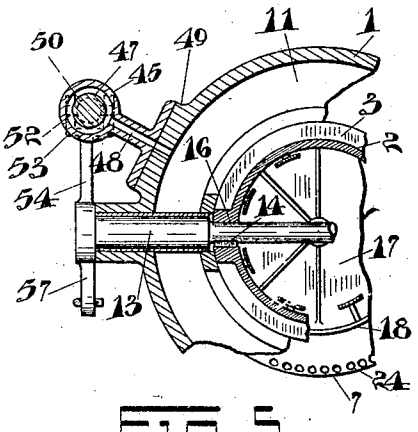


FIG. 5.

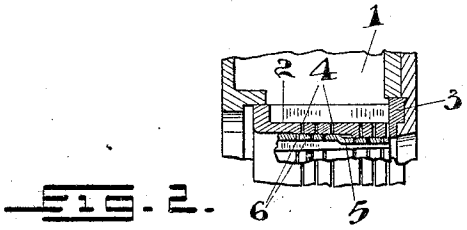


FIG. 2.

INVENTOR

J. P. Northey,

BY J. Edward Maybee.

ATTY.

Patented Apr. 14, 1925. 1,534,016

UNITED STATES PATENT OFFICE.

JOHN P. NORTHEY, OF TORONTO, ONTARIO, CANADA.

SOUND-PRODUCING DEVICE.

Application filed June 5, 1922, Serial No. 566,099. Renewed September 12, 1924.

To all whom it may concern:

Be it known that I, JOHN P. NORTHEY, of the city of Toronto, in the county of York, Province of Ontario, Canada, a subject of the King of Great Britain, have invented certain new and useful Improvements in Sound-Producing Devices, of which the following is a specification.

This invention relates to pneumatic devices for producing sound comprising a cylinder having orifices in its wall and a piston reciprocating in the cylinder also provided with orifices which, by the reciprocation of the piston, are alternately moved into and out of alinement with the orifices in the cylinder to produce a rapid succession of puffs of air. As ordinarily arranged, such devices, when the piston speed is constant, produce a note of a given pitch, and my object is to so construct the device that the pitch of the note sounded may be changed at will without changing the piston speed.

I attain my object by providing means for varying at will the relative position of the piston and cylinder so that the piston orifices come into co-operative relationship with the cylinder orifices a different number of times during each reciprocation of the piston. A simple arrangement will be such that co-operation may take place once for each single stroke of the piston or once during each double stroke, thus giving notes an octave apart.

The invention is hereinafter more specifically described and is illustrated in the accompanying drawings in which

Fig. 1 is a view, partly in elevation and partly in section, of the apparatus;

Fig. 2 is a diagrammatic view showing the relative positioning of the cylinder and piston to produce a puff of air for each single stroke of the piston;

Fig. 3 is a similar view showing the relative positioning of the cylinder and piston to produce a puff of air for each double stroke of the piston;

Fig. 4 is a sectional view of the cylindrical sleeve operating mechanism; and

Fig. 5 a cross sectional detail of part of the casing and the cylinder of the sleeve operating mechanism.

In the drawings like numerals of reference indicate corresponding parts in the different figures.

1 is a casing in which is mounted a cylindrical sleeve 2 so that it may be adjusted longitudinally of the casing. Preferably the wall of the cylinder is made comparatively thin and rims 3 are formed at each end having a suitable sliding bearing on the casing. The wall of this cylinder has a series of sound producing orifices 4 formed therein, which will usually be spaced at equal distances apart. Within the cylinder a hollow piston 5 is adapted to reciprocate, this piston being also provided with sound producing orifices 6 adapted to be brought into alinement with the orifices in the cylinder by the reciprocation of the piston.

The piston is provided with an enlarged part 7 adapted to reciprocate in the part 8 of the casing, which forms a cylinder therefor. The apertured part of the piston is preferably separated from the remainder of the piston by the diaphragm 9. The open end of the piston communicates with the horn 10 which is suitably secured to the end of the casing.

Within the casing is formed the chamber 11 communicating with the air inlet 12. The sound is produced by the reciprocation of the piston, which causes its sound producing orifices to coincide at regular intervals with the orifices of the cylinder 2, thus producing a series of puffs of air which occur at such intervals as to form a musical note.

The cylinder is ordinarily positioned relative to the piston, which has a fixed travel so that the orifices coincide once for each single stroke of the piston. (See Fig. 2.) By shifting the position of the cylinder, however, the piston may be caused to bring its sound producing orifices into alinement with the sound producing orifices of the cylinder once during each double stroke, that is, at the end of the stroke in one direction and the beginning of the stroke in the other direction as illustrated in Figs. 1 and 3. Thus, at will, the device may be adjusted to produce either a high note or a low note, or by intermediate adjustments to cause various modifications in the sound emitted by the instrument. Fur-

ther, even if it be desired to set the device to emit one note only for a given piston speed, there is great advantage in having the cylinder longitudinally adjustable as it may thus be very accurately and easily adjusted to the piston after the device has been assembled.

The longitudinal adjustment of the cylinder may be effected in various ways. Behind the diaphragm 9 the side walls of the cylinder may be of open construction, and this enables me to extend a rock shaft 13 through the walls of the casing and through the open sides of the piston. This rock shaft carries cam projections 14 which are adapted to engage in notches 15 formed in the sides of slots 16 formed in the cylinder wall at opposite sides. By operating this rock shaft the cylinder may be moved backwards or forwards as desired. This rock shaft will be operated as hereinafter described.

The piston and casing are constructed in the following manner to effect the reciprocation of the piston. The enlarged part 7 is formed on a diaphragm 17 on which is formed a sleeve 18 extending in the direction of the cylinder 2 and closely fitting a cylindrical bore formed in the casing. A space 19 for the admission of air behind the outer part of the diaphragm 17 is thus formed. This space communicates with the annular inlet chamber 20 with which communicates the air inlet 21 supplied with air by any suitable means.

A series of ports 22 form the communication between the inlet chamber 20 and the space 19. In the part 7 of the piston is formed an annular groove 23 with which communicate a series of ports 24 opening into the space 19. An annular exhaust groove 25 is also formed in the part 7 of the piston nearer the outer end than the groove 23. A chamber 26 is formed in the part 8 of the casing, and with this space communicate annular grooves 27, and 29, the first groove being an inlet groove for air in front of the piston, the groove 29 an inlet groove for the air behind the piston. An intermediate groove 28 forms an outlet groove which communicates with the atmosphere by one or more holes 30.

The operation is as follows. With the parts shown as in Fig. 1, air passes from the inlet chamber 20 to the space 19, thence through the ports 24 the annular groove 23 and the groove 29 into the chamber 26 and through the groove 27 to act on the outer surface of the diaphragm. The air pressure is thus the same in front of and behind the diaphragm 17, but the effective area against which the pressure in the chamber 19 operates is very much less than the effective area at the outer end of the part 7 of the piston, and consequently the piston is moved to the right. This movement, however, cuts off communication between the annular groove 29 and the space 19 and brings this same groove through the medium of the exhaust groove 25 into communication with the exhaust groove 28 of the casing. The pressure against the outer end of the piston at once falls to that of the atmosphere and the air pressure in the space 19 is then sufficient to throw the piston to the left and back to the position in which there is free communication between the space 19 and the chamber 26, thus re-establishing the equality of pressure between the space 19 and the space between the piston end and the end of the part 8 of the casing. The piston therefore will continue to reciprocate as long as air pressure is supplied through the air inlet 21. This arrangement, however, is old in the art and no claim is made thereto, substantially the same arrangement being shown in my prior United States Patent No. 879190.

The method of supplying air to the air inlet 12 for the production of the sound and to the air inlet 21 for the reciprocation of the piston forms no part of the present invention and the supply of air may be controlled in any suitable manner.

To operate the sleeve 2 to effect the adjustment hereinbefore referred to, I employ control mechanism similar to that now employed for the control of the air to the air inlets. 31 is a drum suitably mounted and rotated in any suitable manner. Its periphery is provided with one or more cam projections 32 which are adapted to rock a lever 33 suitably fulcrumed on a stationary part. This lever is adapted to engage the stem 34 of a valve disk 35 slidable in the valve casing 36, the valve disk being adapted to engage the valve seat 37 so as to normally close the communication between the air inlet 38 and the air outlet 39. The valve is normally held closed by the coil spring 40 engaging the cap 41 of the valve casing and the valve disk itself.

Below the valve seat exhaust ports 42 communicate with the interior of the valve casing. The lower part 43 of the valve stem is of greater diameter than the upper part and serves as a piston valve to open and close the exhaust ports. When the valve disk 35 is raised, the exhaust ports are closed. When the valve disk 35 is seated, there is free communication between the air outlet 39 and the exhaust ports. The air outlet 39 is connected by means of a pipe 44 with the interior of the cylinder 45 in which operates the piston 46, the piston rod 47 being of large diameter so as to materially reduce the effective area of the rear side of the piston. Behind the piston a port 48 communicates with the interior of the cylinder, this port opening through a pad 49 which is se-

cured to the side of the casing 1 and communicates with the air chamber 11 thereof.

The piston rod 47 has a stem 50 connected therewith slidable through a bracket 51 formed on or connected with the cylinder 45. This stem carries a transverse pin 52, which passes through a slot formed longitudinally in the fork 53 formed on the end of the rock arm 54 secured to the rock shaft 13.

It will be noted that the part 61 of the cylinder through which the sound producing orifices are formed is slightly less in diameter than the imperforate portion and also has its diameter reduced slightly adjacent its forward end, and the piston is also necessarily similarly reduced. The piston and cylinder are also so proportioned that, when they are being assembled, the end of the piston enters the part of the cylinder of least diameter at or about the time that the part of the piston of slightly greater diameter enters the part of the cylinder of slightly greater diameter.

Normally the valve disk 35 is closed and the exhaust ports 42 open. There is then no pressure in front of the piston 46 owing to the communication between the cylinder 45 and the air outlet 39. The pressure from the air chamber 11 behind the piston 46 will thus be sufficient to press the piston 46 over to the right as shown in the drawings, thus moving the cylindrical sleeve 2 to its limit of motion in one direction. When, however, the cam projection 32 on the drum 31 engages and rocks the lever 33, the valve disk 35 is raised and the exhaust ports 42 closed. Air pressure entering through the air inlet 38 will thus pass through the valve casing 36, through the pipe 44 to the cylinder 45 and operating against the front end of the piston 46 will push the latter to the left as, though the air pressure behind and in front is the same, the greater effective area of the front of the piston enables the air pressure in front of it to overcome the air pressure behind it. The cylindrical sleeve 2 is thus pressed to the limit of its movement in the opposite direction. The two positions of the sleeve relative to the piston hereinbefore referred to are thus automatically obtained.

In practice the drum 31 is used to effect the timing of the operation of admitting air for the reciprocation of the piston and the production of sound, and the timing of the operation of the piston 46 to shift the position of the sleeve 2 may be set to cause the shift of the position at any desired time while the piston 5 is in motion so as to change the character of the sound emitted as hereinbefore referred to.

It is evident, of course, that many other methods than that described for effecting the shift of the sleeve 2 will fall within the scope of my invention. It is further evident that independently of the change in the character of the note emitted that the movability of the sleeve 2 enables me to accurately adjust its position relative to the piston in any case where it is desired that the instrument shall be used for the production of one note only.

As the horn 10 acts not only as a sound concentrating and directing device, but also as a resonating chamber, it is of the utmost importance that it shall be properly proportioned relative to the note produced by the operation of the piston in the cylinder. It is obvious that if it be of the proper size and proportions to sound one of the notes hereinbefore referred to, it will not be of the proper dimensions to suit the other. I therefore, as the notes will usually be an octave apart, provide the horn intermediate of its length with a series of apertures 55 which are adapted to be opened and closed by a ring 56, this ring, having openings therein which may be caused by the operation of the ring to open or close the apertures 55. This ring may be arranged to be moved in any suitable manner. I show it, however, as being adapted to have an oscillating rotary movement around the horn. This movement must take place synchronously with the movement of the sleeve 2. This movement may be effected in very many ways. I show it as being effected by means of a rock arm 57 secured to the shaft 13, this rock arm being pivotally connected with a connecting rod 58 pivotally connected with a bell crank lever 59 suitably fulcrumed on the horn and having its end engaged with a fork 60 formed on the ring 56. The parts are so proportioned that the apertures 55 are open when the high note is being sounded and closed when the low note is being sounded, the resonating length of the horn being cut in half when the apertures are open.

It is, however, in many cases not essential that the entrance of the parts of the piston of different diameters into the parts of the cylinder in which they have a working fit be simultaneous and either one may enter before the other. The difference in the diameter is very small and the small end of the piston first entering the part of the cylinder of slightly larger diameter is thus guided in substantial parallelism with the cylinder so that the parts of the piston readily enter the parts of the cylinder in which they have a working fit.

What I claim as my invention is:—

1. A pneumatic sound producing device comprising a cylinder having sound producing orifices in its wall; a piston adapted to reciprocate in said cylinder having sound producing orifices adapted to be brought into alinement with the orifices in the cylinder by the reciprocation of the piston; and means for varying the relative positions of the

cylinder and piston to vary the number of times the said orifices are brought into co-operation during each double stroke of the piston.

2. A pneumatic sound producing device comprising a cylinder having sound producing orifices in its wall; a piston adapted to reciprocate in said cylinder having sound producing orifices adapted to be brought into alinement with the orifices in the cylinder by the reciprocation of the piston; and means for varying the relative positions of the cylinder and piston axially thereof to vary the number of times the said orifices are brought into co-operation during each double stroke of the piston.

3. A pneumatic sound producing device comprising a cylinder having sound producing orifices in its wall; a piston adapted to reciprocate in said cylinder having sound producing orifices adapted to be brought into alinement with the orifices in the cylinder by the reciprocation of the piston; and means for varying the relative positions of the cylinder and piston axially thereof so that the reciprocation of the piston may bring the orifices into co-operation either at the end of each stroke of the piston in one direction or intermediate the ends of each stroke.

4. A pneumatic sound producing device comprising a cylinder having sound producing orifices in its wall; a piston adapted to reciprocate in said cylinder having sound producing orifices adapted to be brought into alinement with the orifices in the cylinder by the reciprocation of the piston; means for varying the relative positions of the cylinder and piston to vary the number of times the said orifices are brought into co-operation during each double stroke of the piston; and a timing device adapted to automatically control said position varying means to change the relative position of the cylinder and piston at predetermined intervals.

5. A pneumatic sound producing device comprising a casing; a cylinder supported in said casing so as to be movable longitudinally of its axis and having sound producing orifices formed in its wall; a hollow piston open at one end adapted to reciprocate in said cylinder, said piston having sound producing orifices formed in its wall adapted to be brought into alinement with the orifices in the cylinder wall; and means for moving said cylinder.

6. A pneumatic sound producing device comprising a cylinder with sound producing orifices in its wall and an annular enlargement at one end provided with air ports; a cover for the cylinder; a hollow piston open at one end, having sound producing orifices adapted to co-operate with the sound producing orifices of the cylinder and provided with an enlargement remote from the open end, fitting the annular enlargement of the cylinder and ports in said enlargement co-operating with the cylinder ports to control the admission and exhaust of the air which effects the reciprocation of the piston, the piston adjacent its open end being slightly reduced in diameter and the cylinder correspondingly reduced in diameter and the parts proportioned so that when the piston and cylinder are being assembled the end of the piston enters the part of the cylinder of least diameter at or about the same time that the enlargement of the piston enters the annular enlargement of the cylinder; and a diaphragm in said piston close to the innermost sound-producing orifices.

7. A pneumatic sound producing device comprising a cylinder having sound producing orifices in its wall; a piston adapted to reciprocate in said cylinder having sound producing orifices adapted to be brought into alinement with the orifices in the cylinder by the reciprocation of the piston; means for varying the relative positions of the cylinder and piston to vary the number of times the said orifices are brought into co-operation during each double stroke of the piston; a resonating horn; and means for varying the effective resonating length of the horn to correspond with the pitch of the sound produced and in synchronism with the means for varying the relative position of the cylinder and piston.

8. In a pneumatic sound producing device, the combination of an air motor; two co-operating parts, one movable relative to the other by the air motor, and adapted when supplied with air under pressure to cause a rapid succession of puffs of air adapted to produce a musical note; means for varying the relationship of said parts to vary the pitch of the note; a resonating horn; and means for simultaneously changing the effective resonating length of the horn to suit the pitch of the note produced.

9. A pneumatic sound producing device comprising a cylinder with sound producing orifices in its wall and an annular enlargement at one end provided with air ports; a cover for the cylinder; a hollow piston open at one end, having sound producing orifices adapted to co-operate with the sound producing orifices of the cylinder and provided with an enlargement remote from the open end, fitting the annular enlargement of the cylinder and ports in said enlargement co-operating with the cylinder ports to control the admission and exhaust of the air which effects the reciprocation of the piston, the piston adjacent its open end being slightly reduced in diameter and the cylinder correspondingly reduced in diameter and the parts proportioned so that when the piston and cylinder are being assembled the end of the piston enters the part of the

cylinder of least diameter at or about the same time that the part of the piston of normal diameter enters the end of the part of the cylinder within which it has a working fit.

10. A pneumatic sound producing device including a cylinder having its forward part of slightly reduced diameter and a piston similarly formed, the piston and cylinder also being so proportioned that the end of the piston enters the part of the cylinder of least diameter at or about the time that the part of the piston of normal diameter enters the end of the part of the cylinder within which it has a working fit.

11. A pneumatic sound producing device of the type described including a cylinder with sound producing orifices in its walls and a hollow piston also having sound producing orifices formed in its wall adapted to co-operate with the sound producing orifices of the cylinder, the outer ends of the cylinder and piston being slightly reduced in diameter whereby, when the parts are being assembled, the part of the piston of smaller diameter first enters the part of the cylinder of slightly larger diameter and is thus guided so that the parts of the piston enter the parts of the cylinder in which they have their working fit.

Signed at Toronto, Canada, this 26 day of May 1922.

JOHN P. NORTHEY.