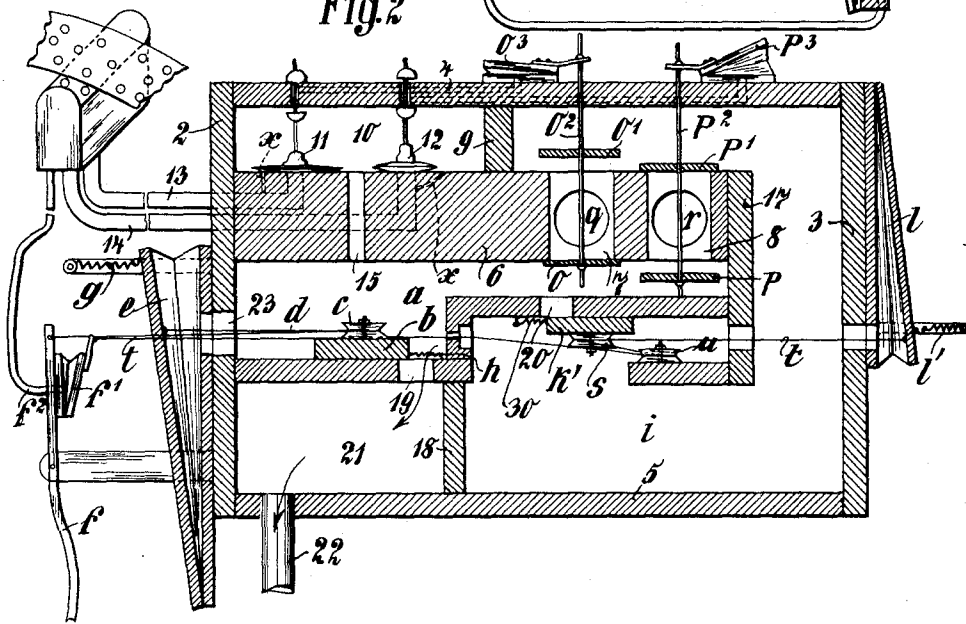
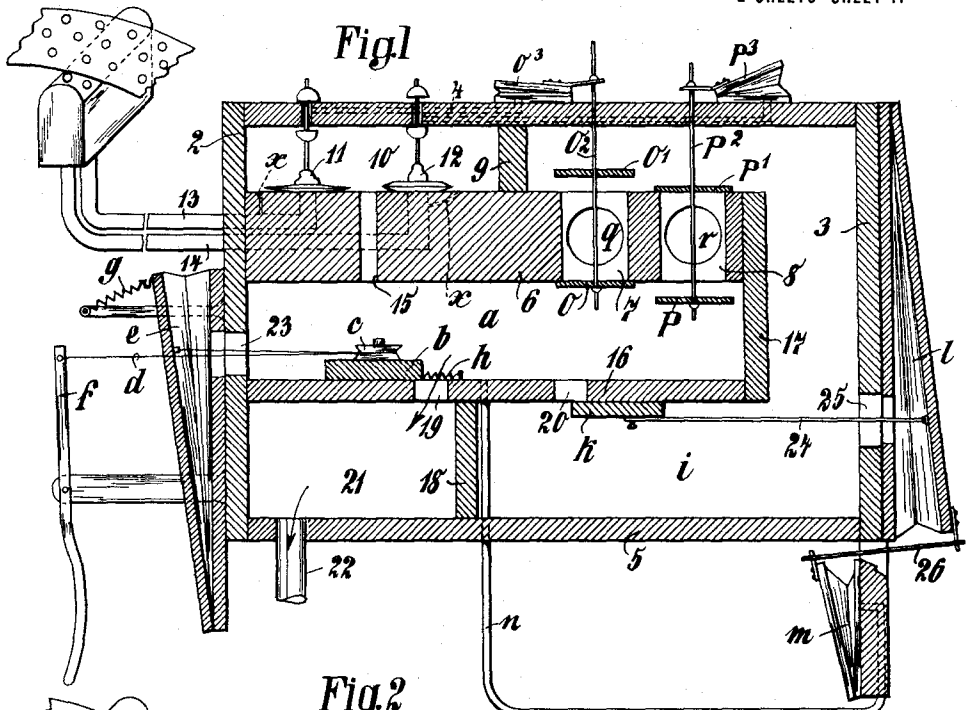


G. K. HENNIG.  
 TONE MODULATOR FOR PNEUMATICALLY ACTUATED MUSICAL INSTRUMENTS.  
 APPLICATION FILED NOV. 23, 1911.

1,164,516.

Patented Dec. 14, 1915.

2 SHEETS—SHEET 1.



Witnesses:  
 B. Rommers  
 E. Leckert.

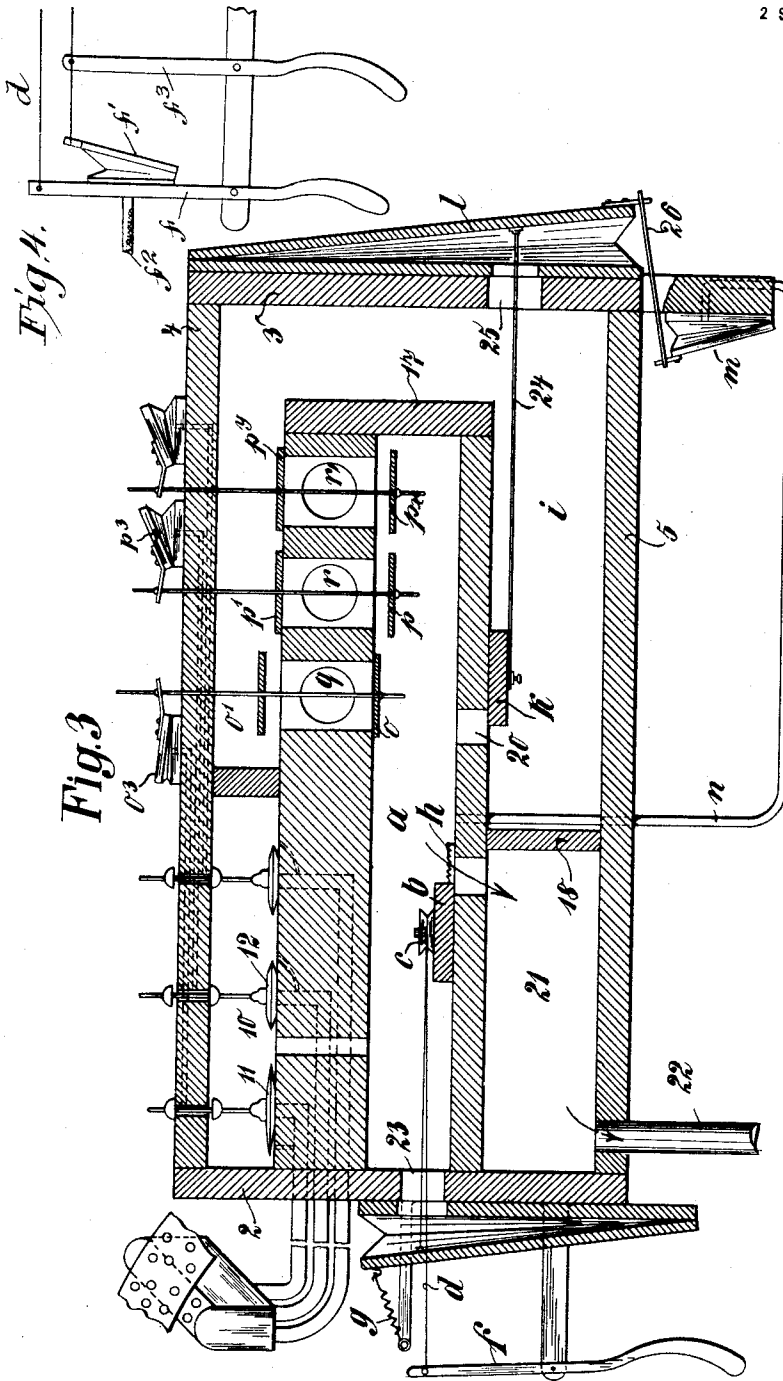
Inventor  
 Gustav Karl Hennig  
 By *[Signature]* atty.

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# UNITED STATES PATENT OFFICE.

GUSTAV KARL HENNIG, OF WAHREN, NEAR LEIPZIG, GERMANY, ASSIGNOR TO THE FIRM OF LUDWIG HUPFELD AKTIENGESELLSCHAFT, BOHLITZ-EHRENBERG, OF LEIPZIG, GERMANY.

tone-modulator for pneumatically-actuated musical instruments.

1,164,516.

Specification of Letters Patent.

Patented Dec. 14, 1915.

Application filed November 23, 1911. Serial No. 661,924.

To all whom it may concern:

Be it known that I, GUSTAV KARL HENNIG, a subject of the King of Saxony, and resident of Wahren, near Leipzig, Germany, have invented certain new and useful Improvements in Tone-Modulators for Pneumatically-Actuated Musical Instruments; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

My invention relates to tone modulators for pneumatically played musical instruments, whereby the desired intensity of tone may be produced by supplying the proper air tension (when the musical instrument is operated by suction), or supplying the proper air pressure (when the musical instrument is operated by air under pressure) to the wind chest, or to a branch of the wind chest, from which the mechanism to be operated is actuated.

The invention comprises the use of a plurality of throttling chambers the tension or pressure in which while different in the several chambers is interdependent, together with means for connecting any one of the chambers to the wind chest or wind chests of the player mechanisms or other conduit or wind actuated mechanism. I also provide means for controlling the tension or pressure in these chambers, either automatically or by hand, or both, said control of each chamber being either dependent upon or independent of the throttling in the other chambers.

I will describe my invention as operating under exhaust, it being understood that the same is applicable to the use of pressure air.

Referring to the drawings, in which like parts are similarly designated—Figure 1 is a vertical section of an apparatus employing two throttling chambers, the exhaust in one of them being controlled by the tension in the other. Fig. 2 is a similar view showing two similar chambers the exhaust in which may be varied independently of one another, as well as being automatically dependent upon one another. Fig. 3 shows a modification with three valve arrangements for a

wind chest with three sections. Fig. 4 is a modified arrangement for moving the valves  $b$  and  $b'$  shown in Fig. 2.

Referring now to Fig. 1, I have shown a casing 2, 3, 4, 5, which is provided with a port block 6, distant from the upper wall 4. This block contains one or more ports or passages, as 7 and 8, passing entirely through the block and in which terminate the connections or conduits  $q$  and  $r$  leading to the wind chest or to the sections of a wind chest, which is divided into a section for the bass part and a section for the discant part of the instrument, for example of a pneumatically operated piano, or it may be to the wind chests of a piano action and of a violin action, as the case may be.

Each of the ports 7 and 8 is under the control of a pair of valves  $o$  and  $o'$ , and  $p$  and  $p'$ . Each pair of valves has a stem  $o^2$  and  $p^2$  common to both valves of the pair. The stems  $o^2$  and  $p^2$  of these pairs of valves pass through the top 4 of the casing and are operated by pneumatics  $o^3$  and  $p^3$  respectively. A partition 9 between the top 4 and port block 6 forms a valve chamber 10 in which are valves 11 and 12 that control the pneumatics  $o^3$  and  $p^3$  in a well known manner, said valves 11 and 12 being themselves controlled from the passages 13 and 14 connected to the tracker bar, and therefore their operation is controlled by the note sheet. In other words, it is my aim to have the operation of the pneumatics  $o^3$  and  $p^3$  controlled from the tracker bar and note sheet, which is attained by the mechanism just described.

The valve chamber 10 is in communication through port 15 passing entirely through the port block 6 with the high tension chamber  $a$  immediately below it. This chamber  $a$  is formed by a partition extending partly across the chamber to the end board 17 thereof, which latter is secured to the right hand end of the port block 6. The space between the partition 16 and bottom 5 of the casing is divided by a partition 18. There are as many ports in the partition 16 as there are tension chambers, in this particular instance two, namely the ports 19 and 20, one on each side of the partition 18. The port 19 opens into the chamber which by reason of its large dimensions acts as an equalizing chamber and prevents great variations of wind tension from being trans-

mitted to the wind pipe 22. The chamber 21 communicates through conduit 22 with the air reservoir or suction device. The chamber 21 may be omitted if desired, and the port 19 may discharge directly into pipe 22.

The port 19 is controlled by a valve *b* urged to closing position by a spring *h*. This valve is provided with a pulley *c*. Around this pulley passes a cord *d*, one end of which is connected to the movable member of a pneumatic *e* whose interior communicates through opening 23 with the high tension chamber *a*. The other end of the cord *d* is connected to one end of a pivoted lever *f*. The pneumatic *e* is urged to distended position by a coil spring *g*.

The port 20 is controlled by a slide valve *k* connected by rod 24 to the movable member of pneumatic *l* whose interior is in communication with the low tension chamber *i* through opening 25. The movable member of the pneumatic *l* may be urged to distended position by a spring, but in lieu thereof I prefer to use in this connection a pneumatic *m* connected by pipe *n* to the high tension chamber *a*. The movable members of the pneumatics *l* and *m* are connected by a rod 26.

The operation is as follows: Air suction being established in chamber 21, there will be a slightly lower tension in chamber *a* which communicates with 21. The chamber *i* which communicates with the high tension chamber *a* through port 20 will have a lower tension than that in *a*. Either high tension chamber *a* or lower tension chamber *i* may be placed in communication with the wind chests through *q* and *r* by operating the valve pairs controlling the ports 7 and 8. This is controlled by the music sheet. When one of the passages 13 or 14, as the passage 14, is vented by the music sheet to the atmosphere, air enters the membrane of valve 12, which, by reason of the suction in the valve chamber 10 that communicates with *a* through 15, lifts, thereby venting the pneumatic *p*<sup>3</sup> to the atmosphere and allowing it to expand under the action of its spring. The rod *p*<sup>2</sup> will be thereby moved down, if the rod is positively connected to the movable member of the pneumatic *p*<sup>3</sup>. But if the rod *p*<sup>2</sup> be slidably connected to the pneumatic, as shown, the greater suction in chamber *a* will pull valves *p* and *p*<sup>1</sup> downward, closing valve *p*<sup>1</sup> and opening valve *p* so that the wind chest or a section of the wind chest connected with *r* will be in communication with the high tension chamber *a* through *r* and 8. In this instance the pneumatics *o*<sup>3</sup> and *p*<sup>3</sup> will not require distending springs.

When a passage 13 or 14, as passage 13, is closed by the music sheet, the diaphragm is deflated through vent *w* and the pneumatic *o*<sup>3</sup> is in communication with valve

chamber 10, becomes deflated and collapses, raising the lower valve *o* to its seat, and opening the valve *o*<sup>1</sup> to the low tension chamber *i*.

The pairs of valves *o*, *o*<sup>1</sup> and *p*, *p*<sup>1</sup> may 70 be rigidly secured to their respective rods or not, as desired. They will operate if mounted in either way, the opening movement of both being rendered certain by the suction in chambers *a* and *i*, while the closing movement of the upper valves *o*<sup>1</sup> and *p*<sup>1</sup> is effected by the greater suction in the high tension chamber *a* assisted by the weight of the valve.

The tension in chamber *a* is automatically controlled by the pneumatic *e* which operates the valve *b* while the lower tension in *i* is automatically controlled by the pneumatic *l*, partly under the control of the variations of tension in the high tension chamber *a* through *n* and *m*.

By reason of *i* communicating with *a*, variations of tension in one of the chambers affect to a certain extent the tension in the other, but by reason of the high tension chamber *i* being connected to the exhaust 22 the pneumatic *e* tends to automatically maintain a uniform high tension in *a* while the pneumatic *l* tends to maintain a uniform lower tension in chamber *i*, although one tension is dependent upon the other.

The hand lever *f* is adapted to move the valve either simultaneously with or independently of the pneumatic *e* thereby increasing or decreasing the tension in *a*, and to an extent in *i*, since *i* is exhausted through *a*.

In Fig. 2 I have shown the same structure with the modification that the valve *k*<sup>1</sup> is urged to closing position by a spring and is provided with a pulley *s* around which passes a cord *t* from the movable member of the pneumatic *l* thence around a pulley *u* to the movable member of a pneumatic *f*<sup>1</sup> on the hand lever *f*. The pneumatic *l* is provided with a spring *l*<sup>1</sup>, and the pneumatic *f*<sup>1</sup> is connected by a flexible tube *f*<sup>2</sup> to the tracker bar. This arrangement permits variation of the low tension in *i* under the control of the music sheet, as well as by hand, for the movement of lever *f* bodily moves the pneumatic *f*<sup>1</sup> to allow *k*<sup>1</sup> to open and close at the will of the person playing. The valve *b* being also connected to *f* will be moved simultaneously with *k*<sup>1</sup>, but it is obvious that I may provide a second lever as *f*<sup>3</sup>, Fig. 4, similar to lever *f* to which the cord *t* is connected, so that the valves *b* and *k*<sup>1</sup> may be moved independently of one another by hand. In Fig. 4, the hand lever *f*<sup>3</sup> is connected to the cord *t* so that said cord may be pulled either by the pneumatic *f*<sup>1</sup> or by lever *f* together with cord *d* or by lever *f*<sup>3</sup> independently of cord *d*.

More than two valve arrangements as  $o$ ,  $o'$  and  $p$ ,  $p'$  with conduits  $q$ ,  $r$  may be used, if more than two sections of wind chests exist. Fig. 3 of the drawings shows a modification with three valve arrangements  $o$ ,  $o'$ ,  $p$ ,  $p'$ ,  $p^x$ ,  $p^y$  and conduits  $q$ ,  $r$ ,  $r'$  leading to three sections of the wind chest. The operation is the same as in the first modification.

10 I claim—

1. In a tone modulator for pneumatically actuated musical instruments, the combination with a main chamber, of a plurality of chambers connected in succession to said main chamber and successively decreasing in tension, and throttle valves controlled by the tension in the respective chambers for controlling the passage from one chamber to another to successively throttle the wind passing through said chambers.

2. A tone modulator for pneumatically actuated musical instruments, comprising a plurality of communicating tension chambers, the tensions in which differ but are dependent upon one another, a wind chest or other connection with said chambers, means to place said connection in operative relation to any one of said chambers and means to maintain the dependent relation of the tensions in the respective chambers.

3. In a tone modulator for pneumatically actuated musical instruments, the combination with a series of chambers in successive communication, throttle valves controlling the communication between the chambers, and means dependent upon the wind pressure in said chambers and operated thereby to vary the degree of movement of said valves and thereby the throttling between the chambers.

4. In a tone modulator for pneumatically actuated musical instruments in combination; a series of chambers in successive connection, throttle valves controlling the communication between the chambers, means in each chamber automatically controlled by the tension existing in its chamber for varying the valve position, and means under the control of the operator to independently vary said connection, a wind chest or other connection, and means to place the same in communication with the chambers.

5. A tone modulator for pneumatically actuated musical instruments, comprising a plurality of communicating tension chambers, the tensions in which differ but are dependent upon one another, means to automatically maintain the tensions in said chambers, a wind connection with said chambers and pneumatic means to place said connection in operative relation to any one of said chambers.

6. A tone modulator for pneumatically actuated musical instruments, comprising a plurality of communicating tension cham-

bers the tensions in which differ but are dependent upon one another, means actuated by the tensions in the respective chambers to maintain said tensions, a wind chest or other connection with said chambers and note sheet controlled means to place said connection in operative relation to any one of said chambers.

7. A tone modulator for pneumatically actuated musical instruments, comprising a plurality of tension chambers under different tensions, means to control the tension of each chamber, said means under control of the tension existing in each chamber, a wind connection and means to place said connection in communication with any one of said chambers.

8. A tone modulator for pneumatically actuated musical instruments, comprising a plurality of tension chambers under different tensions, means to automatically control the tension of each chamber, said means under control of the tension existing in each chamber, means to control the tension in each chamber independently of the aforesaid automatic control, a wind connection and means to place said connection in communication with any one of said chambers.

9. A tone modulator for pneumatically actuated musical instruments, comprising a plurality of communicating tension chambers under different tensions dependent upon one another, means in each chamber to control its tension, said means under the automatic control of the tension therein, hand-actuated means to control the tension in each chamber independently of the automatic control, a wind connection and means to place said connection in communication with any one of said chambers.

10. A tone modulator for pneumatically actuated musical instruments, comprising a plurality of tension chambers under different tensions, means in each chamber to control its tension, said means under control of the tension therein, independent note sheet controlled means to control the tension in the chambers beyond the first chamber, a wind connection and means to place said connection in communication with any one of said chambers.

11. A tone modulator for pneumatically actuated musical instruments, comprising a plurality of tension chambers under different tensions, means in each chamber to control its tension, said means under control of the tension therein, independent note sheet controlled means to control the tension in the chambers beyond the first chamber, manually operated means to vary the tension in all the chambers, a wind connection and means to place said connection in communication with any one of said chambers.

12. A tone modulator for pneumatically actuated musical instruments, comprising a

plurality of tension chambers under different tensions, means to control the tension of each chamber, said means under control of the tension therein, independent note sheet controlled means to control the tension in the chambers beyond the first chamber, manually operated means to simultaneously vary the tension in all the chambers, a wind connection and means to place said connection in communication with any one of said chambers.

13. A tone modulator for pneumatically actuated musical instruments, comprising a plurality of successively communicating tension chambers having successively increasing tension therein, means in each chamber to automatically control its tension, means to manually control the tension in each chamber, and note sheet controlled means to control the tension, said controlling means independently operable, a wind connection and means to place said connection under the tension of any one of said chambers.

14. A tone modulator for pneumatically actuated musical instruments, comprising a plurality of successively communicating tension chambers having successively increasing tension therein, means to automatically control the tension in each chamber, means to manually control the tension in each chamber, and note sheet controlled means to control the tension, said control-

ling means independently operable, a wind connection and means to place said connection under the tension of any one of said chambers, and an equalizing chamber into which the high tension chamber discharges.

15. The combination with two chambers under different tension; of a port block having a port therein connecting the chambers, a valve stem passing through the port, two valves loose on said stem to control the ends of the port, a pneumatic to operate the stem and a connection communicating with the port between its ends.

16. The combination with two chambers under different tension; of a horizontally disposed port block between them having a substantially vertical port therethrough connecting the chambers, the higher tension chamber being below said block, a connection communicating with the port between its ends, a valve stem passing through the port, a pair of valves loose on the stem each controlling an end of the port, and a note sheet controlled pneumatic to control the operation of the stem.

In testimony that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

GUSTAV KARL HENNIG.

Witnesses:

EMIL GEUDTNER,

RUDOLPH FRICKE.