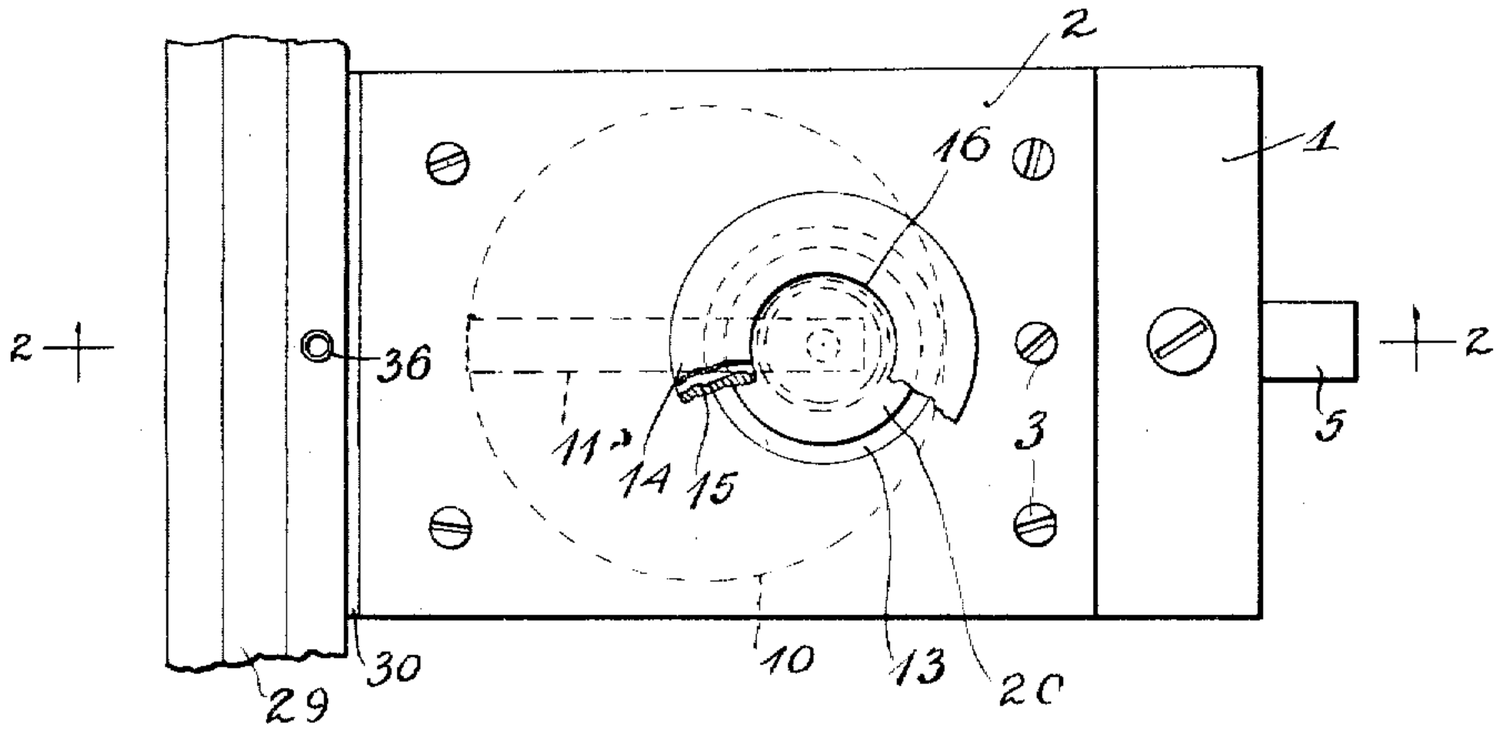
A. G. GULBRANSEN.

PNEUMATIC ACTUATING UNIT.

APPLICATION FILED MAR. 20, 1909.

944,034. **Patented Dec. 21, 1909.**

Fig. 1.



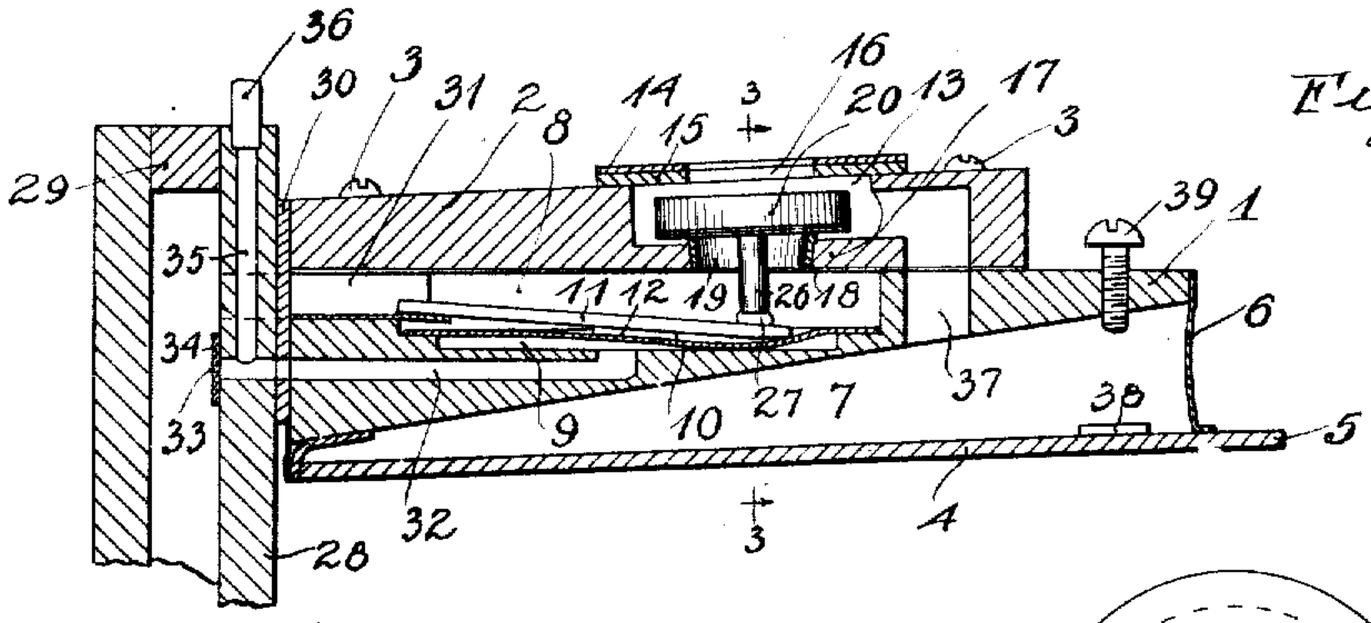


Fig. 2

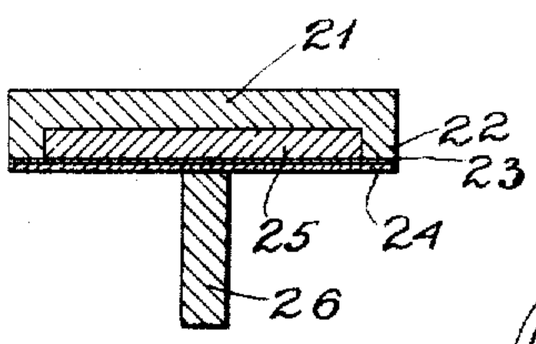


Fig. 3

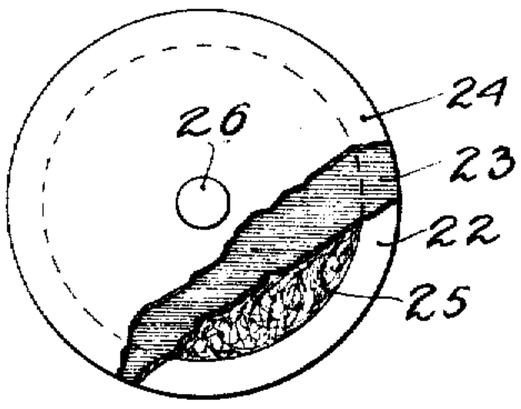


Fig. 4.

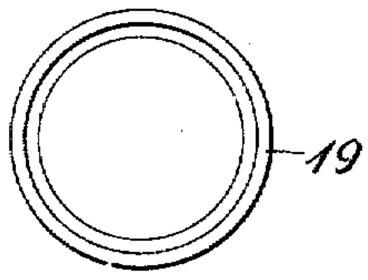


Fig. 5.

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UNITED STATES PATENT OFFICE.

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PNEUMATIC ACTUATING UNIT.

944,034. Specification of Letters Patent. Patented Dec. 21, 1909.

Application filed March 20, 1909. Serial No. 484,634.

To all whom it may concern:

Be it known that I, AXEL G. GULBRANSEN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Pneumatic Actuating Units for Use in Pneumatically-Operated Pianos, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to pneumatic actuating units for use in pneumatically operated pianos and its object is to provide improved construction and arrangement, particularly of the primary valve mechanism.

In pneumatic actuating units the primary valve is operated rapidly and suddenly and should have, therefore, great freedom of movement. The seats for the valve should be rigid and secure and should be constructed to insure good engagement and to prevent leakage. The construction and arrangement should also be such that the engagement between the valve and its seats is noiseless. All these various desirable features are obtained by my construction and arrangement which is clearly shown in the accompanying drawing, in which—

Figure 1 is a top view of a pneumatic actuating unit: Fig. 2 is a section view taken on plane 2—2, Fig. 1; Fig. 3 is a section view taken through the valve on plane 3—3, Fig. 2; Fig. 4 is an underside view of the valve, parts being broken away; and Fig. 5 is a top view of a ring forming a seat for the valve.

The actuating unit frame comprises the main supporting block 1 and the valve block 2 mounted on the main block and removably secured thereto as by means of screws 3. Hinged at the left lower edge of block 1 is the movable member or plate 4 having at its right end an extension or shelf 5 for engaging directly or through connecting mechanism with the abstract rods or striking mechanism of the piano. Glued about the edges of the block 1 and plate 4 is flexible fabric 6, which with said block and plate forms a bellows chamber 7. The block 1 is recessed from the top to form the upper and lower diaphragm chambers 8 and 9, separated by the diaphragm 10. Hinged at the left end of the upper diaphragm chamber and extending diametrically across said chamber and over the diaphragm is a lever 11 secured at an intermediate point to the center of the diaphragm by means of a felt disk 12.

Into the valve block 2 is cut the cylindrical valve chamber 13 whose upper end is covered by the annular metallic seat 14 cushioned by a leather washer 15, the opening 16 communicating with the atmosphere. The lower wall 17 of the valve chamber has the central opening 18 connecting the valve chamber with the upper diaphragm chamber. The sides of this opening taper downwardly the entire distance and are lined by a metal ring 19 correspondingly tapered and whose upper edge is finished to form a smooth annular valve seat. The ring is glued in the opening and the tapered arrangement assists in rigidly and securely holding the ring in place and also prevents the ring from falling into the diaphragm chamber, should it ever become loosened. This arrangement also causes the seat ring 19 to be compensating as should for any reason the opening 18 become larger and the ring loosened as by contraction of the block 2, the valve 20 which is under atmospheric pressure will force the ring downwardly into firm and close engagement with the opening, thus maintaining at all times a perfect fit between the ring and the opening.

Within the valve chamber is the cylindrical valve 20, whose detail construction is shown in Figs. 3 and 4. The main member is a wooden disk 21 having the annular flange 22 extending downwardly from its edge. A diaphragm or disk 23 of air tight fabric, such as rubber, is glued at its edge to the end face of the flange and said disk is reinforced by a diaphragm or disk 24 glued thereto at its edge, said disk 24 being preferably of leather. Within the compartment formed by the flange and the disks 21 and 23, some soft cushioning material 25 is placed and this may be in the form of a felt disk inserted before the rubber disk 23 is applied to the flange. The upper end of seat ring 19 extends a short distance above the wall 17 and the valve is normally seated thereon, the inner diameter of the flange being greater than that of the ring and the outer diameter of the disk 21 being sufficiently less than the diameter of the valve

chamber to allow perfect freedom of operation of the valve. Glued at its upper end to the center of the leather disk 24 is the valve stem 26, which extends downwardly through opening 18 and into the upper diaphragm chamber, its lower end being secured to the right end of lever 11 by means of a felt disk 27.

The left ends of blocks 1 and 2 are in vertical register and are secured to the wall 28 of a vacuum chamber frame 29, a washer 30 of leather being interposed. A passageway 31 connects the upper diaphragm chamber with the vacuum chamber and a passageway 32 connects the lower diaphragm chamber with the vacuum chamber, this connection, however, being throttled by the small opening 33 through disk 34 applied over the end of said passageway. The passageway 32 also connects via passageway 35 with a conductor 36 leading to an opening in the tracker board over which the music sheet travels, this tracker board not being shown. A passageway 37 connects the valve chamber with the bellows compartment 7.

When the tracker board openings are closed, both diaphragm chambers connect with the vacuum chamber; the diaphragm is down and the valve is held against the ring seat by atmospheric pressure. When a tracker board opening is exposed by the sheet, air under atmospheric pressure rushes through passageway 35 and 32 to blow up the diaphragm and to raise the valve, the diaphragm force being multiplied by the lever connection between the diaphragm and valve which has already been described. The valve now closes atmosphere outlet 16 and allows the bellows compartment to connect with the vacuum chamber through opening 18 and passageway 31. The plate 4 is therefore raised and the piano striking mechanism having connection with the extension 5, is actuated. When the tracker board opening is again closed, the pressures in the diaphragm chambers equalize through opening 33 and the valve returns to its lower seat to disconnect the bellows chamber from the vacuum chamber and to reconnect the bellows chamber with atmosphere, whereupon plate 4 drops and the striking mechanism is released. The upward throw of the plate 4 is cushioned by a pad 38 which strikes the abutment screw 39, this abutment screw also allowing adjustment of the actuation of the striking mechanism by the plate 4.

True and accurate engagement of the valve with its seats is always assured, on account of the flexible felt connection between the stem and lever, and the flexible connection of the stem with the leather disk or diaphragm 24. These connections allow the valve to move freely and practically independently of the lever 11. The cushioning material 25 absorbs all shocks and softens the engagement of the valve with its seats. The rubber disk 23 prevents leakage of air through opening 18 when the valve seats on ring 19. The opening 18 being tapered throughout its length, the tapered seat ring 19 will at all times be held with perfect fit in the opening by the valve pressing against the ring.

The result of the various features described above is to produce very efficient and noiseless operation.

As changes both in construction and arrangement could be made without departing from the spirit of my invention, I do not limit myself to the exact construction and operation shown, and I desire to secure the following claims by Letters Patent:

1. In a pneumatic actuating device of the class described, the combination with a valve having an opening and a diaphragm secured over said opening, of a seat for engaging said diaphragm within the edge of said opening.

2. In a pneumatic actuating device of the class described, the combination of a frame forming a valve chamber, a valve in said chamber having a cavity and a diaphragm secured over said cavity, a diaphragm chamber below the valve chamber, a diaphragm in said chamber, a valve stem having connection at one end with the diaphragm in said diaphragm chamber and at its other end being connected with the valve diaphragm, and a passageway controlled by said valve.

3. In a pneumatic actuating device of the class described, the combination with a valve comprising a disk having a cavity, cushioning material filling the cavity, and a diaphragm closing the cavity, of a frame forming a valve chamber for said valve, a stem secured to the diaphragm and extending therefrom, actuating mechanism for said valve connected with said stem, and a passageway controlled by said valve.

4. In a pneumatic actuating device of the class described, the combination with a valve comprising a disk having a cavity, cushioning material in said cavity, and a diaphragm covering the cavity and secured to the disk, of a stem secured at one end to the diaphragm, actuating mechanism having flexible connection with the other end of said stem, and a passageway controlled by said valve.

5. In a pneumatic actuating device of the class described, the combination of a disk having a rim forming a cavity with said disk, an air tight diaphragm secured to the rim over the cavity, a reinforcing diaphragm also secured to the rim on top of the first mentioned diaphragm, said disk and diaphragms constituting a valve structure, a seat for said valve structure, a stem secured at one end to the reinforcing diaphragm,

and actuating mechanism having flexible connection with the other end of said stem.

6. In a pneumatic actuating device of the class described, the combination of a body part having a rim forming a cavity therewith, a diaphragm secured to the rim over the cavity, said disk and diaphragm constituting a valve structure, and an annular valve seat for engaging with the diaphragm within said rim.

7. In a pneumatic actuating device of the class described, the combination of a body part having a rim forming a cavity therewith, a diaphragm secured to the rim over the cavity, said disk and diaphragm constituting a valve structure, an annular valve seat for engaging with the diaphragm within said rim, a valve stem secured to the diaphragm, and actuating mechanism having connection with said stem.

8. In a pneumatic actuating device of the class described, the combination of a body part having a rim forming a cavity therewith, a diaphragm secured to the rim over the cavity, said disk and diaphragm constituting a valve structure, an annular valve seat for engaging with the diaphragm within said rim, a valve stem secured at one end to the diaphragm, and actuating mechanism having flexible connection with the other end of said stem.

9. In a pneumatic actuating device of the class described, the combination of a rigid disk having a rim forming a cavity therewith, a flexible disk secured to the rim over the cavity, cushioning material in the cavity, said disks and material constituting a valve structure, and an annular valve seat for engaging with the flexible diaphragm within the rim.

10. In a pneumatic actuating device of the class described, the combination of a rigid circular valve disk having an annular flange on one face forming a compartment therewith, a flexible disk secured to the flange end and covering the compartment, and an annular seat for engaging with said flexible disk, the diameter of said seat being less than the inner diameter of the flange.

11. In a pneumatic actuating device of the class described, the combination of a rigid circular valve disk having an annular flange on one face forming a compartment therewith, a flexible disk secured to the flange end and covering the compartment, an annular seat for engaging with said flexible disk, the diameter of said seat being less than the inner diameter of the flange, and cushioning material within the compartment.

12. In a pneumatic actuating device of the class described, the combination of a rigid valve disk having a flange extending from one face thereof and forming therewith a compartment, an inner flexible disk secured to the flange end over the compartment, an outer flexible disk superposed on the inner flexible disk, and an annular valve seat for engaging the outer disk and having a diameter less than the inner diameter of the flange, said inner flexible disk being impervious to air.

13. In a pneumatic actuating device of the class described, the combination of a rigid valve disk having a flange extending from one face thereof and forming therewith a compartment, cushioning material within the compartment, an inner flexible disk secured to the flange end over the compartment, an outer flexible disk superposed on the inner flexible disk, and an annular valve seat for engaging the outer disk and having a diameter less than the inner diameter of the flange, said inner flexible disk being impervious to air.

In witness whereof I hereunto subscribe my name this 17th day of March, A. D. 1909.

AXEL G. GULBRANSEN.

Witnesses:

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