

(No Model.)

5 Sheets—Sheet 1.

G. SANDER.  
PNEUMATIC ACTION FOR ORGANS.

No. 367,666.

Patented Aug. 2, 1887.

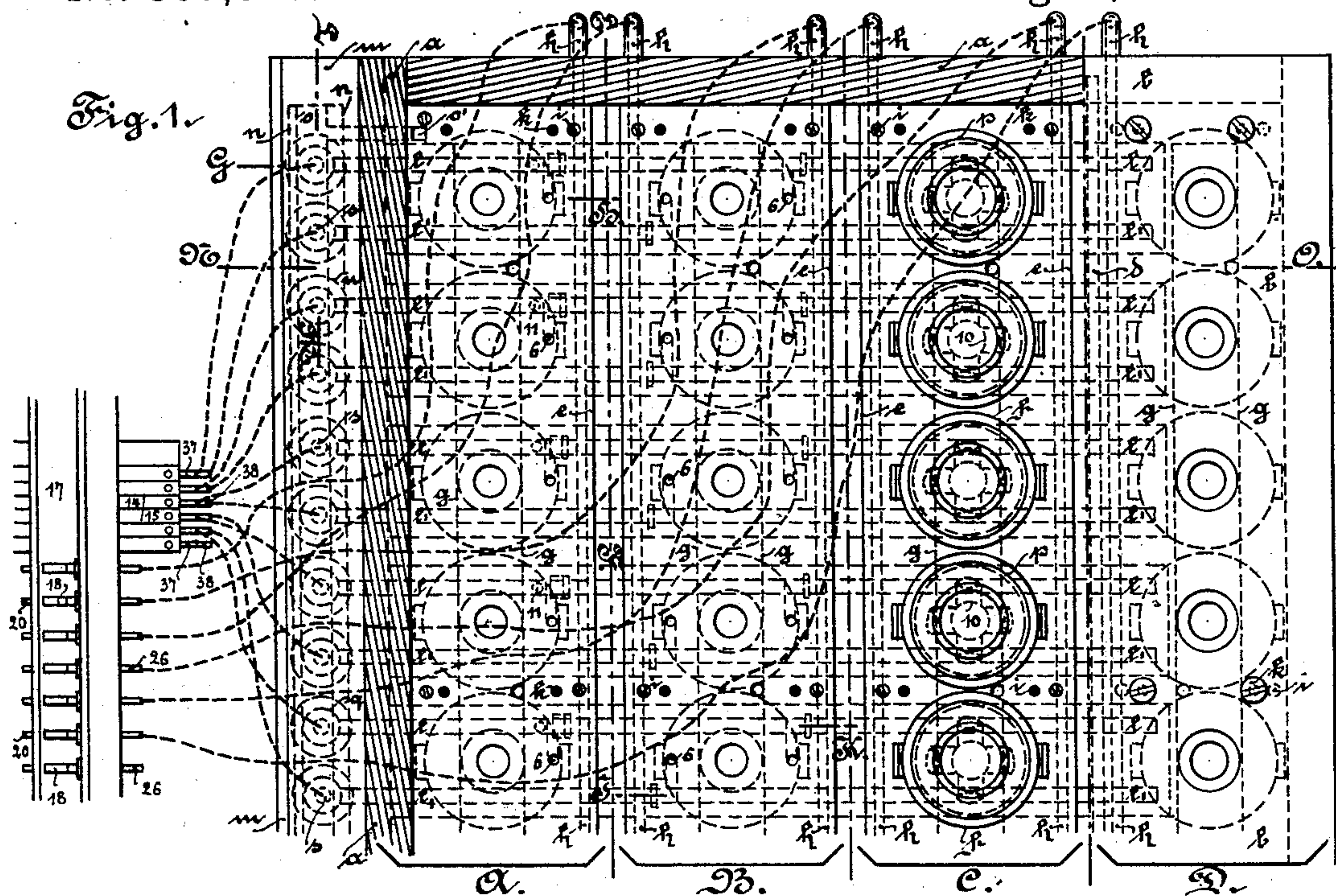
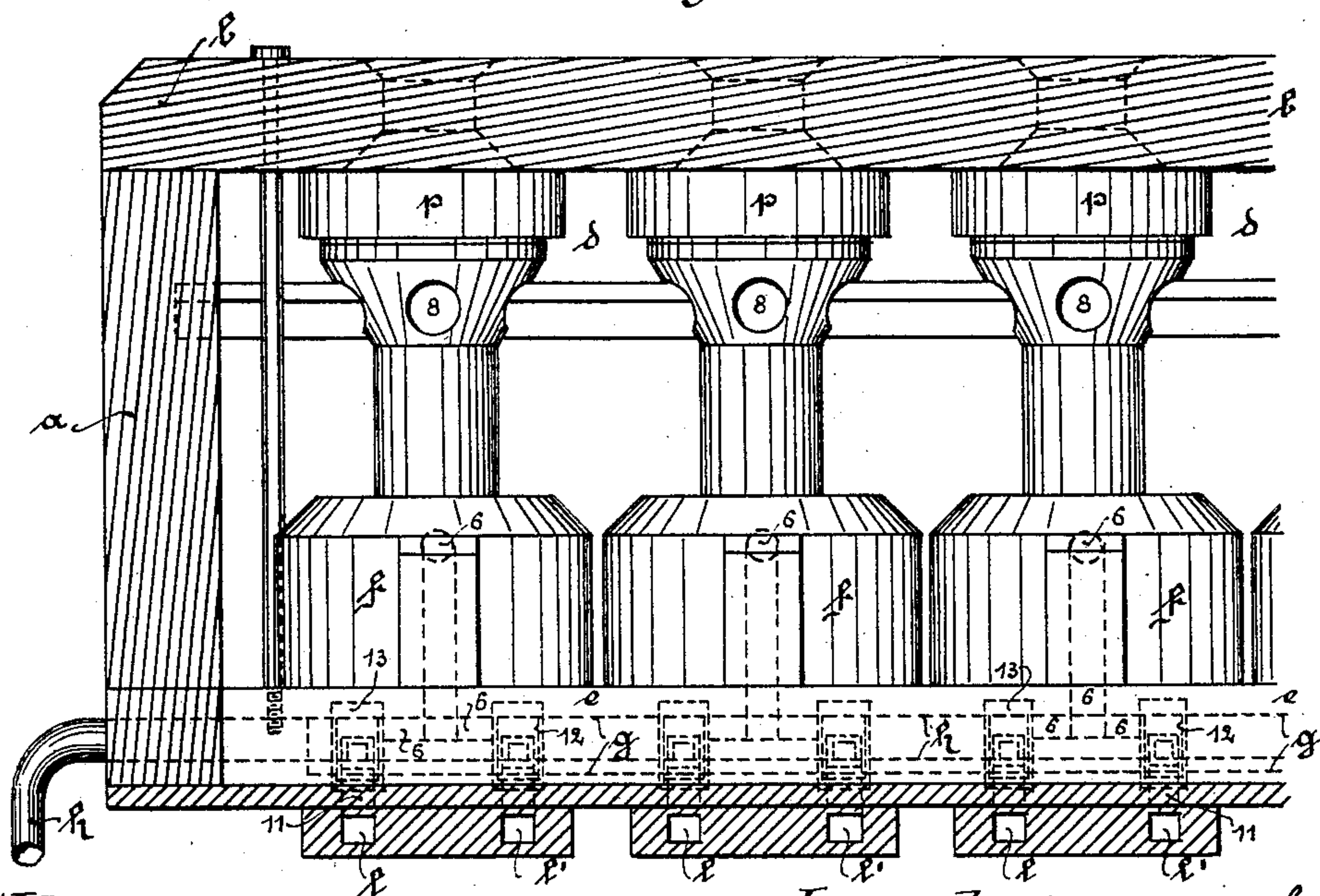


Fig. 2.



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per *Charles Rættig*  
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Fig. 3.

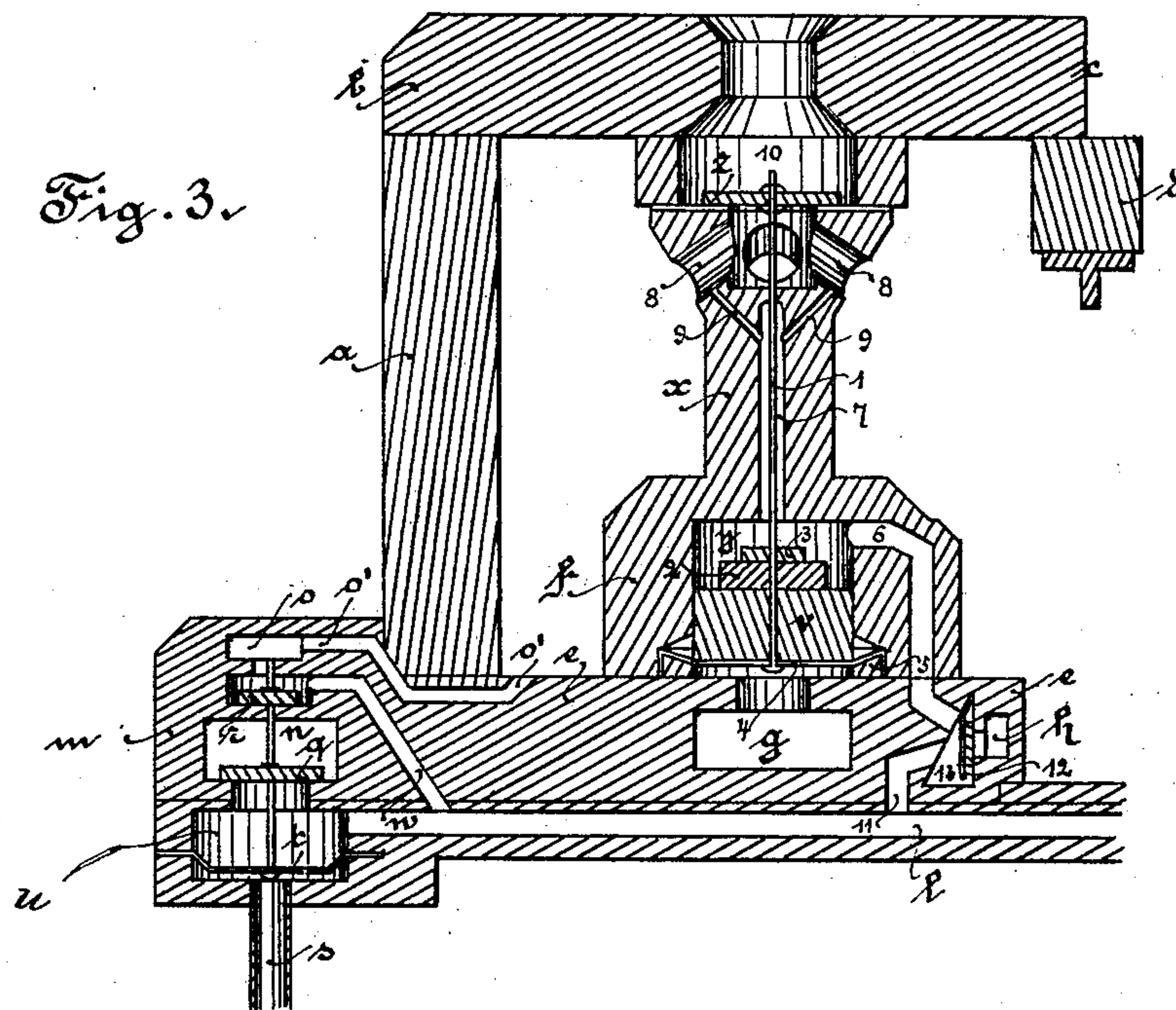


Fig. 4.

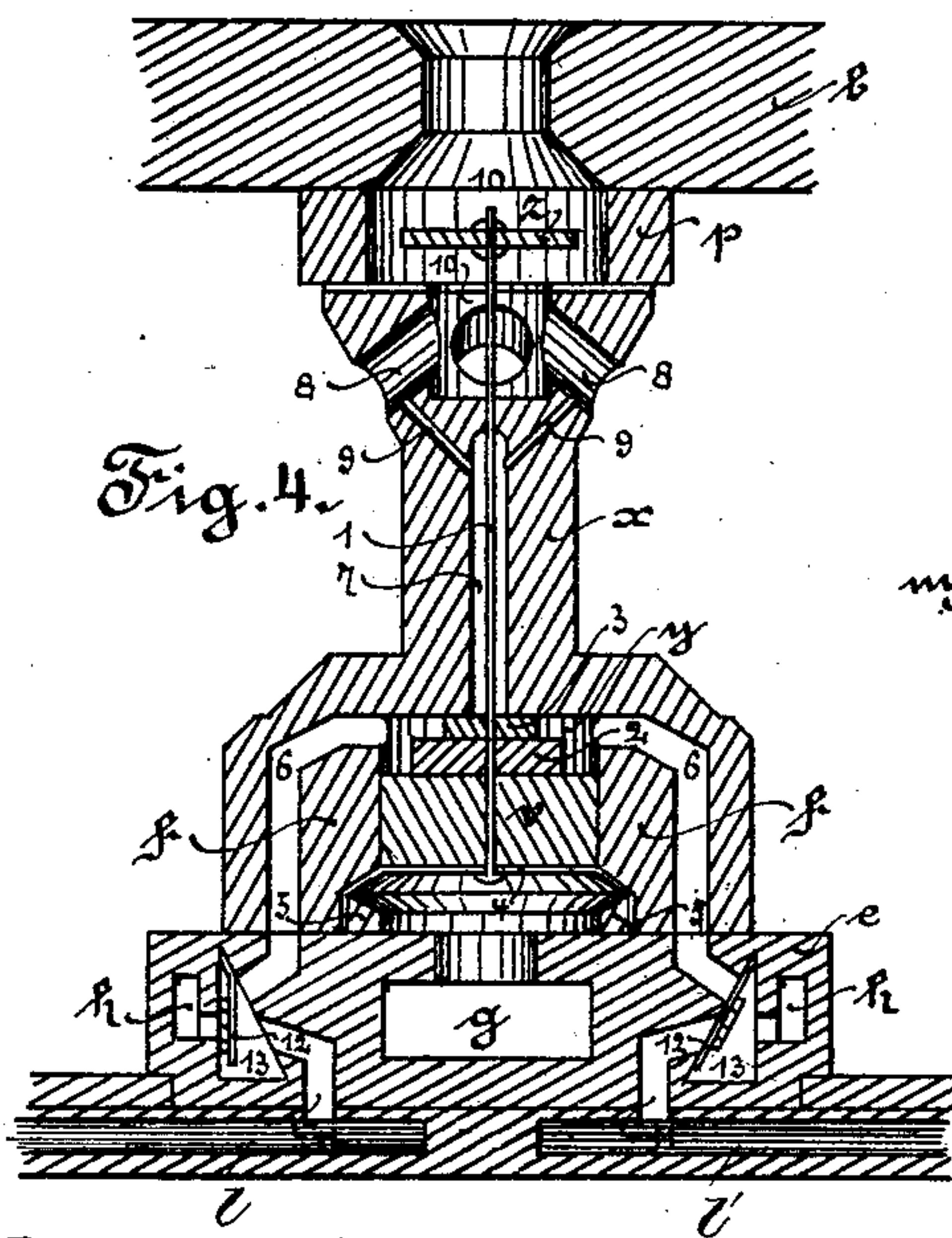
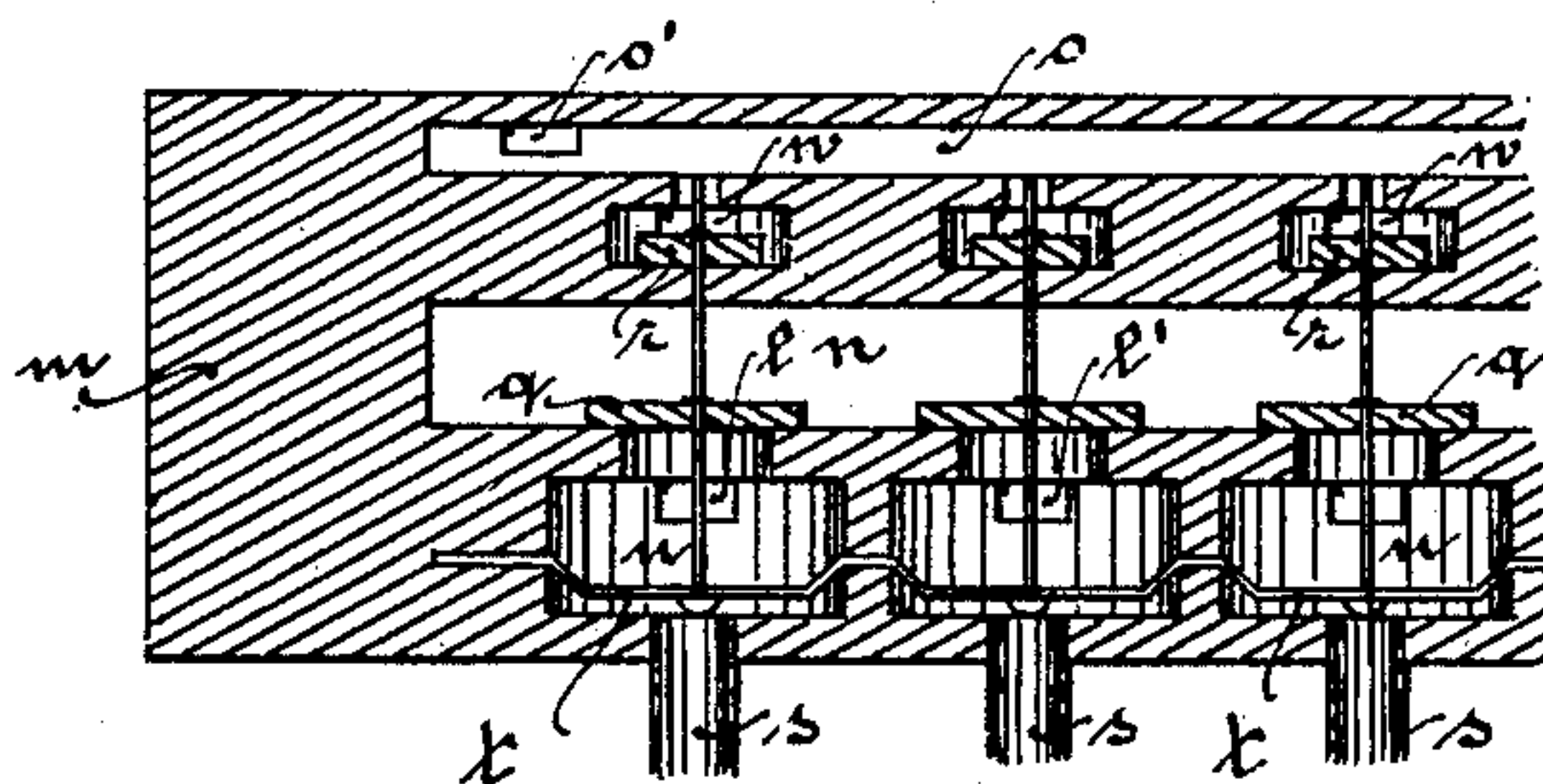


Fig. 5.



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Fig. 6.

Fig. 7.

Fig. 8.

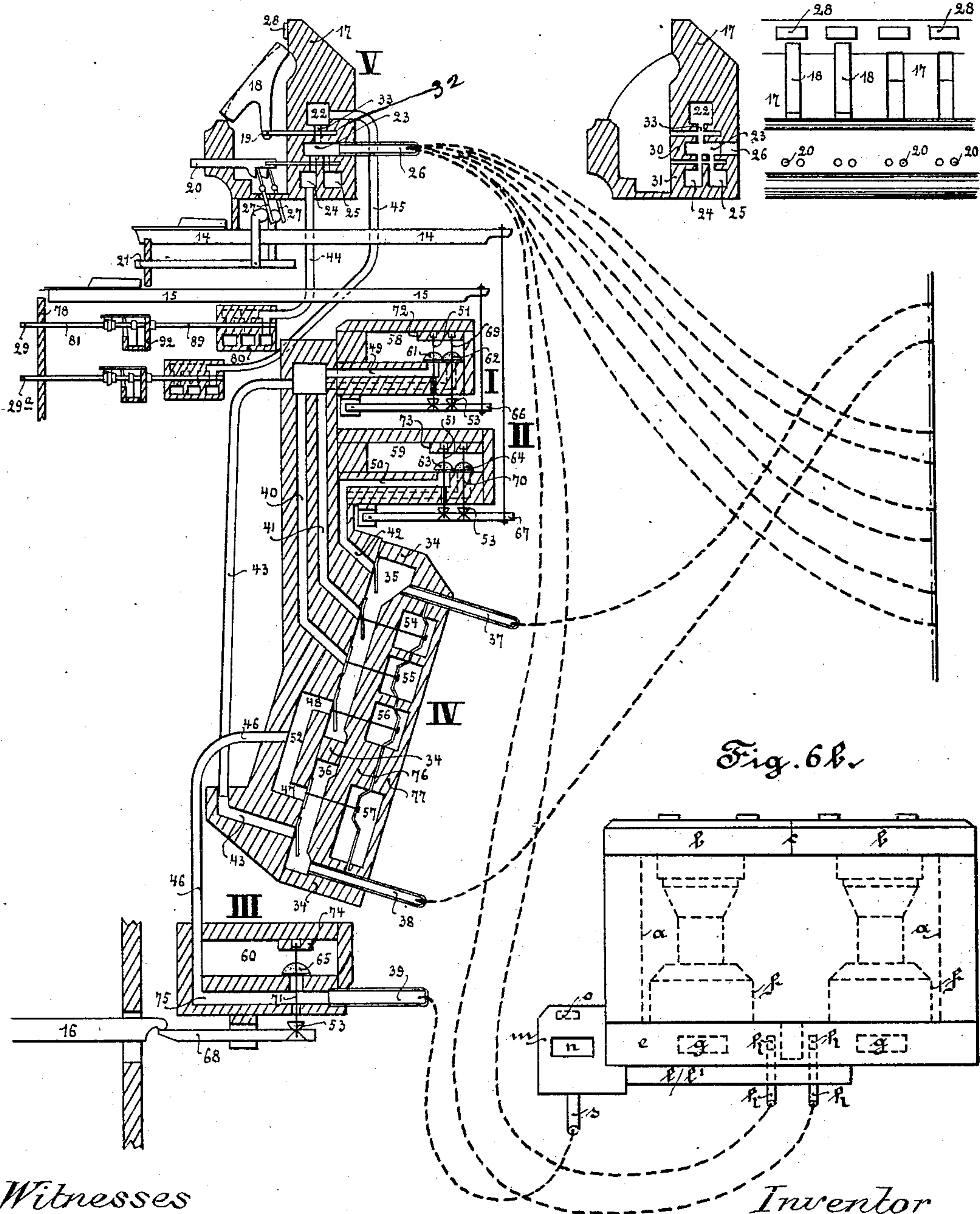


Fig. 6b.

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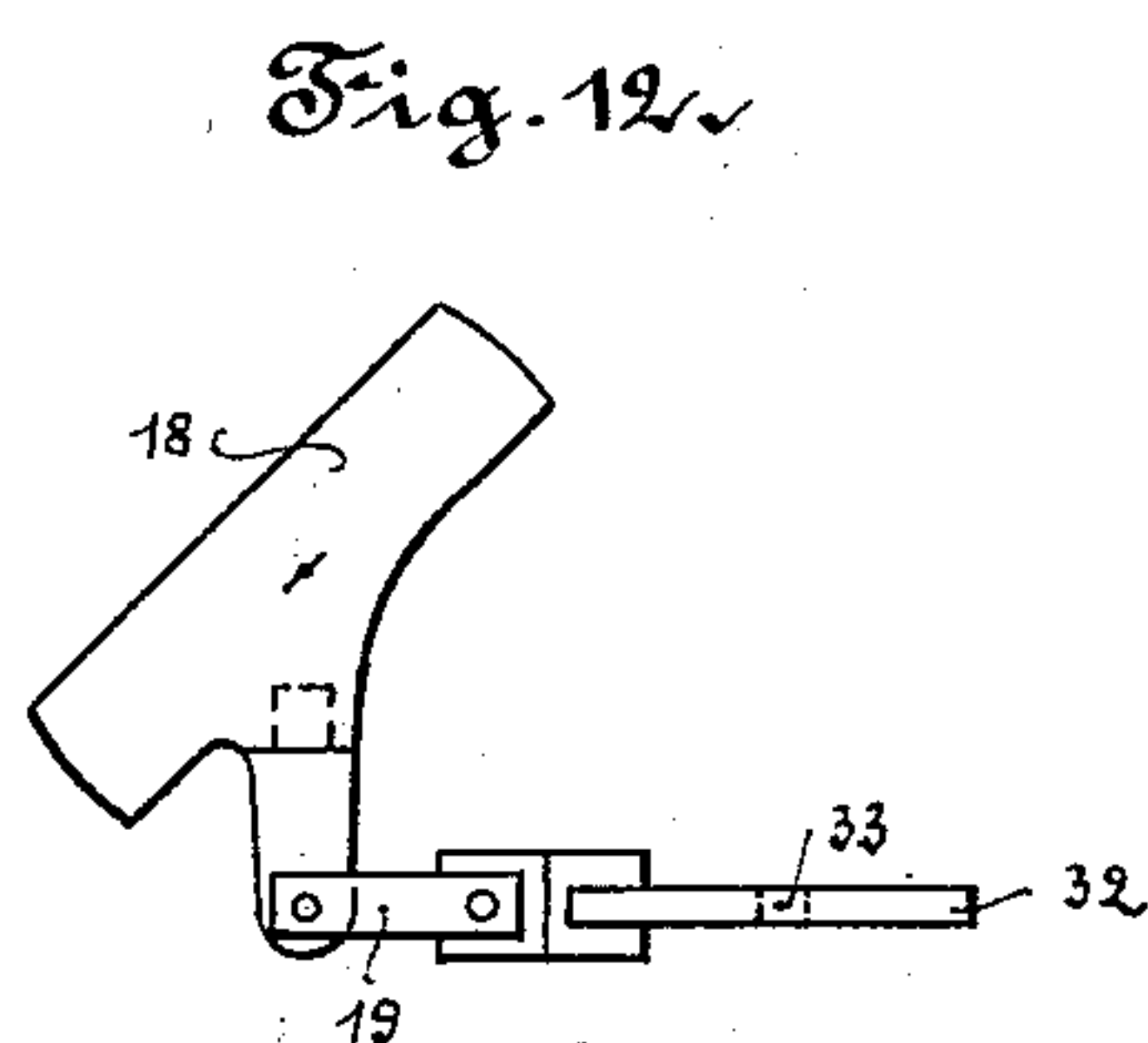
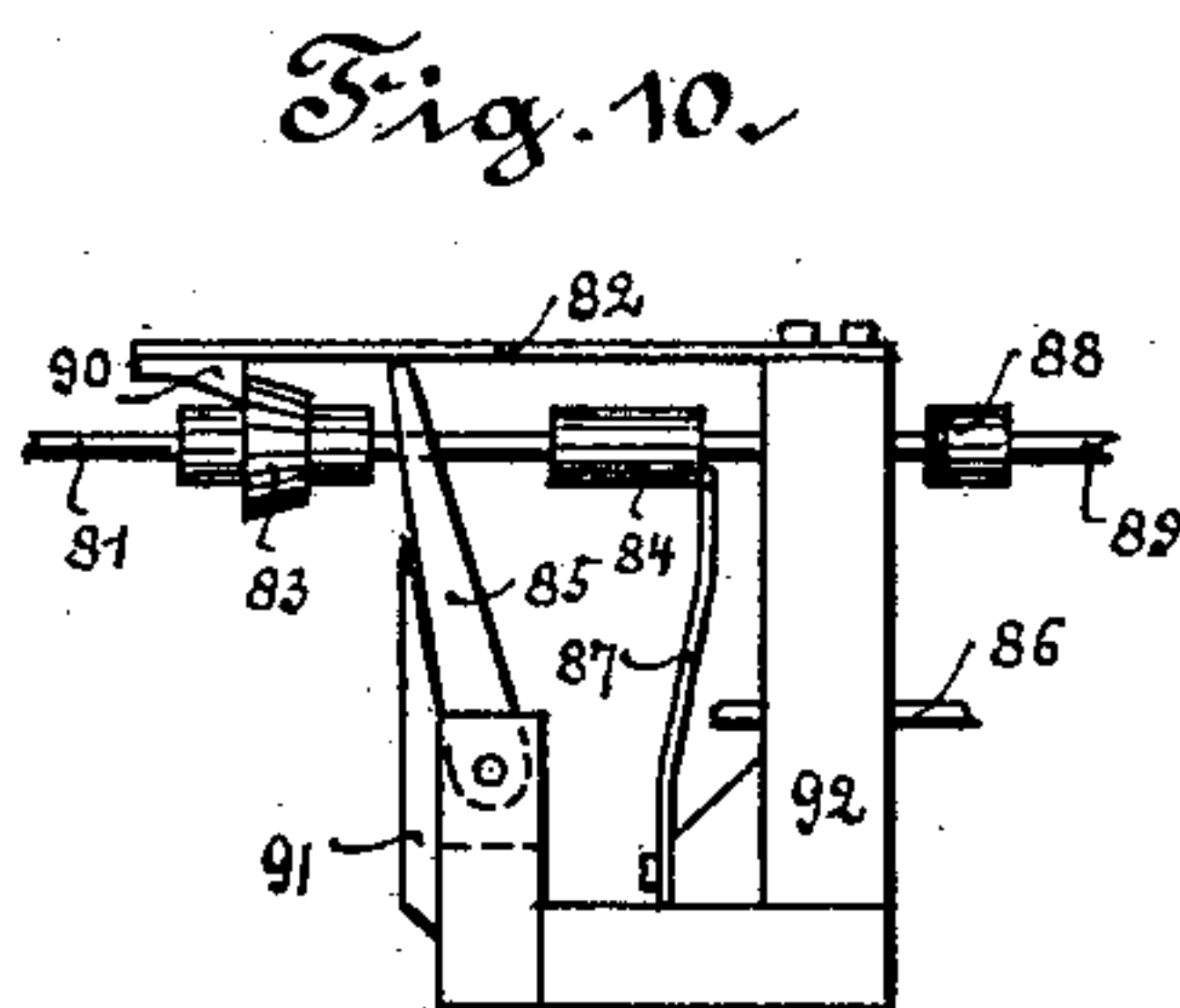
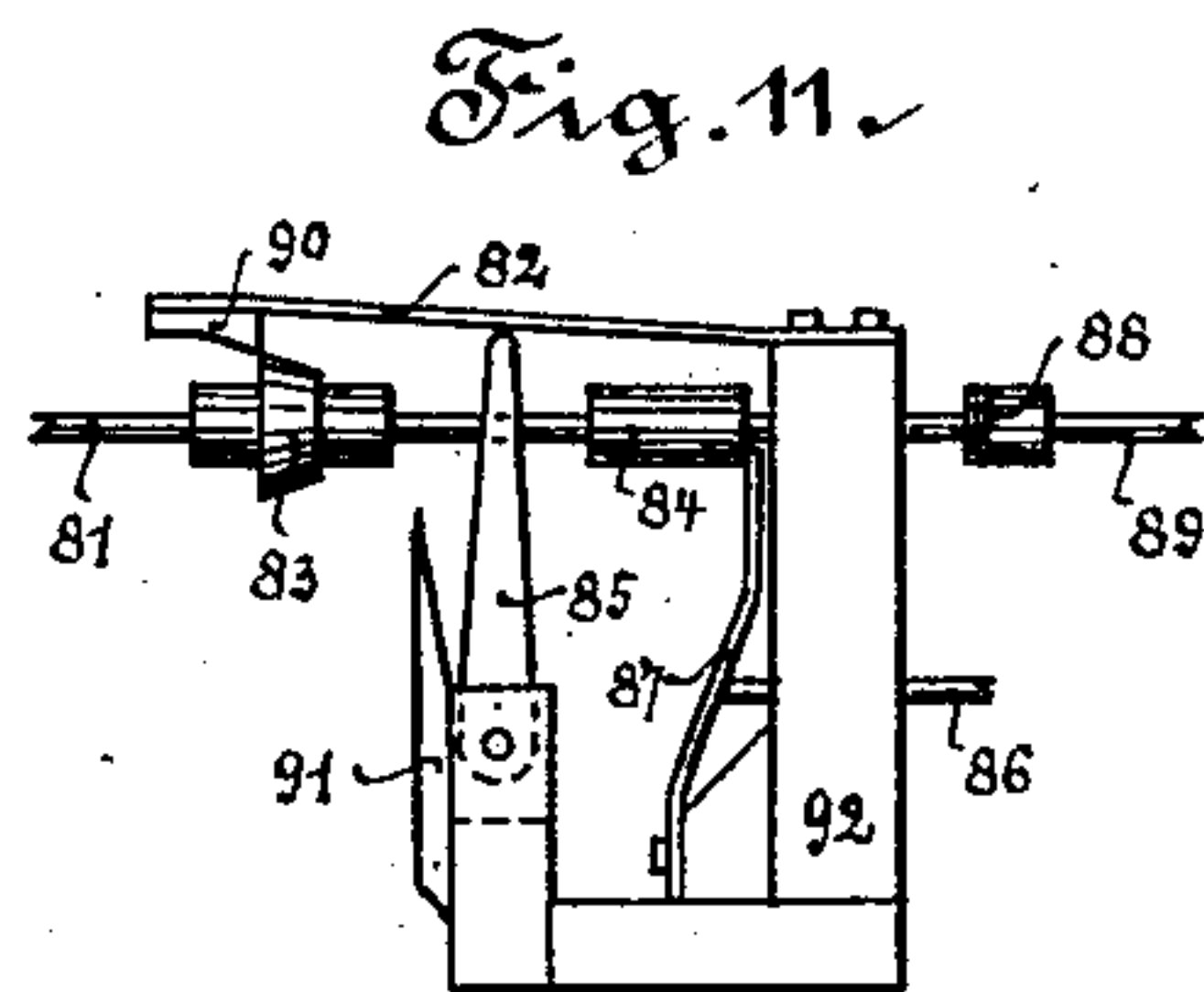
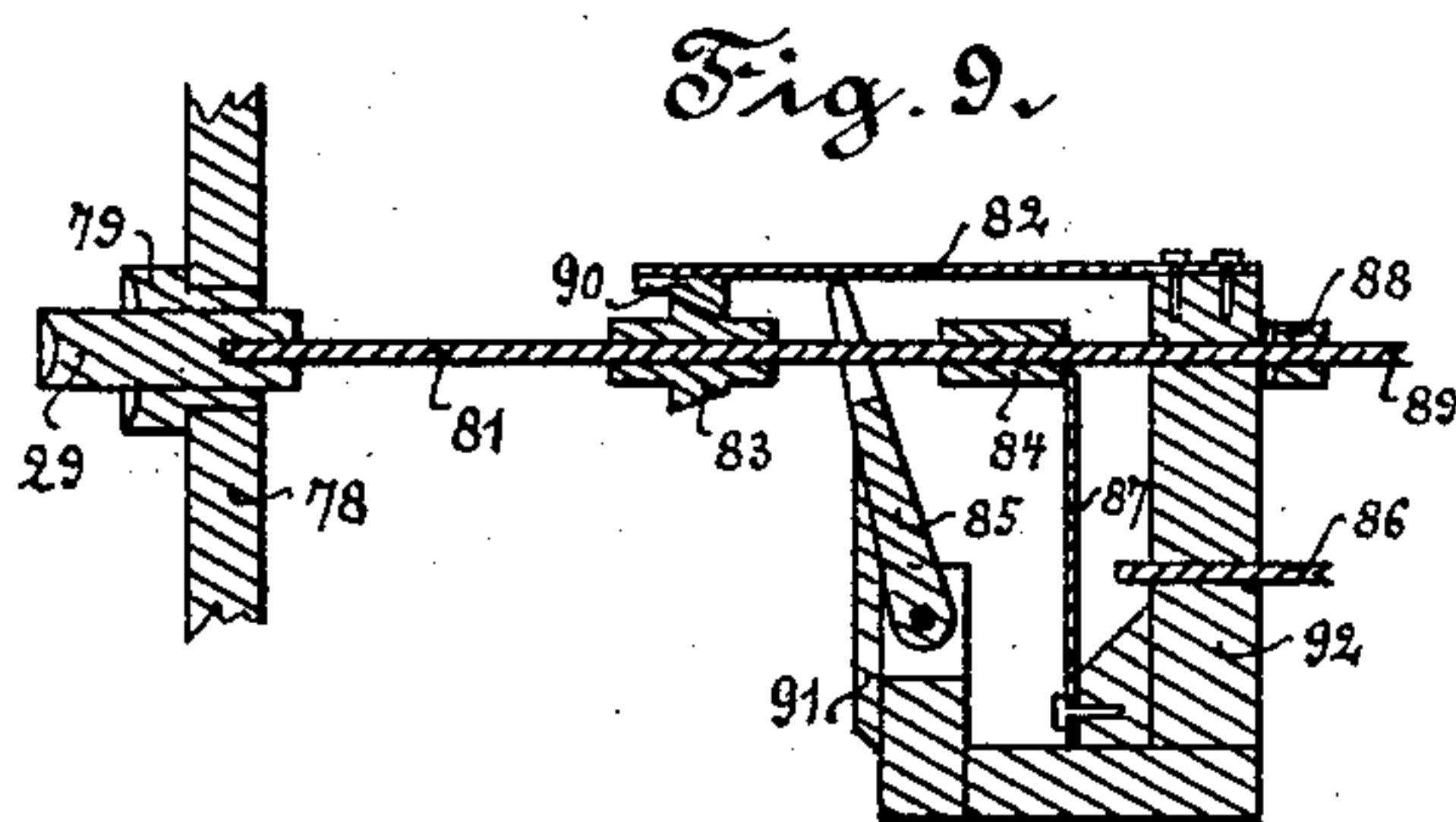
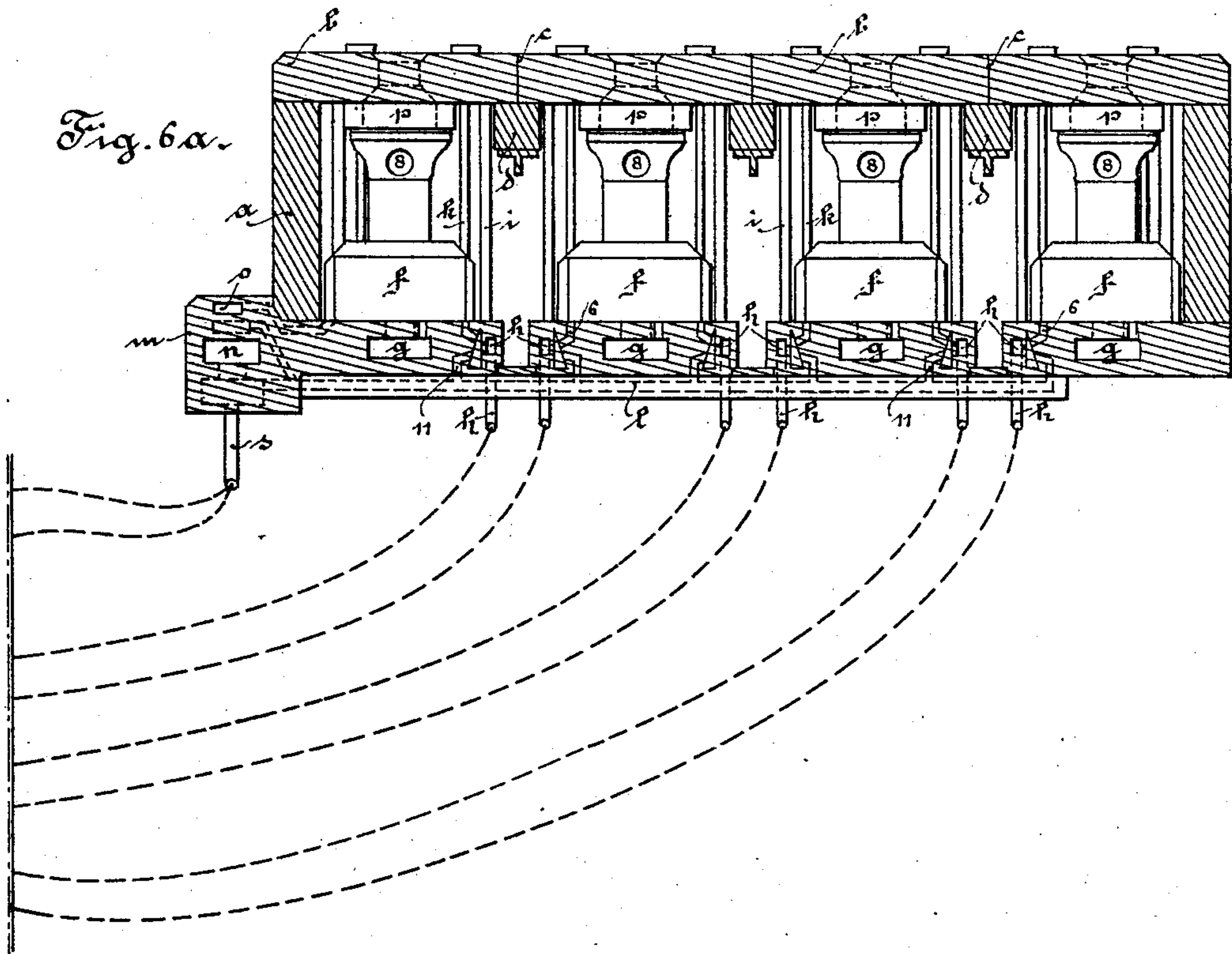
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Witnesses.

B. Vitzthum  
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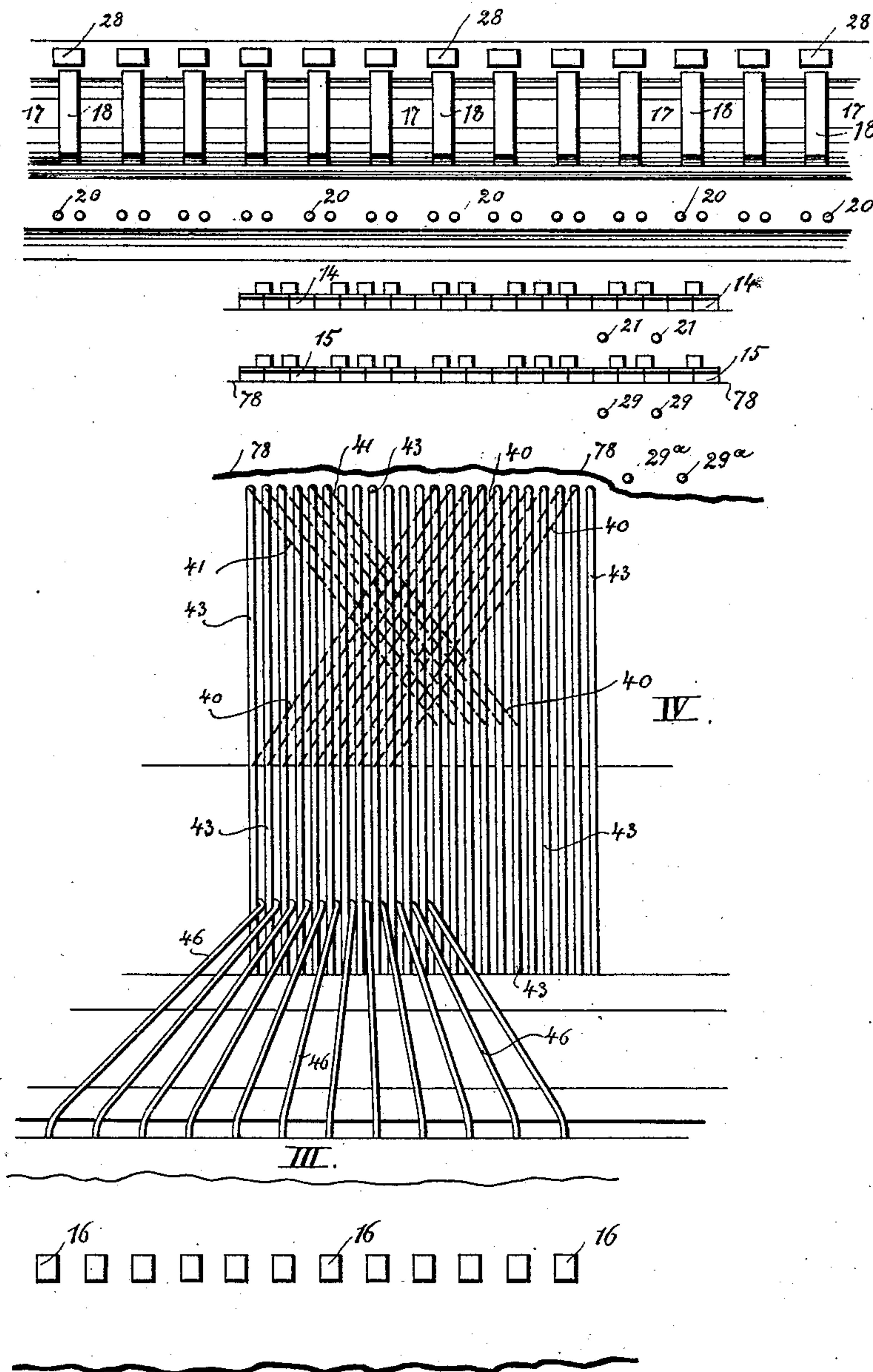
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Fig. 13.



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# UNITED STATES PATENT OFFICE.

GUSTAV SANDER, OF BRUNSWICK, BRUNSWICK, GERMANY.

## PNEUMATIC ACTION FOR ORGANS.

SPECIFICATION forming part of Letters Patent No. 367,666, dated August 2, 1887.

Application filed February 7, 1887. Serial No. 226,843. (No model.)

*To all whom it may concern:*

Be it known that I, GUSTAV SANDER, a subject of the Regent of Brunswick, in the German Empire, and a resident of the city of Brunswick, in the Dukedom of Brunswick, Germany, have invented certain new and useful Improvements in Organs, of which the following is a specification.

My invention relates to a construction of organs and similar musical instruments so that those mechanical devices may be dispensed with which have been used hitherto to cause the said musical instruments to sound, and by which devices the varieties of expression and power of tone are obtained—that is to say, to dispense with the register draw-stops arranged at the side or above the manual, and to effect by pneumatic action all functions hitherto executed by drawing or pushing these mechanical devices by hand, and thus to perform the different functions more rapidly and precisely and with greater accuracy, and also to render the playing on these instruments easier and more convenient.

With this view the invention consists, first, in a new and complete construction of a pneumatic wind chest, by the arrangement of the several parts of which, as well as by its simplicity and the insensibility to temperature, a positive action of all shut-off devices necessary to cause the pipes to sound is obtained; second, in a simple apparatus by which, through pipes of two inches in diameter, air is admitted to or let out of the wind-chest by means of the clavier, and that the desired locking devices of the pipe-holes are opened by the change of air-pressure; third, in a manual, instead of the actual register-stops, with a device to cause several registers at pleasure to sound or to be silent at the same time, the whole device being called "balance-register clavier;" fourth, in a pneumatic coupling of the different clavier to each other—that is to say, in a device by which the movements of any key of one clavier can be transmitted to the pipe of the other clavier. This coupling may also be such as to unite the voices of the clavier in octaves.

On the accompanying drawings, Figures 2 to 5 are given double the size of Figs. 1 and 6 to 8, and Figs. 9 to 12, showing details, are considerably larger than those first named.

Fig. 1 is a plan of the wind-chest and its connections with the clavier. The part A represents the wind-chest and its connections with the balance-register clavier, the pneumatic-action cylinders being taken off. The part B is a similar view. The part C represents the wind-chest, the cover being taken off in order to show the pneumatic action cylinders with the apertures for admitting air. The part D shows the cover provided with holes for the pipes. Fig. 2 is a longitudinal section of the wind-chest, following line E F in the half-size, Fig. 1. Fig. 3 is a section following line G H in Fig. 1, in larger size, it being supposed that each separate tone is used for one clavier only. Fig. 4 is a section, following line J K in Fig. 1, in larger size, the arrangement being so that the same tone can be caused to sound by one pipe-valve only, independently of one or the other of the clavier, or by both simultaneously. Fig. 5 is a longitudinal section following line L M in Fig. 1. Fig. 6 shows the arrangement of the mechanisms for playing on an upper manual, a lower manual, and a pedal, and their connections with the appertaining wind-chests. Fig. 6<sup>a</sup> is the cross-section of the pneumatic wind-chest, following line N O through Fig. 1, and its pipe leading to the balance-register clavier. Fig. 6<sup>b</sup> is a view of the wind-chest for the pedal and its connection with the mechanism of the balance-register clavier. Fig. 7 is a cross-section of the clavier-beam. Fig. 8 is a front view of the same. Figs. 9 to 11 represent the pressure-action on an enlarged scale, by which all voices can be caused to sound or to be silent—namely, Fig. 9 in repose, Fig. 10 after working, Fig. 11 at the moment of returning into repose. Fig. 12 represents a key of Fig. 6 considerably enlarged. Fig. 13 represents a front elevation of the organ.

The pneumatic wind-chest represented by Fig. 1 is supposed to be constructed for four register-pipes, and is arranged in such a manner as to allow of playing on all four registers by one manual, or of playing on two of these registers only by a second manual. The arrangement, however, may also be so that all registers or each of the same can be acted upon, directly and at pleasure, by a second or third manual.

As shown in Figs. 2 and 6<sup>a</sup>, the frame *a a*



of the wind-chest is closed at the top by the pipe-boards *b*, which rest on cross-beams *d* at their joints *c*. To increase the capacity of bearing at the cross-beams *d* they are provided  
5 underneath with angle-irons, in order to secure the pipes in an immovable and certain position.

The bottom of the wind-chest is formed by the valve containing boards *e*, upon which are  
10 fixed the pneumatic-action cylinders *f*, belonging to the relative register, the wind-chest being closed air-tight by this means. In these boards *e* are arranged the small air-channels *h*, communicating with the interior of the  
15 wind-chest, the channels thus being provided with air by the function of the register-keys. As soon as the entrance of air is shut off from the channels the relative register will be prepared for being played on, so that impulse  
20 given by the clavier acts upon all cylinders *f* communicating with the said channels. This arrangement is for providing each register with two or more channels, and for connecting the same with two or more clavier, and  
25 thereby rendering it possible to play on the relative register from different clavier independently.

In order to close the pneumatic-action cylinders *f* air-tight at both ends, stays *i* and  
30 screw-bolts *k* are provided, by means of which the board *e* and pipe-board *b* of the wind-chest can be connected with each other. Directly underneath the board *e*, crossing the wind-chest at the bottom, wooden ledges are placed,  
35 each of which contains for every key two channels, *l* and *l'*, the channels *l* belonging to one clavier and the channels *l'* to another clavier. The channels communicate at each tone and at each register with the interior of  
40 the cylinder *f*, situated above, and thus any change in filling these channels with organ-wind, or after its dispersion with atmospheric air, will act upon the interior of the cylinders *f*. At the outer side of the wind-chest is ar-  
45 ranged a controlling apparatus, *m*, containing the necessary valves for the entrance and escape of air.

Fig. 3 shows the interior of a cylinder, *f*, in its position in the wind-chest and its connection with the controlling apparatus *m*, provided with the channels *n* and *o* and two valves,  
50 *q* and *r*. In this figure a construction is supposed in which each single tone of a register can be used for one clavier only, while Fig. 4 represents an arrangement in which the same  
55 tone can be caused to sound independently of one or other of the clavier, or of both simultaneously, by one pipe-valve only.

As shown in Figs. 3 and 4, *y* is the bore in  
60 which the plunger *v* can play up and down easily, according as the cylinder is used for one, Fig. 3, or two clavier, Fig. 4. Bores 6, which lead into the upper part of the bore *y*, are arranged in such manner as to combine the  
65 top part of the plunger *v* with the exhaust-channel *l* by the air-duct 11. Above the bore

*y* the cylinder *f* is prolonged in the form of a thin cylindrical post, *x*, provided with a vertical bore, 7, and above the same with another bore, 10, through which the wind passes to  
70 the pipe-hole.

To prevent the compressed air which acts beneath the plunger *v*, Fig. 4, from passing over to the upper side of the same, a membrane, 4, of leather is attached to the lower  
75 side of the plunger. The rim of this membrane is glued over a ring, 5. A wire, 1, which passes through the plunger *v* and the bores 7 and 10 of the post *x*, is fixed at the lower side of the plunger *v* by means of a  
80 screw-nut. The upper end of this wire supports the valve *z*, by which an air-tight closure of the bore 10 can be effected. In the top of the post *x* two, three, or more bores, 8, are made, the number of the same varying accord-  
85 ing to the diameter of the said top. Thus if the wind-chest is filled with organ-wind the pressure existing below the valve *z* endeavors to lift the latter.

To prevent the valve opening of itself and the air from escaping, a weight, 2, corresponding to the weight of the plunger and to the diameter of the bore, is arranged on the upper  
90 side of the plunger *v*. This weight must be such as to allow the plunger *v* to rise easily and quickly as soon as air-pressure acts upon the same from below, Fig. 4, and in other cases to keep the hole 10 closed air-tight by the valve  
95 *z*, Fig. 3. As air of the same pressure acts not only through the bores 9, which lead from the bores 8 to the central bore, 7, (intended for wire 1,) upon the upper side of the plunger, but also through the channel *g* upon the lower  
100 side of the plunger, the latter will be kept down, if the weight 2 is properly regulated, and the hole 10 thus kept closed constantly.

As stated above, the plunger is provided with a membrane by which the pressure-air contained in the channel *g* is prevented from  
110 passing over the bore *y*, and is thus forced to act upon the lower side of the plunger *v*, while the upper side of the latter, during this action, comes in communication with the exhaust-channel *l*, through the air-ducts 6 and 11, as soon as the small valve 12 hangs down perpen-  
115 dicularly in the chamber 13, Figs. 3 and 4. The valve 12 serves to close either the bores 6 and 11, leading to the exhaust-channel *l* or the channel *h*, leading to the register.

The above-mentioned controlling or detach-  
120 ing apparatus *m*, Fig. 3, consists of two channels, *n* and *o*, the former of which is open at both ends, while the latter is closed, but remains in constant communication with the interior of the wind-chest through the air-  
125 duct *o'*, and is thus supplied with organ-wind. The exhaust-tube *l* is in communication with the air-duct *o* by the bore *w*. For each tone is arranged below the said channel *o* a separate little bore, which can be closed by a corre-  
130 sponding valve, *r*, and which remains open as long as no tone is produced.



Circular valves  $q$  are arranged in the interior channel,  $n$ , for each key. These valves are connected with the valves  $r$  by thin wires in such manner that the valve  $r$  closes the corresponding bore at the same time as the valve  $q$  opens the bore below it. Below the bore closed by valve  $q$  another larger bore,  $u$ , is provided, which bore has two divisions formed by a membrane,  $t$ . The upper division communicates with the exhaust-tube  $l$ , the lower with the tube  $s$ , which is led as far as the clavier. Tube  $s$  is filled with atmospheric air, the mechanism being in repose. The membrane  $t$  is connected to the lower end of the wire 1, which connects valves  $q$  and  $r$ , and therefore at the time with channel  $n$ . Supposing the wind-chest is filled with organ-wind, this wind will enter through the channels  $o'$   $o$ , the opened valve  $r$ , and the channel  $w$ , and the exhaust-tube  $l$ , whence it passes into the bore  $u$  and causes pressure upon the upper side of the membrane  $t$ , the lower side of which is acted upon only by light atmospheric air contained in the tube  $s$ . In fixed proportion to the greater diameter of exhaust-tube  $l$  compared with the bottom of valve  $q$  the membrane  $t$  is forced down. Thus the valve  $q$  is pressed upon its seat and the exhaust-tube  $l$  closed air-tight. If, now, one cylinder or all cylinders  $f$  are to be set in action, the exhaust-tube  $l$  must be put in communication with the upper side of the plunger  $v$ . This will be arrived at by opening the channel  $h$  at one end to allow the atmospheric air to enter said channel  $h$ . The small valve 12 rests on the hole which leads to the channel  $h$ , Figs. 3 and 4, and thus the air-ducts 11 and 6 are opened and a communication obtained between exhaust-tube  $l$  and the upper side of the plunger  $v$ . In a possible change of the air's weight in the tubes  $l$  this change will act upon the little plungers  $v$ , which are in connection with them by the said valves. On the pressing down of a clavier-key organ-wind is admitted into the corresponding tube,  $s$ . This wind enters below the membrane  $t$ , and air of the same pressure acts upon the upper surface of the membrane. Under these circumstances the air-pressure in the tube  $l$ , acting upon the bore  $u$ , suffices to lift valve  $q$ , by which the motive air enters the channel  $n$  and lifts at the same time the valve  $r$  in such a manner as to close channel  $o$  air-tight and to prevent the rushing in of wind from the wind-chest through the bore  $w$  to tube  $l$ . Therefore tube  $l$  is filled now with air of atmospheric pressure, which, as the valve 12 is open, passes through bores 11 and 6 to the upper side of plunger  $v$ ; but as at this moment the air beneath plunger  $v$  and beneath valve  $z$  is of greater density than the air above plunger  $v$  the latter is lifted with great velocity, whereby valve  $z$  is opened and the organ-wind allowed to pass through the bores 8 over to the pipe arranged above these bores. At the same time bore 7 is closed air-tight by the leather plate 3 on weight 2, so that the rushing in of

air at this point is rendered impossible, Fig. 4. As soon as the key is liberated atmospheric air enters again tube  $s$ , the air-pressure in the channel  $o$  opens valve  $r$  and allows the entrance of the compressed air through  $w$  and  $l$  into  $u$ , closing at the same time valve  $q$  by the descension of membrane  $t$ . Therefore the communication with atmosphere through channel  $n$  is cut off. The organ-wind passes again from  $l$  over plunger  $v$ , which falls now by the pressure of weight 2, drawing with it valve  $z$  and closing bore 10, so that the rushing in of air to the pipe ceases, Fig. 3. The closing of hole 10 by valve  $z$ —that is to say, the descension of plunger  $v$ —can be performed also, as the key is being pressed down, by allowing the organ-wind to pass into channel  $h$  by drawing a register. The air enters by valve 12 into chamber 13, and closing at the same time air-duct 11—that is to say, the communication between tube  $l$  and the space above the plunger  $v$ —it passes through 6 and enters the space over this plunger  $v$ , whereby the pressure from below is balanced, so that the plunger is pressed down by weight 2 and hole 10 closed by valve  $z$ . By the descending of plunger  $v$  the leather plate 3 on weight 2 opens immediately bore 7, and consequently allows wind enough to enter into the bores 9 and over the plunger  $v$ , so that its descension and the closing of hole 10 is secured in the same sure and precise manner as its opening.

Fig. 4 shows a cylinder arranged for two claviers. Channel  $h$ , on the right hand, is filled with wind. Therefore valve 12 closes tube  $l$ —that is to say, the way to the space over the plunger  $v$ . In this case it is not possible to play upon the register by using the relative clavier. On the left side, however, valve 12 is in such a position as to allow free communication through tube  $l$  to the space over the plunger  $v$ . Thus it will be possible to play upon the register. The air-duct 11 on the right discharging into tube  $l$  of one clavier, while air-duct 11 on the left is in communication with tube  $l$  of the other clavier, it will be possible to make one tone-sound and two claviers by using only one stream of air.

In Fig. 6 the pneumatic action apparatus I II III are shown, in a small size, in their construction, viz: for the upper manual, 14, for the under manual, 15, for the pedal, and their pneumatic couplings IV and connection with the wind-chests. It can be seen in Fig. 6 that pneumatic couplings IV join the apparatus II and III, and that instead of the usual stop-pulls there is a balance-register clavier, V, arranged above the manuals 14 and 15. The keys 18 to this clavier V are arranged on double-armed levers, Fig. 12, their surface forming with that of the manuals an angle of forty-five degrees, and in such manner as to allow of their being moved up and down about half an inch in the notches of the clavier beam, Fig. 7.

In proportion to the size of the organ, har-



monium, or other instruments of the same sort, the clavier-beam 17 can be of any length, and may project on both sides beyond the key-board of the manuals. Therefore it is easy to  
5 arrange fifty or more keys in one line. With a greater number of registers two claviers may be placed one above the other.

One, two, or more small knobs, 20, Fig. 8, are below each of the keys and serve to pre-  
10 pare the desired registers for whatever effect of tone or kind of sound is desired, by pushing in these knobs, so that all voices can be made to sound or to be silent by one pressure on the knobs 29, which are under the manual  
15 of the lower clavier, 15, by which action all registers played upon before remain still in readiness for playing on, as well after as before combination.

All registers played upon before can be  
20 caused to be silent simultaneously by means of the pressure-knob 29<sup>a</sup>, similar to those 29. Wind is prevented by tube 45 from entering channel 22, so that the tone-coloring prepared by the combination is alone heard. The knobs  
25 29 correspond with those, 20, which are placed below the keys 18. Two or three knobs, 21, are placed between the key-board of the upper manual, 14, and that of the under manual, 15, Fig. 6, according as to whether two or more  
30 preparation-knobs 20 are found under each register-key. These knobs 20 are always pushed off as they are pushed out by the double lever 27, mounted on a shaft, as soon as a combination is prepared by one or more knobs  
35 20. In case it is desired to stop this preparation for combinations, it requires only a slight pressure on one of the knobs 21 to force out all the corresponding knobs 20, which action will cause the preparation of the registers to cease.  
40 Small plates 28, of china, metal, or any other suitable material, with the names of the registers corresponding to the keys 18, are placed over them.

The clavier-beam, Fig. 7, consisting of three  
45 parts, 17, 30, and 31, screwed together, is provided with grooves 22, 24, and 25. Between these grooves is a small closed slit, 23, for each key, provided with a bore for tube 26. This tube 26 connects on its other end to the  
50 wind-chest of the great organ or pedal-organ, as shown in Fig. 6, connecting with the channel *h* of the wind-chest in a similar manner as that shown in Figs. 3, 4, and 5, for the channel *l*, consisting in a distributing-valve, by  
55 means of which the channel *h* is alternately connected with the wind-chest and the atmospheric air, so that when tube 26 is connected with the wind-chest the organ-wind opens the distributing-valve connecting channel *h* with  
60 the atmospheric air.

A small bolt, 32, having a longitudinal slit, 33, is jointed by a link, 19, to the one arm of register-key 18, Fig. 12. Such bolts are also  
55 to be found in the interior of the clavier-beam on the knobs 20, Fig. 6. The bolts 32 slide easily between the upper part, 17, and the

middle piece, 30, of the clavier-beam, the same as the bolts on the knobs 20 do between middle piece, 30, and under part, 31, of said beam. Slit 33 of bolt 32 communicates, Figs. 70  
6 and 7, with channel 22, through middle piece, 30, with slot 23, and the slits in the bolts of knobs 20, Fig. 6, communicate with those in the middle piece, 30, and under part, 31, of the clavier-beam. They thus join slot 23  
75 with channel 24 or channel 25, in accordance as to whether the first or the second knob is to work. Channel 22 is always supplied by organ-wind, while the channels 24 and 25 receive active wind only by the pressure on knob  
80 29. Therefore it can be worked only on such voices as are prepared by knobs 20 for combination purposes. In the case of stopping the admission of air by one of the said knobs the corresponding voices are silenced immedi-  
85 ately.

The register-keys 18, Fig. 12, are double-armed levers with the pivots in the middle, and project with their front ends about half  
90 an inch over the under edge of the vaulted clavier-beam, Fig. 6. It suffices to press slightly on the lower end of the key 18 in question to make the corresponding register ready to be played upon. On the contrary, a slight pressure at the upper end is sufficient to  
95 get the register out of action.

For combination purposes, two knobs have hitherto been arranged, namely, either for sounding or for being silent, so that one knob  
100 produces a contrary effect to the other, or one knob is arranged for detaching the others. For instance, the third detaches the second, the fourth the third, and the first both the fourth and second. All these arrangements are very inconvenient for the performer, and  
105 are now entirely replaced by the knob contrivances, Figs. 6, 9, 10, and 11, described hereinafter. Instead of the usual stop-pulls, the present invention makes use of the balance-register clavier, Fig. 6, which has as many  
110 keys 18 as the organ has registers and couplers.

Figs. 9 to 12 represent details for the knob arrangement 29 in a larger size. As may  
115 be perceived in Fig. 9, knob 29 can slide in box 79, which is made of ebony or other suitable material and attached to clavier-board 78. At the interior end of knob 29 a wire, 81, is fastened, and wooden nuts 83, 84, and 88 are attached. The nut 83 when in repose has its  
120 oblique bevel in perpetual contact with stop-pin latch 90 on spring 82. When the knob is pushed in, this latch slides over the bevel of nut 83. Spring 87, pressing on nut 84, now reaches also the adjusting-screw 86 and the  
125 performer is conscious of a perceptible resistance, by which he knows that the stoppage is effected and that on the withdrawal of his finger knob 29 and those devices connected with it cannot return to their former position,  
130 Fig. 11. By pushing in knob 29 the movable wooden arm 85, which at first was lying on 91,



lifts spring 82, provided with latch 90, and remains in a fixed position to this spring. At the moment of stopping, female screw or nut 83 reaches the arm 85, Fig. 10. A slight pressure only on knob 29 suffices to cause the registers in readiness by knobs 20 to sound, and to continue this sounding in the position arrived at, Fig. 10.

As already mentioned, organ-wind is found in the channels 24 and 25 only when its entrance is effected by knob 29—that is to say, by pressing down this knob.

Wire 81 is firmly connected with a bolt, which is arranged precisely in the same manner as bolt 32, already described, Fig. 12, and leads, according to the number of contrivances for combinations in each register, into one, two, or three channels, 80, which are in the ledge, Fig. 6. These channels are always filled with organ-wind, and communication is established between them and the channels 24 and 25, or, as it is shown in the drawings, with one of them, by slots in the bolt, which slots agree with tube 44. By the pressure on knob 29 the said slots will be free and the organ-wind can pass without obstacle through tube 44 into channel 24 or channel 25. If it is desired to silence the registers, the pressure on knob 29 must be repeated a little harder, by which action wire 81 is pushed rather more. Nut 83 now draws with it arm 85, which lifts spring 82 little by little until wire 81 and said arm 85 form a right angle, Fig. 11, and spring 82 is in such a position that nut 83 can pass freely under latch 90, by which movement the pressure devices are detached and brought back to their former state. By releasing knob 29 metal spring 87 causes wire 81 to spring back. Spring 82 is held up by arm 85 until latch 90 reaches its former position behind female screw 83, Fig. 9. Knob 29 is thrust out until wooden nut 88 touches ledge 92.

The pneumatic-action apparatus I II III (represented in Fig. 6) consists chiefly of the cases 58, 59, and 60, which when used are filled with organ-wind. For each key corresponding circular metal valves, 61 62 63 64 65, are found in the cases, and the weight of such valves is so calculated that the touching of the clavier is rendered easy and precise. Beneath these cases and under said valves other metal valves, 53, of half the size but the same number, are arranged and connected by wire with valves 61 62 or 63 64 or 65, respectively, and with the corresponding levers 66, 67, and 68. Both valves are adjustably fixed on a pushing-wire, 69, 70, or 71, which is arranged with the top and in a perforated ledge, and with the bottom end is guided in the small lever in such a manner that valves 61 62 or 63 64 cover and close the bore beneath, and valve 53 that above it. To insure a good closing of the bores and an elastic touch on the clavier, the valves are provided with felt or leather. Levers 66, 67, and 68 are either in direct con-

tact with the keys or they are connected with their corresponding keys by wire.

The working of the apparatus is as follows: When a key is pressed down, one of the metal valve pair 61 62 or 63 64 or valve 65 opens the bore beneath, while valve 53 at the same time closes the small bore above. Valve 53 already closes this bore when valves 61 62 or 63 64 or 65 are lifted about one twenty-fourth of an inch, but by the elasticity of the felt or leather valve 53 allows the lifting of the other valves one-eighth of an inch or more. Organ-wind is admitted by opening valve 65 into the bore underneath it and into leading-tube 39, and according as one or the other clavier is to be played on the wind will enter into tube 37 or 38. As the tubes 37, 38, and 39 need only to be connected with air-ducts—that is to say, to establish communication between the pneumatic-action apparatus and its corresponding wind-chest—it is of no consequence how or where the clavier is arranged in the organ, if there are two, three, or more clavier, and if two, three, or more pneumatic-action apparatus are placed one above the other connected with their corresponding clavier. A diameter of one-fourth of an inch is sufficient for all air-ducts to connect wind-chest and pneumatic-action apparatus, even supposing the greatest distance occurring in practice to be between them, the tones will be repeated correctly and entirely.

Pneumatic coupling apparatus IV, consisting, substantially, of a thin wooden board, 34, of the same length as the clavier, is arranged below the pneumatic-action apparatus I and II. For each key compartments 35 and 36 are cut in board 34. Tubes 37 and 38 lead the first from compartment 35, the second from 36 to tubes of the common wind-chest of the great and the upper organ. If these organs have each a separate wind-chest, tube 38 leads then into the wind-chest of the great organ and 37 into that of the upper one. Air-ducts 40 41 42, cut into wooden plates, lead to the compartments 35 and 36, air-duct 42 discharging into bore 50 of action apparatus II, intended for the upper organ, while the air-ducts 40 and 41 communicate with bore 49 of apparatus I for the great organ. Besides this, bore 49 is connected directly by air-duct 43 with compartment 36, and therefore, also, with tube 38. Air-duct 41 is so arranged, and with the compartment 35 and air-duct 37 so connected, that the bass C of the upper organ and the C of the great organ are combined. This air-duct, coming from the first clavier of apparatus I, discharges into the thirteenth cell of compartment 35. For instance, if wind be admitted through the first valve, 61, into air-duct 41 of apparatus I, it will enter the thirteenth air-duct, 37. Striking, now, the first tone of the lower clavier, the thirteenth tone of the upper organ will sound, and the same happens in a corresponding manner with all the rest of clavier 14 and 15. Concerning the



pneumatic-action apparatus III, serving for the pedal-organ, an air-duct, 46, leads to the cell 52, which branches off to the outlets 48 and 47, the first leading to compartment 35 of the upper organ and the second, 47, to cell 36 of the great organ. In order to keep the apertures 40, 41, 42, 43, 47, and 48 continually open, the valves of the air-ducts discharging into the compartments 35 and 36 are so arranged that they hang down freely.

Orifices 42 and 43, which serve for direct communication only with the air-duct 37 or 38, respectively, are provided with valves only to prevent the wind after entering by another air-duct from returning by 42 or 43 to the pneumatic-action apparatus, and from rushing out by the open valve 53 beneath. Behind the compartments—that is to say, cells 35 and 36—are long straight channels 54, 55, 56, and 57, which are closed on one side and divided in their middle by adjustable leather plates. These plates are provided with wire rods, which push the corresponding valves hanging over the apertures 40, 41, 47, and 48. The right-hand compartment of these channels 54, 55, 56, and 57 is always filled with organ-wind as long as the bellows are working. At the time of this action the valves are pressed closely on the apertures by the wires, for preventing the rushing in or out of wind through them. If, now, one of the pneumatic couplings is to be set in action, organ-wind must be let in on the left side of the leather plate—that is to say, the side where are the pins or wire rods, and this plate will take the position as in 54 and 56. The wire connected with the leather plate liberates the corresponding valve, as shown, before the orifices 41 and 48—that is to say, opens the aperture and allows the action-wind entering the corresponding air-ducts and setting in action the pneumatic apparatus appertaining thereto. If organ-wind be let into the right-hand division of the channels by a suitable arrangement, so that the leather plates take the position as shown at 55 and 57, the coupling is thereby put out of action.

Having thus described my invention, what I claim is—

1. In organs with pneumatic action, the

regulating-valve chest *m*, containing the channels *n* and *o*, the air-ducts *o'*, *w*, and *u*, the valves *q* and *r*; connected by means of a wire to the elastic partition-walls *t*, in combination with the wind-chest of the organ, the exhaust-channels *l l'*, tubes *s*, and cylinders *f*, as and for the purposes herein shown and described.

2. The balance-register clavier V, consisting of the register-keys 18 and their connections 19 and 32, mounted in the clavier-beam 17 30 31, containing the grooves 22, 24, and 25, and the slits 23, connecting by tubes 26 with the channels *h*, the knobs 20 21 and their connections, and the levers 27, in combination with knobs 29 and their connections 81 83 84 88, box 78, nut 83, spring 82, carrying stop-pin 90, spring 87, and lever 85, with knobs 29<sup>a</sup>, tubes 45, and with the apparatuses I, II, III, and IV, as and for the purposes herein shown and set forth.

3. The coupling apparatus IV, consisting of a chest, 34, with compartments 35 36, connecting with the tubes 37 and 38, respectively, air-ducts 40 41 42 43 46 47 48, valves leading into compartments 35 and 36 and operated from the channels 54, 55, 56, and 57, said valves connecting with an elastic partition, dividing said channels by means of a connecting-wire, in combination with the pneumatic-action apparatuses I, II, and III, as and for the purposes herein shown and described.

4. In organs with pneumatic action, the cylindrical post *f*, provided near its upper end with the channels or bores 7 8 9 10, the piston *v*, carrying weight 2 and washer 3, and connected to valve *z* by rod *i*, the membrane 4 and ring 5, in combination with the wind-chest *a b d e*, containing the channels *g l l' h* 11 6, chambers 13, and the valve 12, as and for the purposes herein shown and set forth.

Signed at Brunswick, in the Dukedom of Brunswick, this 15th day of November, A. D. 1886.

GUSTAV SANDER.

Witnesses:

HANS BAUTLER,  
O. KAHUT.