No. 697,980. Patented Apr. 22, 1902.

J. CARPENTIER.

AUTOMATIC MUSICAL INSTRUMENT.

(Application filed Dec. 17, 1900.)

(No Model.) 8 Sheets—Sheet 1.

Fig. 1.

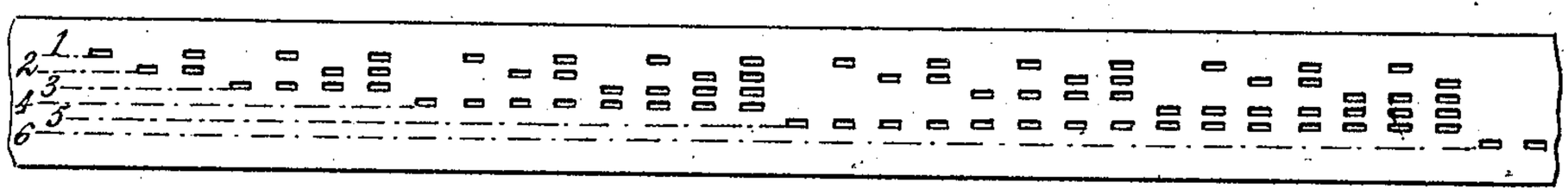


Fig. 6.

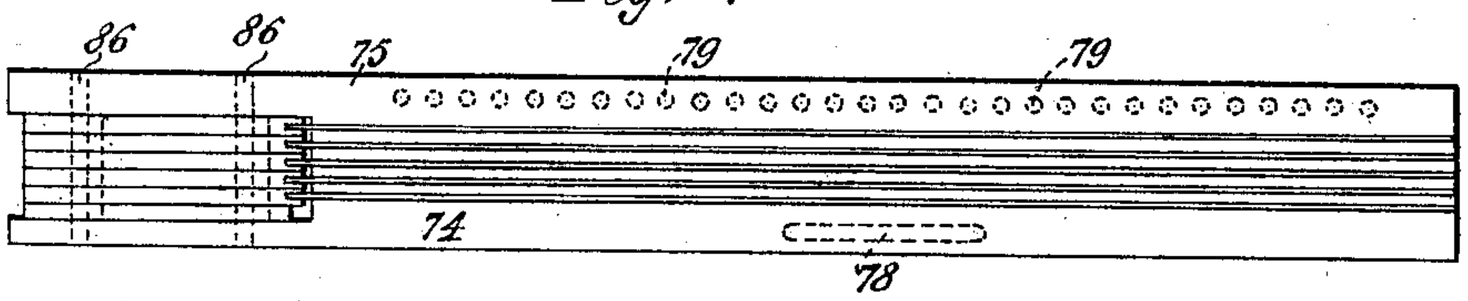


Fig. 7.

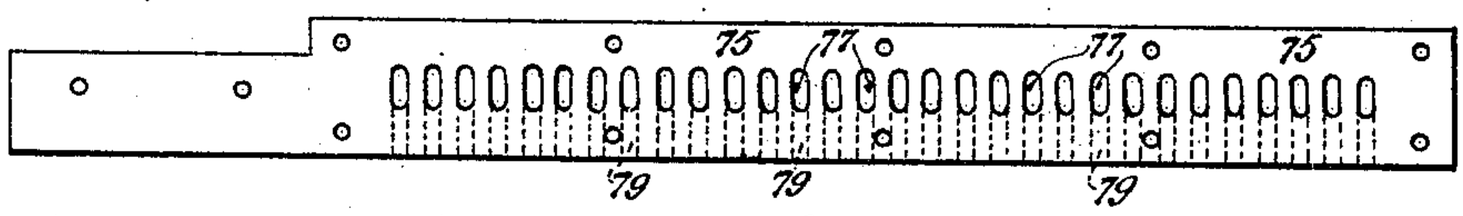


Fig. 8.

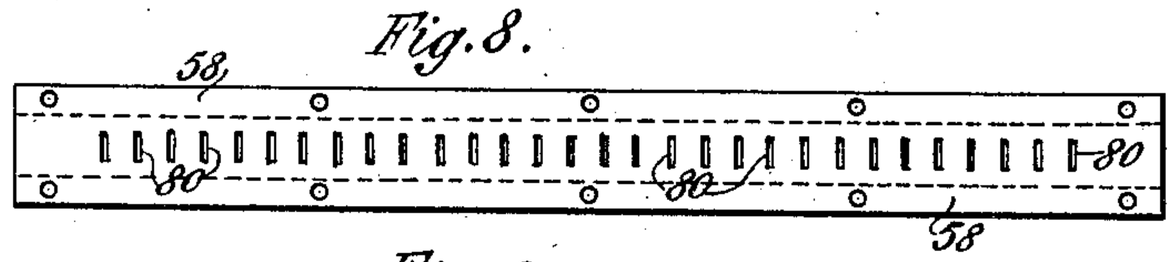


Fig. 9.

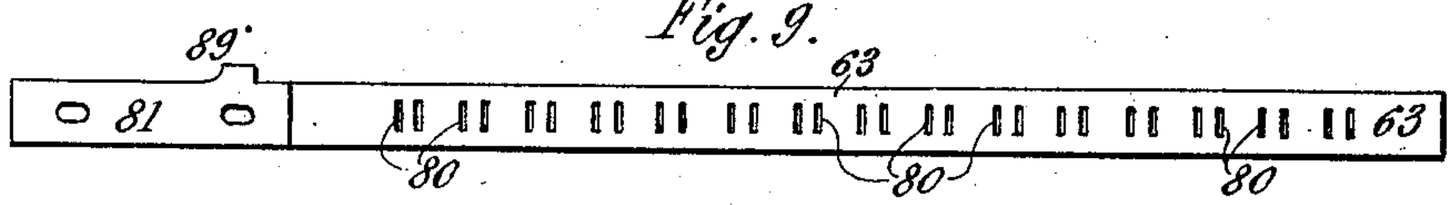


Fig. 10.

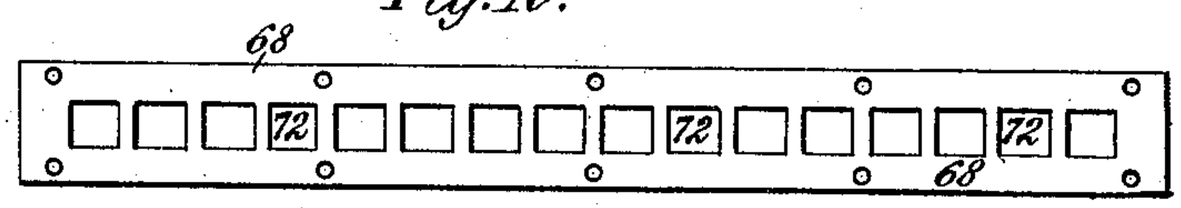


Fig. 11

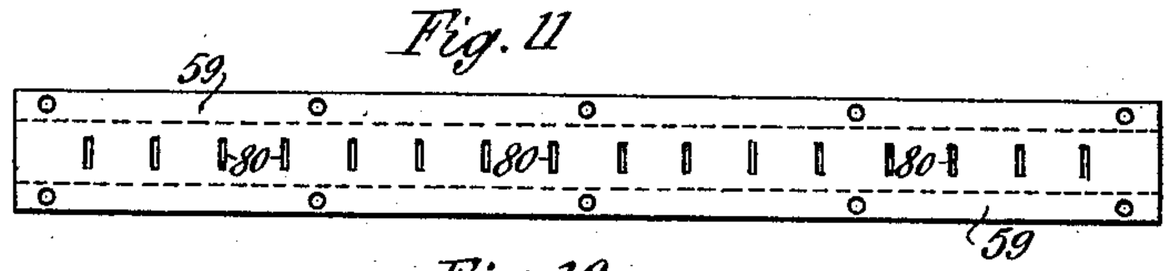
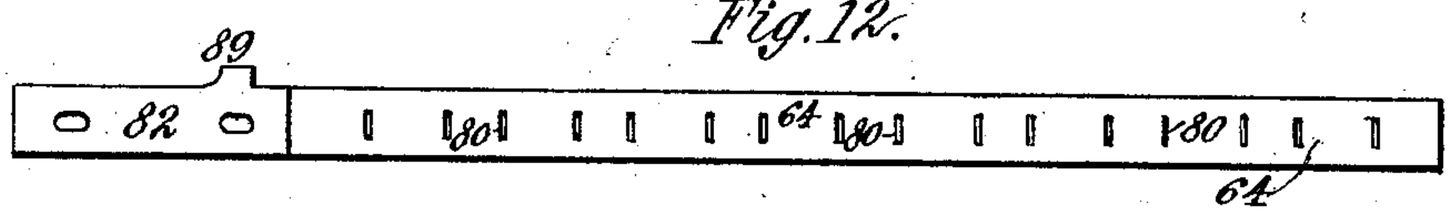


Fig. 12.



WITNESSES:
Fred White
Thomas F. Wallace

INVENTOR:
Jules Carpentier,
By his Attorneys:
Arthur G. Fraser & Co

No. 697,980. Patented Apr. 22, 1902.

J. CARPENTIER.

AUTOMATIC MUSICAL INSTRUMENT.

(Application filed Dec. 17, 1900.)

(No Model.) 8 Sheets—Sheet 2.

Fig. 2.

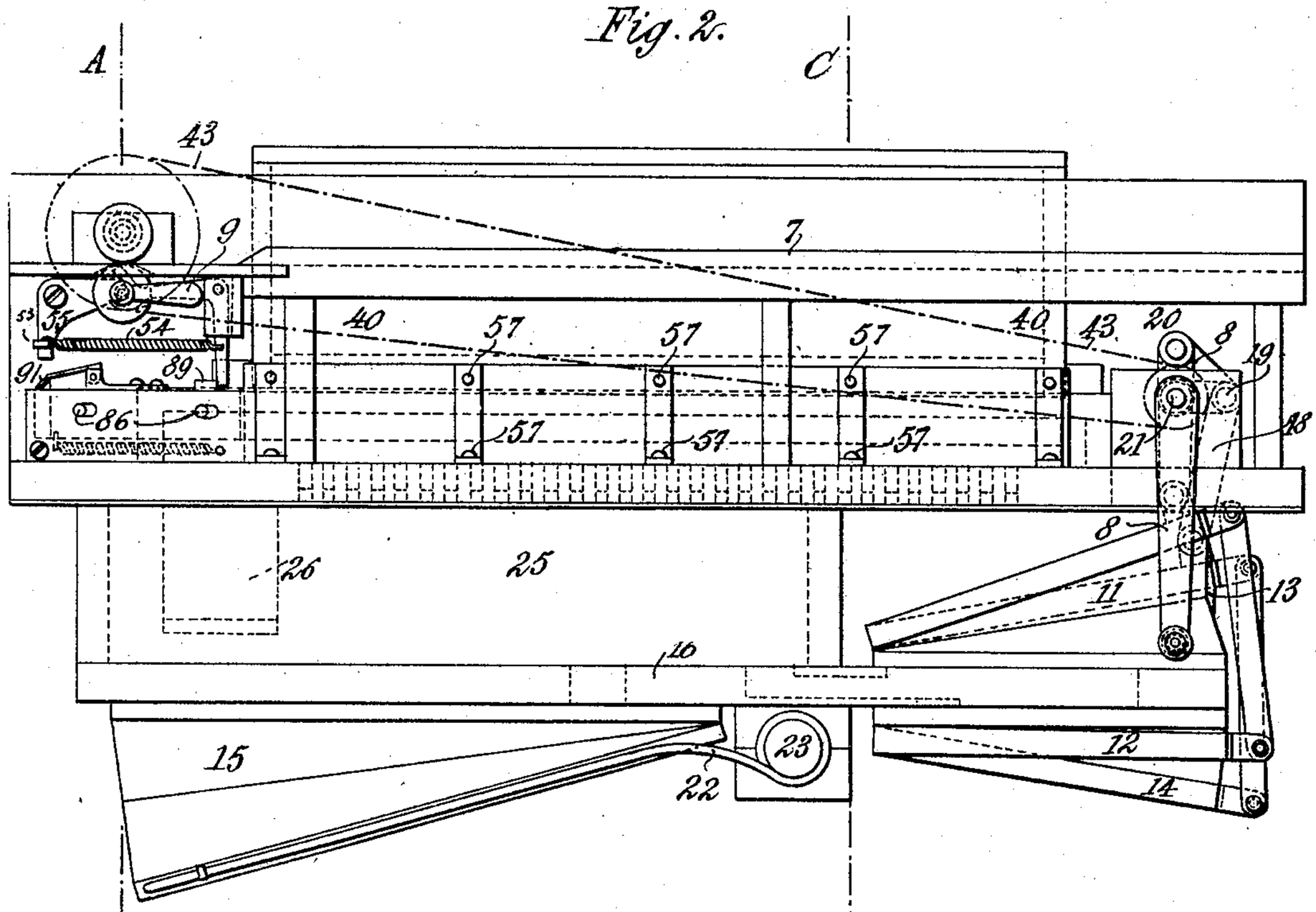
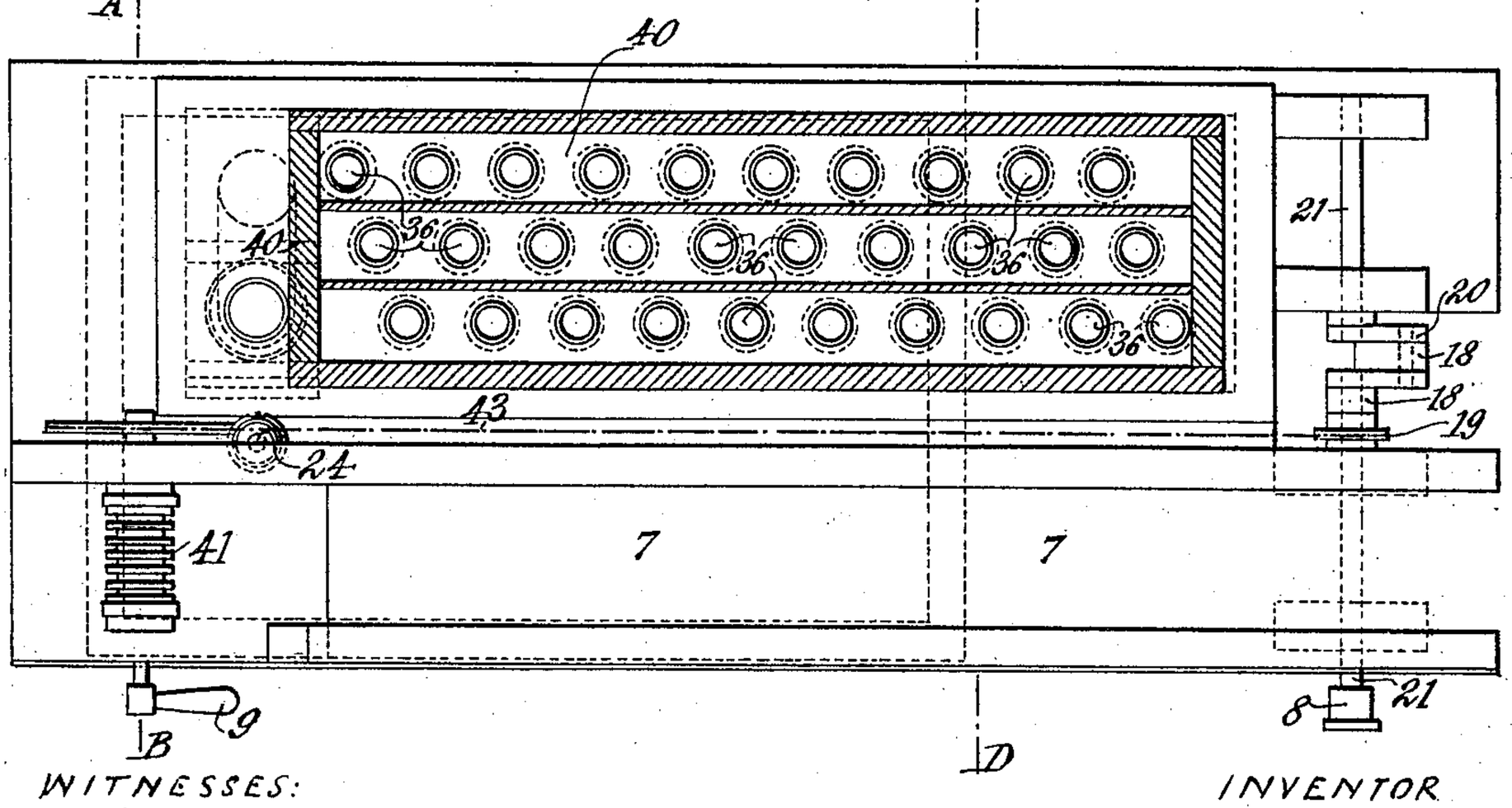


Fig. 3.



WITNESSES:
Fred Whitty
Thomas J. Wallace

INVENTOR
Jules Carpentier,
By his Attorneys:
Arthur C. Fraser & Co.

No. 697,980. Patented Apr. 22, 1902.

J. CARPENTIER.

AUTOMATIC MUSICAL INSTRUMENT.

(Application filed Dec. 17, 1900.)

(No Model.) 8 Sheets—Sheet 3.

Fig. 4.

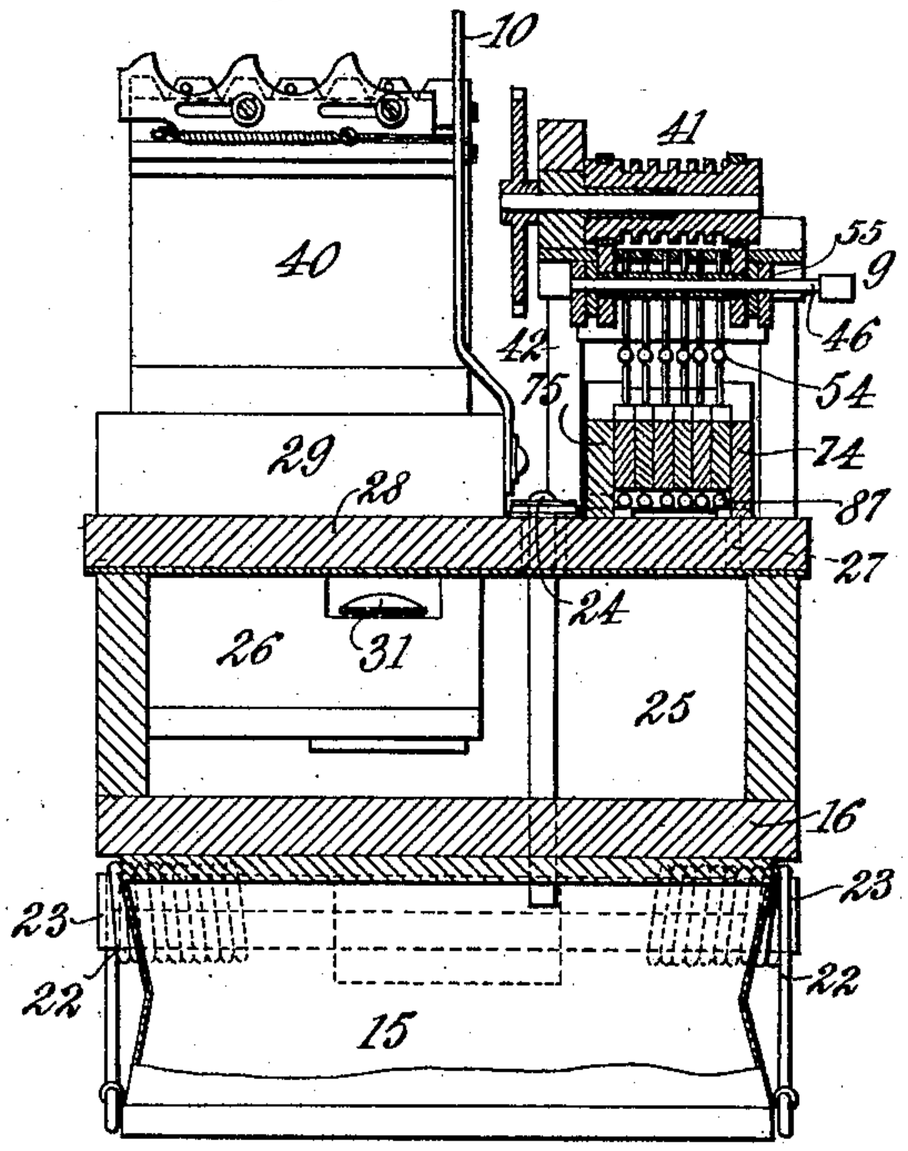


Fig. 4a.

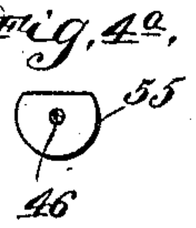
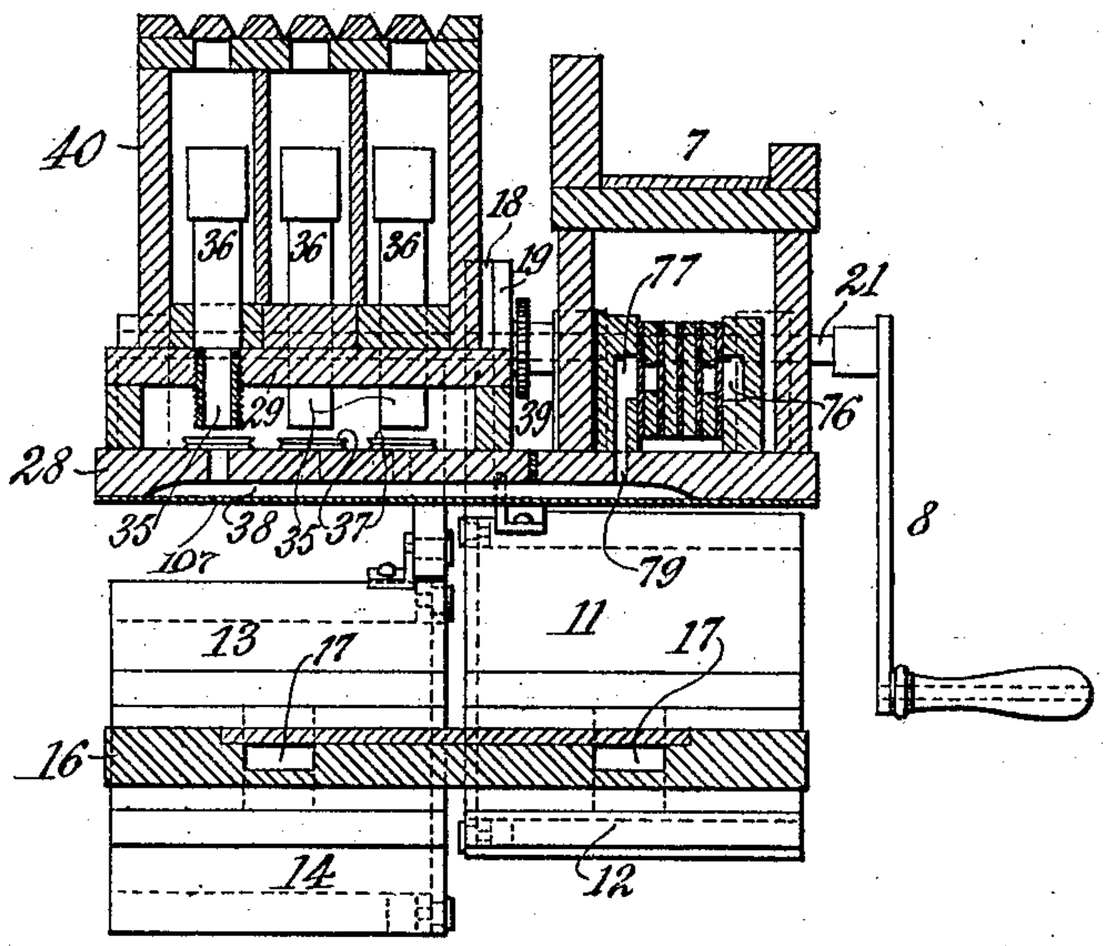


Fig. 5.



WITNESSES:
Fred Whitte
Thomas L. Wallace

INVENTOR:
Jules Carpentier,
By his Attorneys:
Arthur C. Fraser & Co.

No. 697,980. Patented Apr. 22, 1902.

J. CARPENTIER.

AUTOMATIC MUSICAL INSTRUMENT.

(Application filed Dec. 17, 1900.)

(No Model.) 8 Sheets—Sheet 4.

Fig. 13.

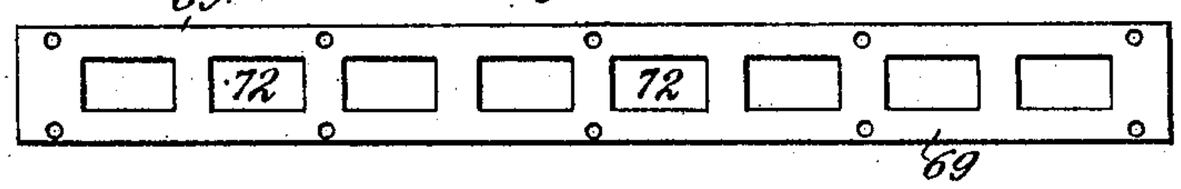


Fig. 14.

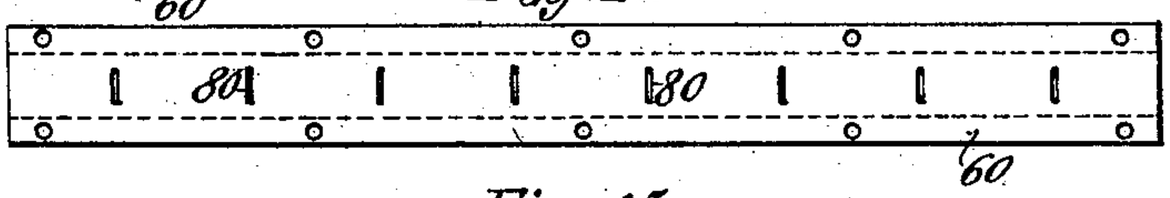


Fig. 15.

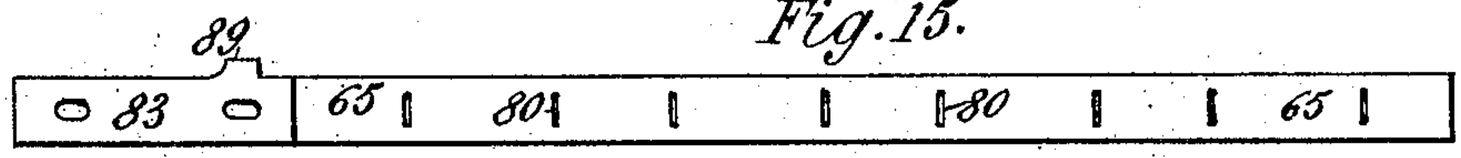


Fig. 16

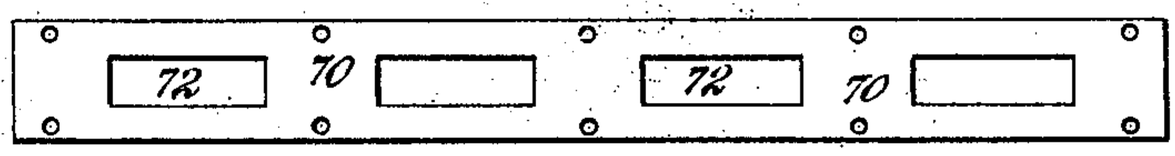


Fig. 17.

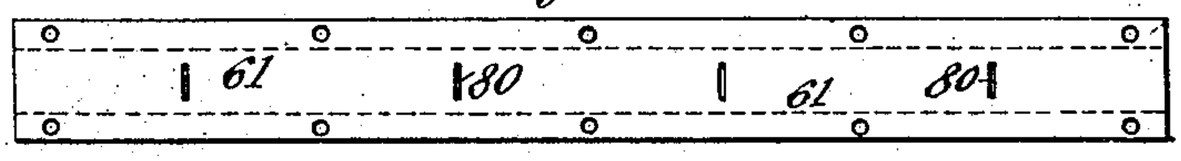


Fig. 18.

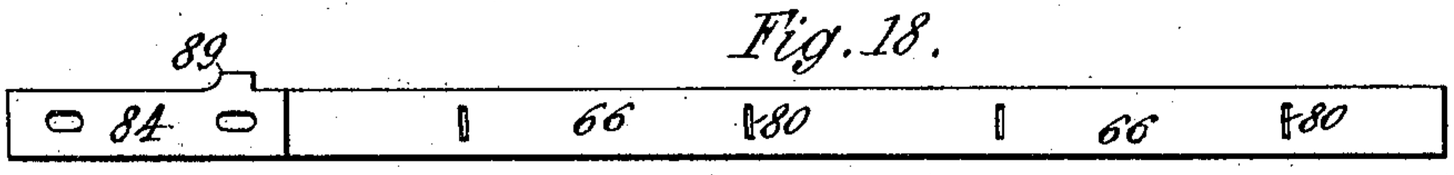


Fig. 19.

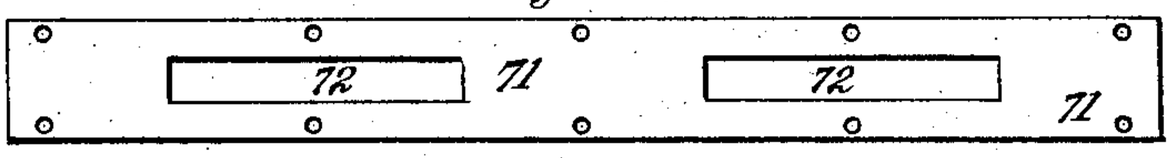


Fig. 20

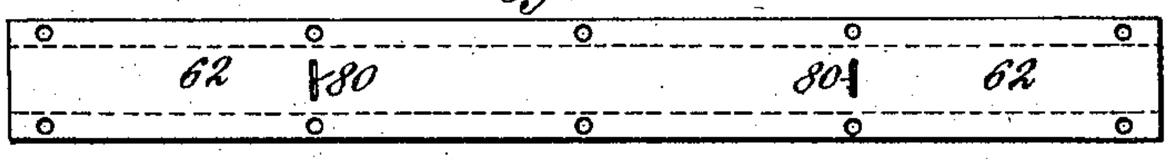


Fig. 21.

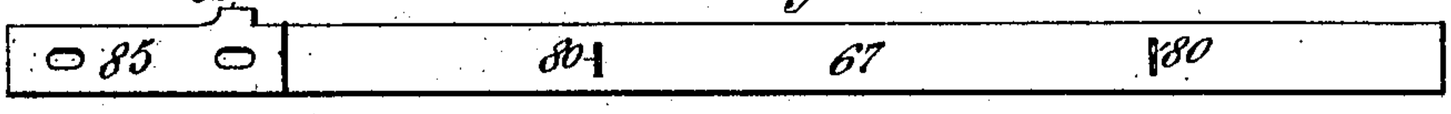
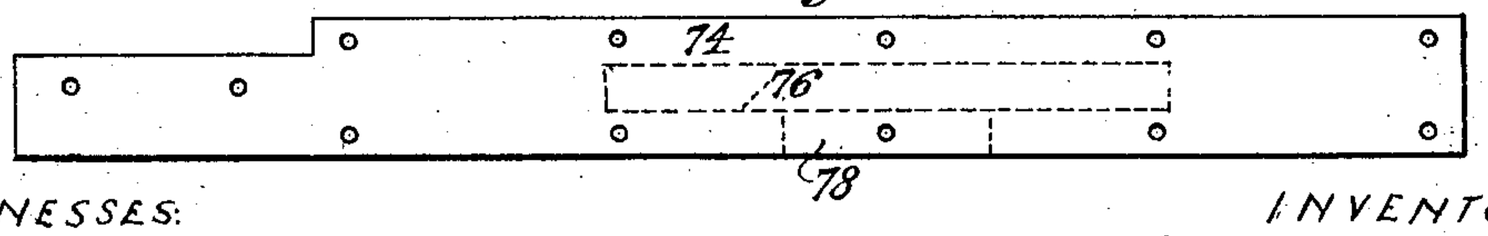


Fig. 22.



WITNESSES:
Fred Whitg
Thomas Wallace

INVENTOR:
Jules Carpentier,
By his Attorneys:
Arthur C. Fraser & Co

No. 697,980. Patented Apr. 22, 1902.

J. CARPENTIER.

AUTOMATIC MUSICAL INSTRUMENT.

(Application filed Dec. 17, 1900.)

(No Model.) 8 Sheets—Sheet 5.

Fig. 23.

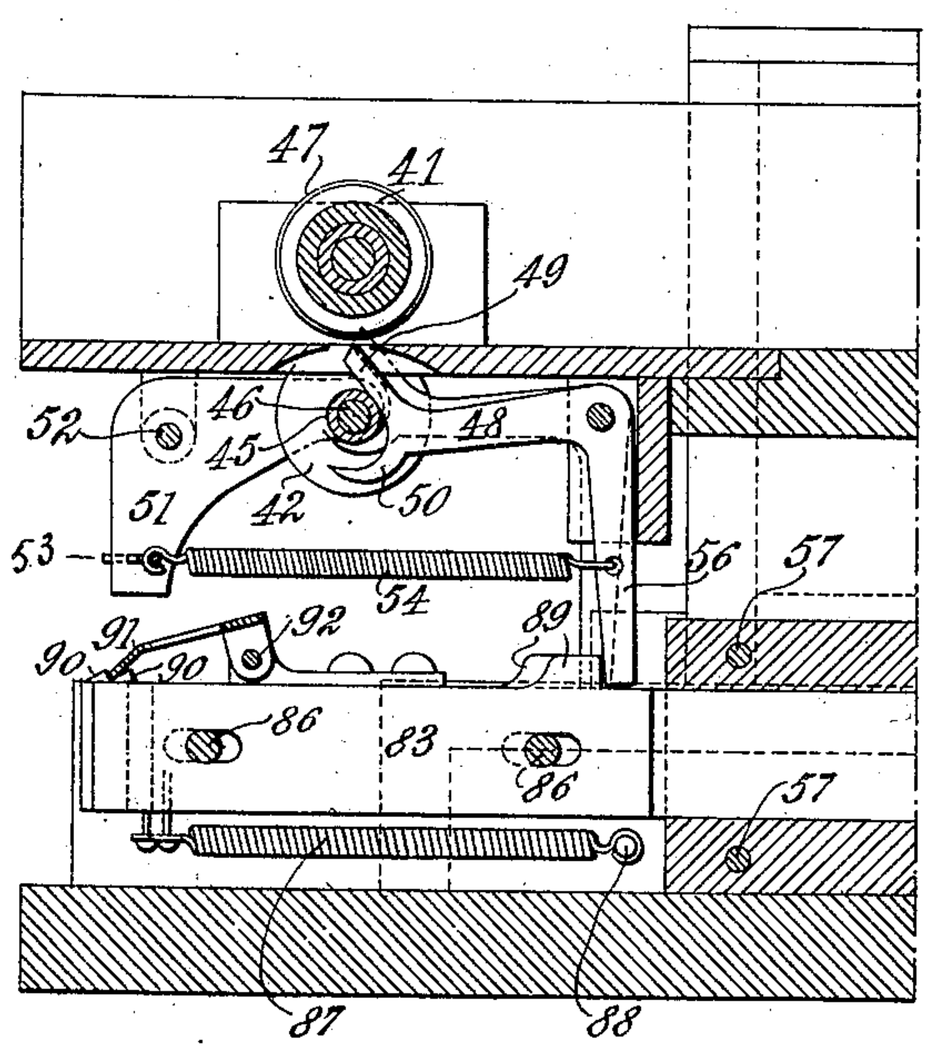


Fig. 24.

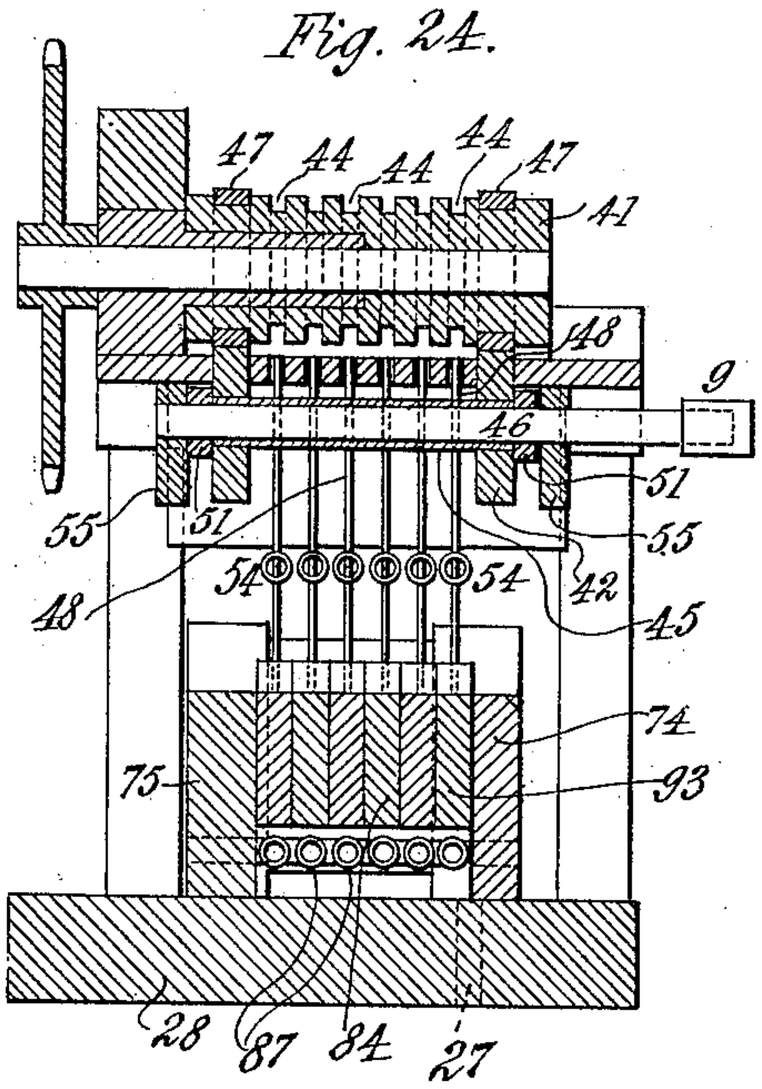


Fig. 25.

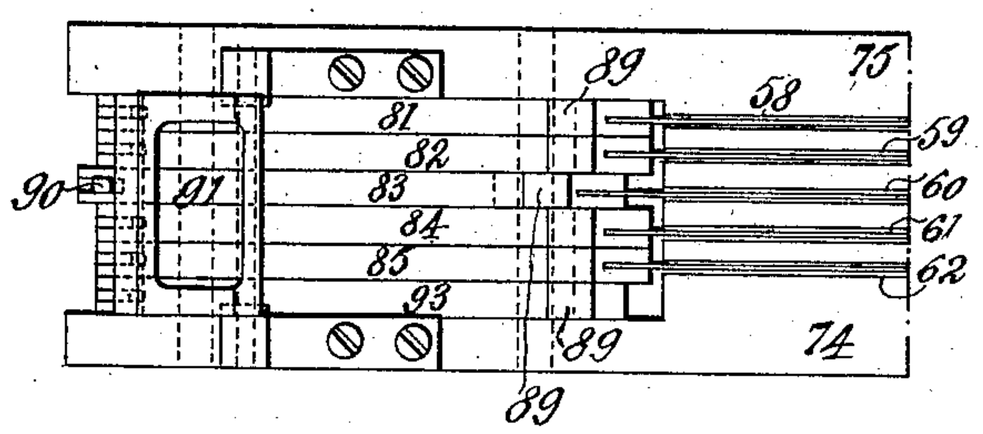
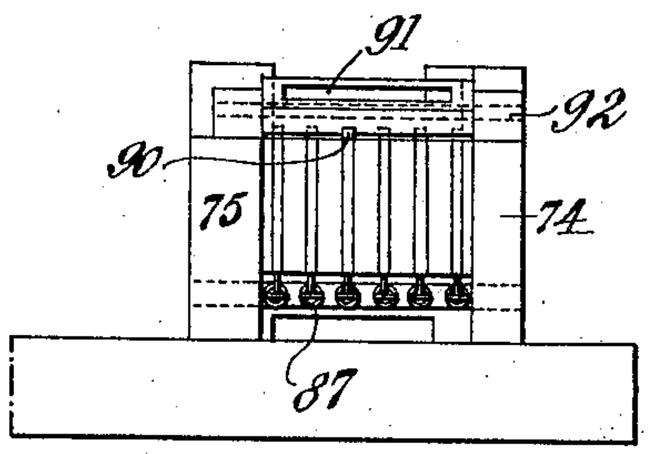


Fig. 26.



WITNESSES:

Fred White

Thomas F. Wallace

INVENTOR:

Jules Carpenter,

By his Attorneys

Arthur O. Fraser & Co.

No. 697,980. Patented Apr. 22, 1902.

J. CARPENTIER.

AUTOMATIC MUSICAL INSTRUMENT.

(Application filed Dec. 17, 1900.)

(No Model.) 8 Sheets—Sheet 6.

Fig. 29.

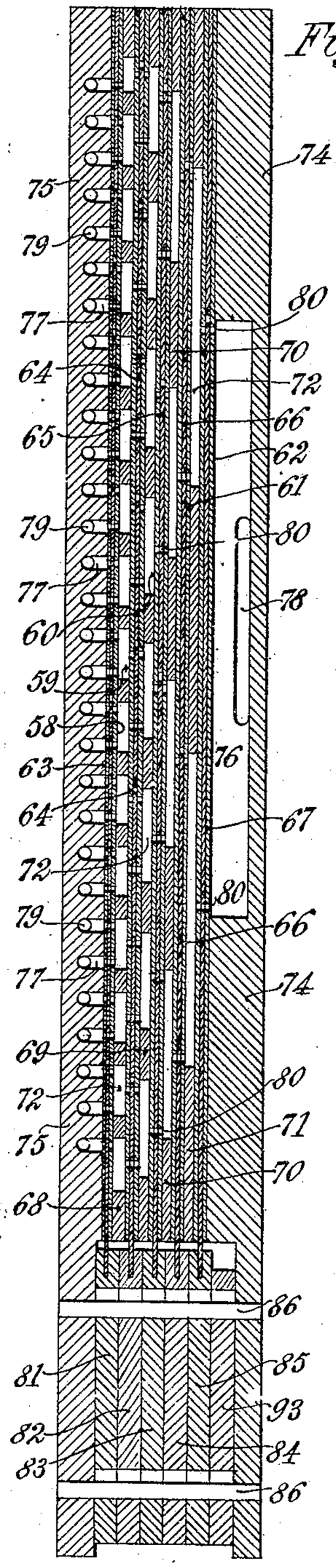


Fig. 30.

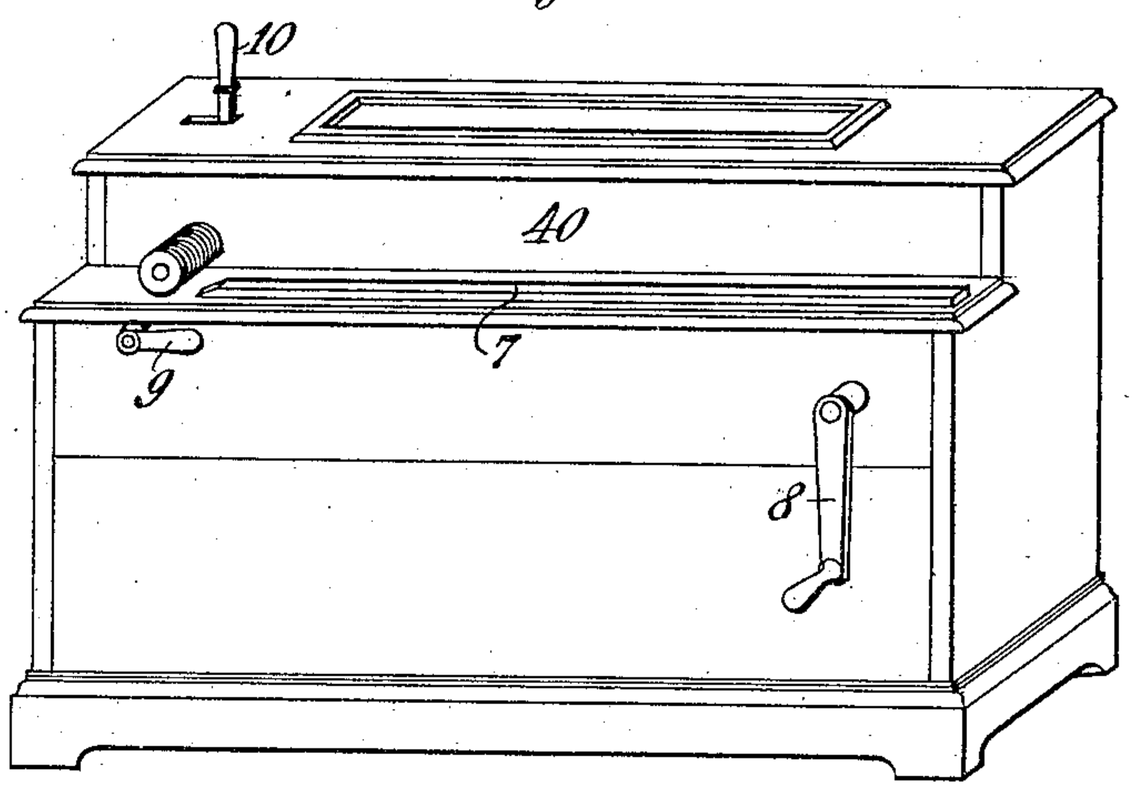


Fig. 27.

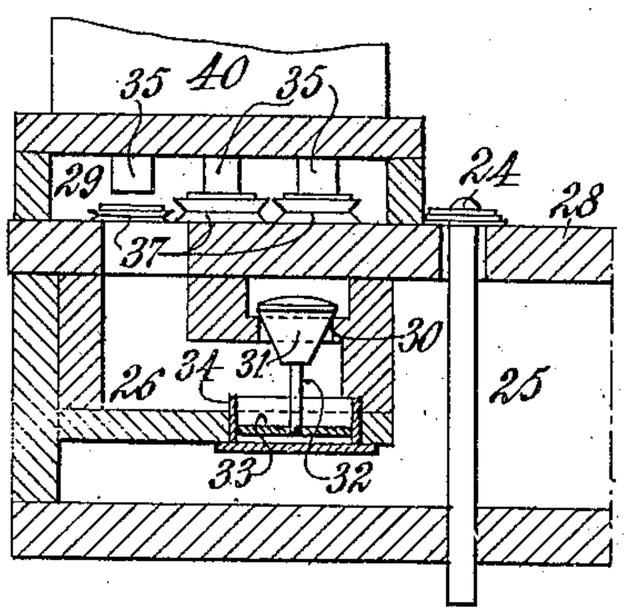
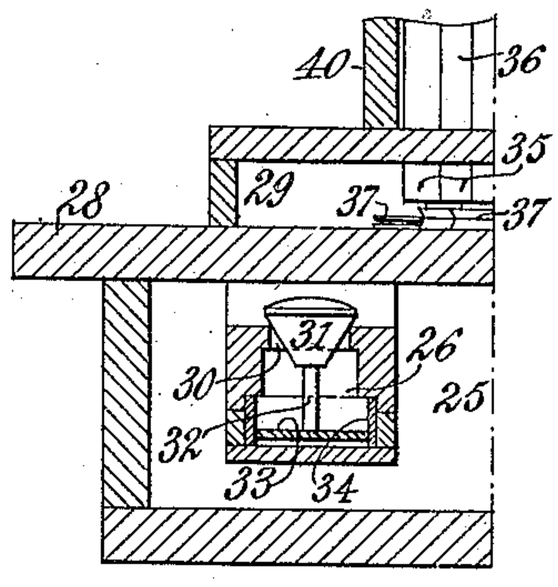


Fig. 28.



WITNESSES:
Fred Whitg
Thomas F. Wallace

INVENTOR:
Jules Carpentier,
By his Attorneys:
Arthur G. Draper & Co.

No. 697,980. Patented Apr. 22, 1902.

J. CARPENTIER.

AUTOMATIC MUSICAL INSTRUMENT.

(Application filed Dec. 17, 1900.)

(No Model.) 8 Sheets—Sheet 7.

Fig. 31.

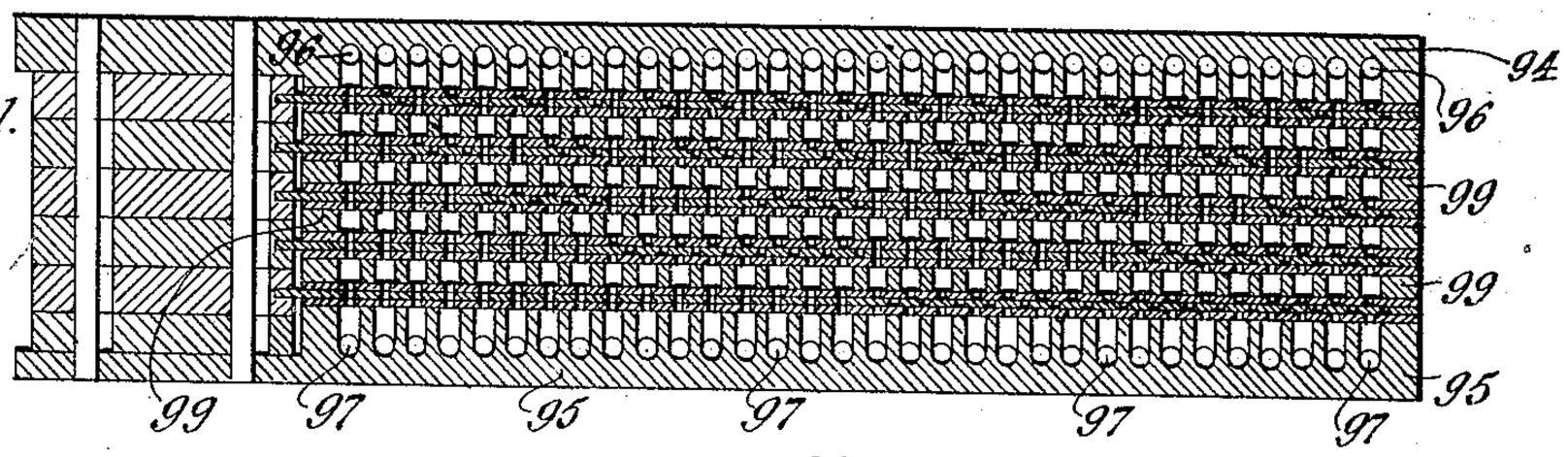


Fig. 32.

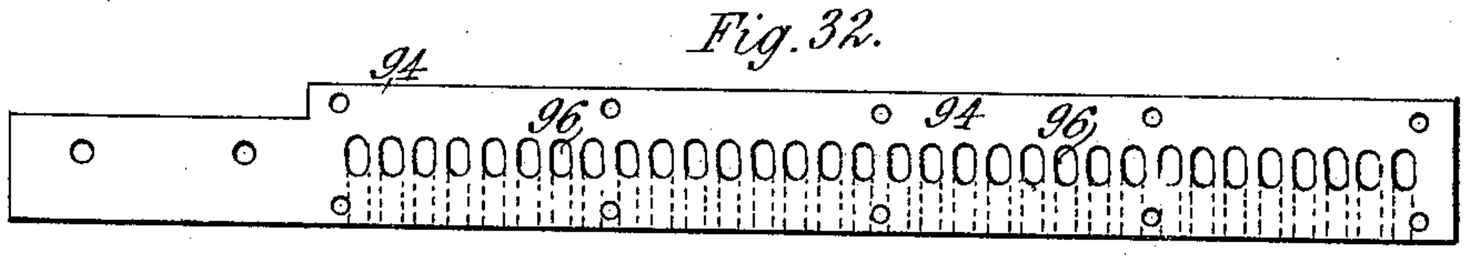


Fig. 33.

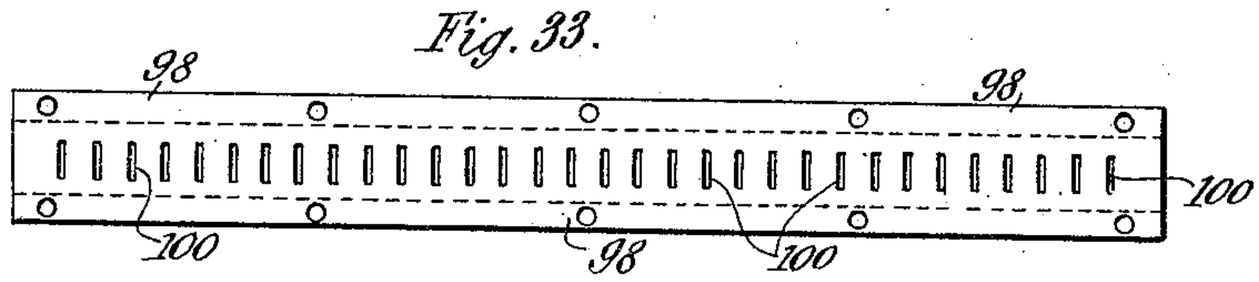


Fig. 34.

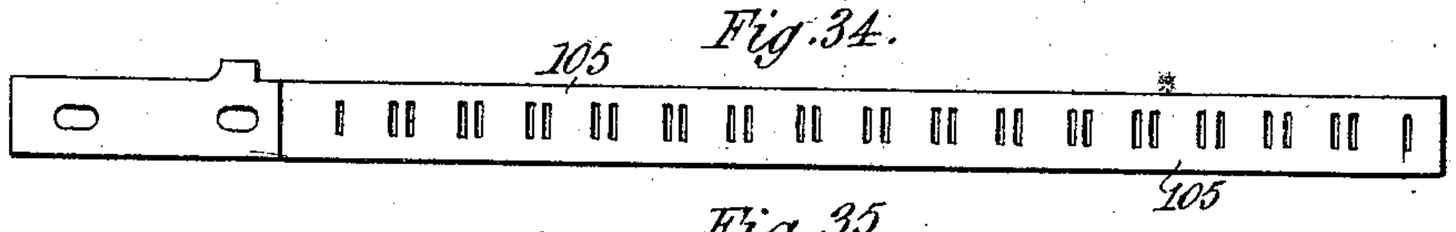


Fig. 35.

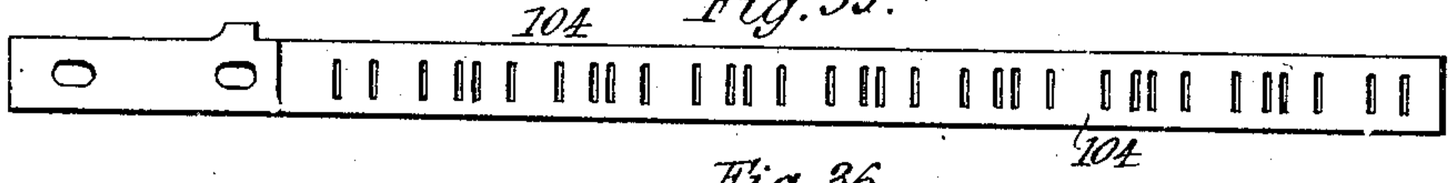


Fig. 36.

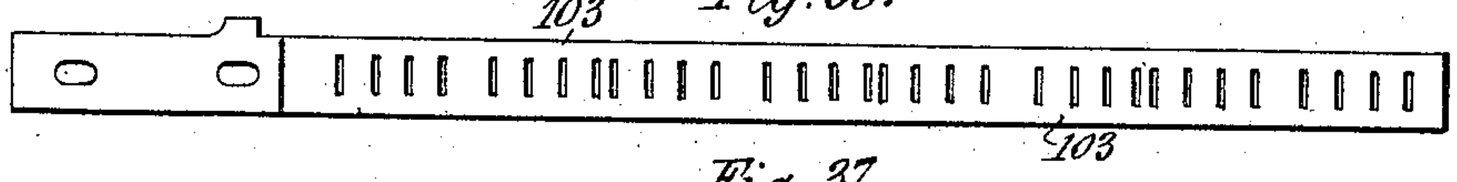


Fig. 37.

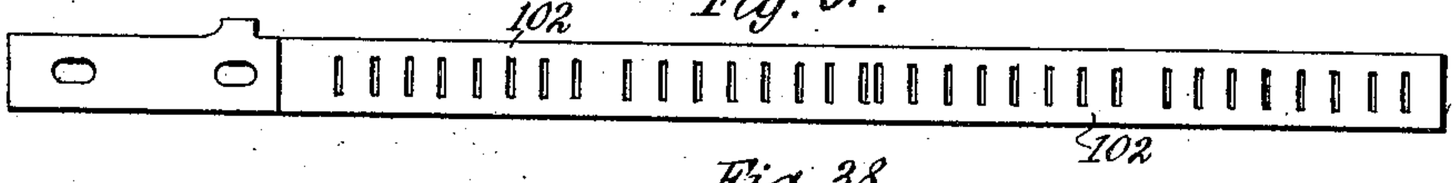


Fig. 38.

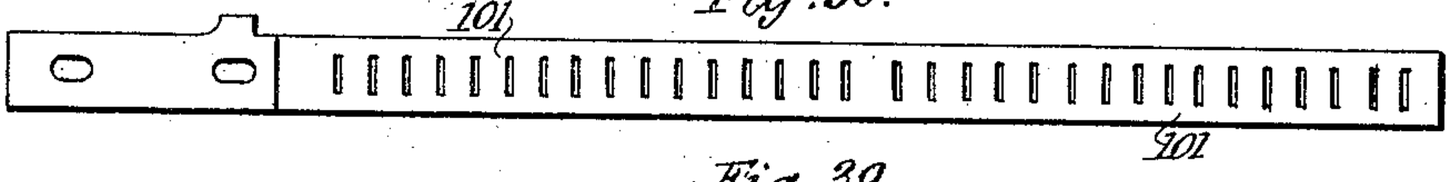


Fig. 39.

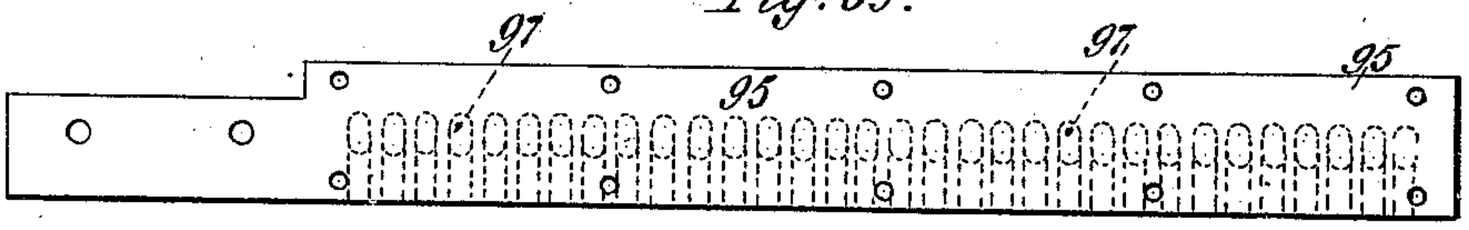
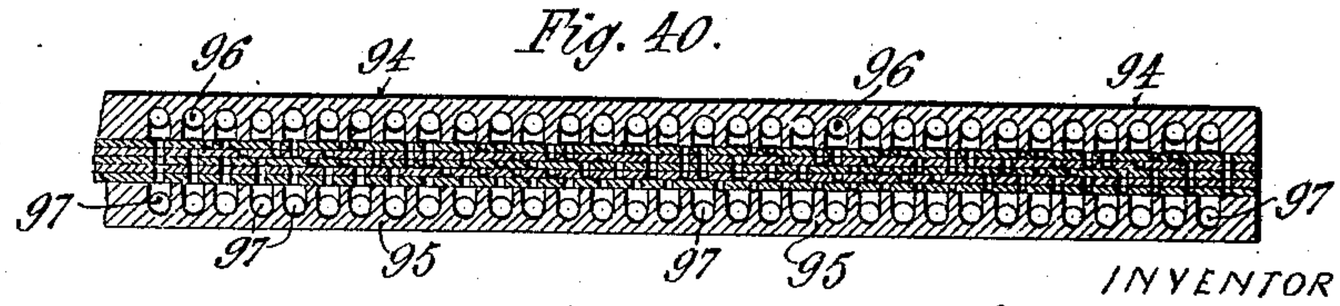


Fig. 40.



WITNESSES:
Fred White
Thomas J. Wallace

INVENTOR:
Jules Carpentier,
By his Attorneys:
Arthur G. Dixon & Co.

No. 697,980. Patented Apr. 22, 1902.

J. CARPENTIER.

AUTOMATIC MUSICAL INSTRUMENT.

(Application filed Dec. 17, 1900.)

(No Model.) 8 Sheets—Sheet 8.

Fig. 42.

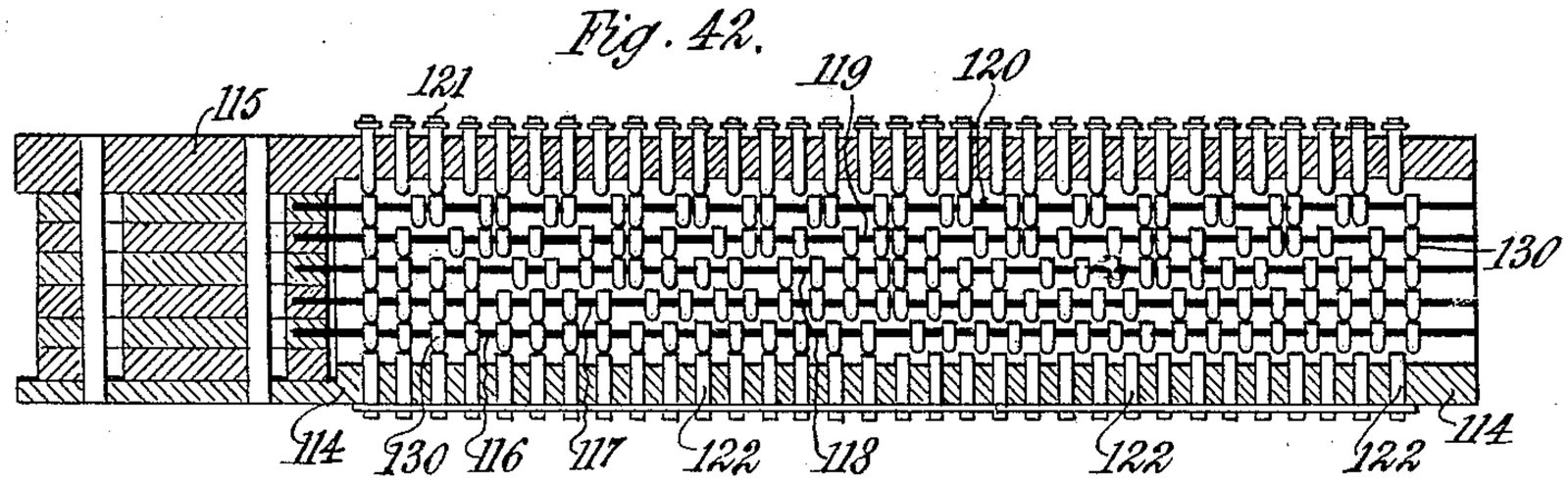


Fig. 43.

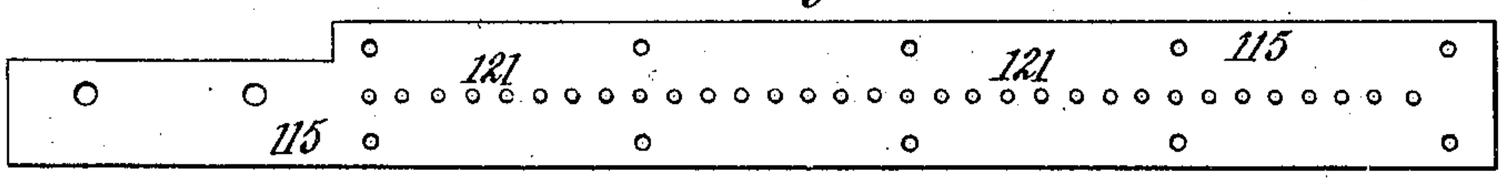


Fig. 44.

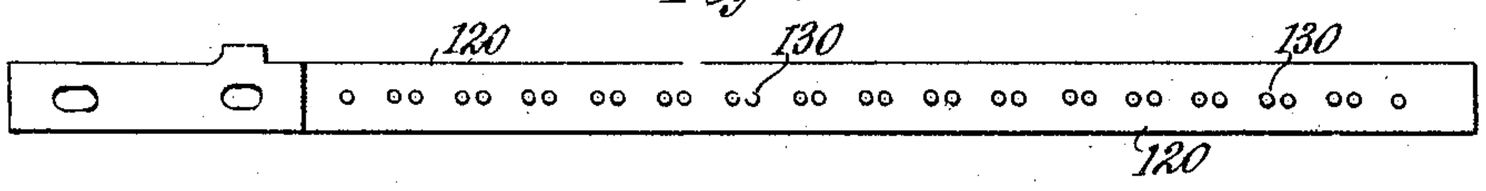


Fig. 46.

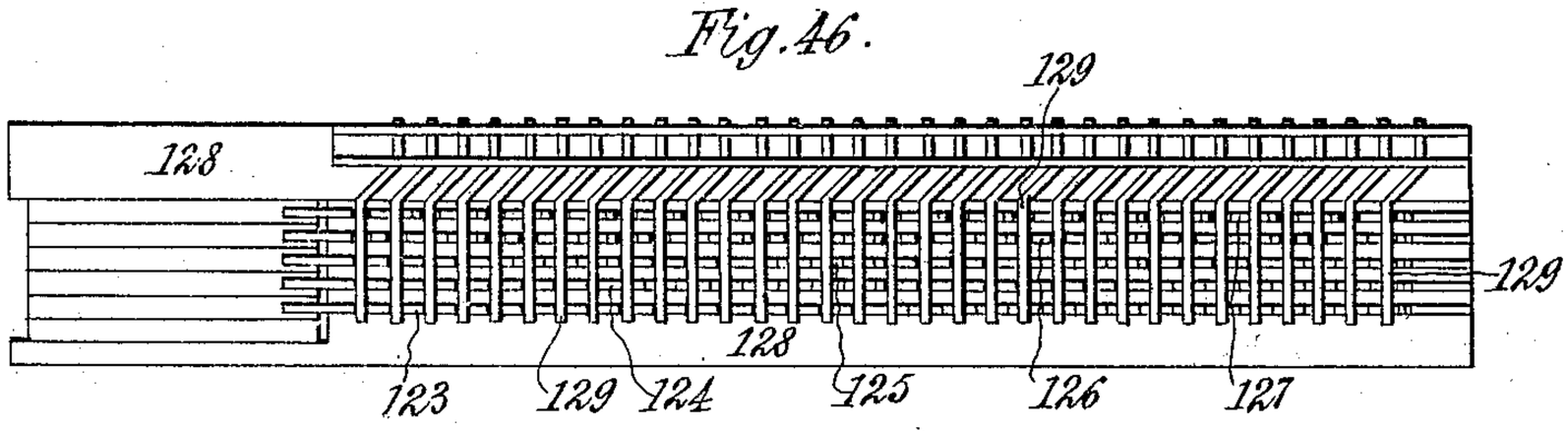


Fig. 48.

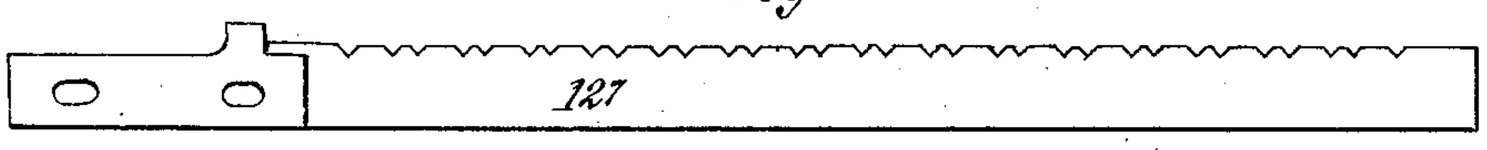


Fig. 45.

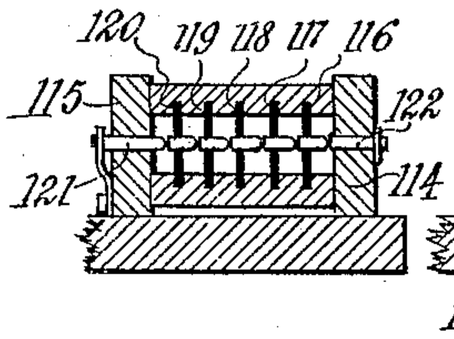


Fig. 47.

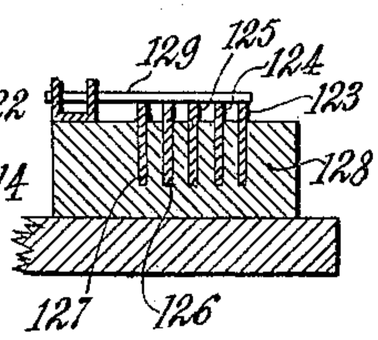
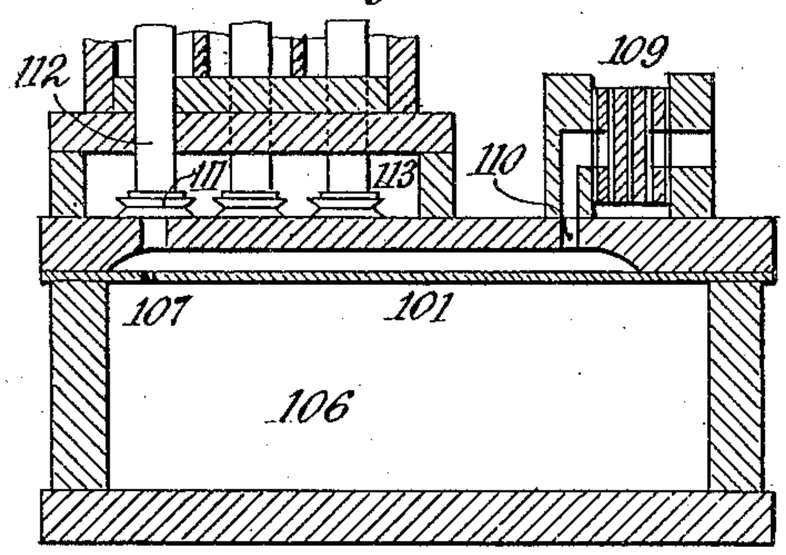


Fig. 41.



WITNESSES:
Fred White
Thomas F. Wallace

INVENTOR:
Jules Carpentier,
By his Attorneys:
Arthur G. Fraser & Co.

UNITED STATES PATENT OFFICE.

JULES CARPENTIER, OF PARIS, FRANCE.

AUTOMATIC MUSICAL INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 697,980, dated April 22, 1902.

Application filed December 17, 1900. Serial No. 40,107. (No model.)

To all whom it may concern:

Be it known that I, JULES CARPENTIER, a citizen of the Republic of France, residing at Paris, France, have invented certain new and useful Improvements in Automatic Musical Instruments, of which the following is a specification.

The invention herein described relates to an automatic musical instrument for music previously composed, worked, for example, by perforated bands, disks, cylinders, &c. The fundamental characteristic of the system consists in that in this instrument every note sounded instead of being caused by passage through one hole or by one peg under the reading-comb depends on the passage of a combination of these elements under this comb.

In its elementary form this instrument can execute simple melodies—that is to say, pieces consisting of a succession of separate notes without any harmony.

In order in this description to render the explanation of the system more clear, I shall particularly describe the arrangement with perforated band, which I have carried out as its first application and which is shown in the accompanying drawings.

Figure 1 shows the perforated band. Fig. 2 is a longitudinal elevation of the mechanism. Fig. 3 is a sectional plan. Figs. 4 and 5 are transverse sections respectively on the lines A B and C D of Figs. 2 and 3. Fig. 6 is a plan of the group of organs that compose the translator—an apparatus that determines the note to be sounded according to the combination of the band which passes under the drawing-roller. Figs. 7 to 22, inclusive, show the different parts, the juxtaposition of which constitutes the translator. Figs. 23, 24, and 25 are respectively a vertical section, a transverse section, and a plan of the parts which work the translator; and Fig. 26 is an end view. Figs. 27 and 28 are part sections at right angles of the valved air-duct. Fig. 29 is a horizontal section, on an enlarged scale, of the translator; and Fig. 30 is an external view in perspective. Fig. 31 is a horizontal section of a modified form of translator. Figs. 32 to 39 illustrate in elevation the different parts of such modified form. Fig. 40 is a horizontal section of another modified form of translator. Fig. 41 is a cross-sectional view illustrating in connection with the translator a valve mechanism for use with pressure-operated reeds or pipes. Fig. 42 is a horizontal section of a third form of translator. Figs. 43 and 44 illustrate in side elevation certain parts of such modified translator. Fig. 45 is a cross-section of Fig. 42. Fig. 46 is a plan of a fourth modification of the translator. Fig. 47 is a cross-section thereof, and Fig. 48 is a side elevation of one of its members.

The band, Fig. 1, is four centimeters wide and has six rows of holes, (marked 1 to 6, inclusive,) those marked 1 to 5, inclusive, being active and 6 being accessory.

The combinations employed in the instrument result from the use of one or more of the five active holes formed in a line transversely of the band. In order to avoid theoretical considerations, I have shown in Fig. 1 a band on which the combinations employed are drawn. These combinations are thirty in number. With five holes combined in all possible ways two more combinations are possible, one containing none of the holes and one containing all of them; but these combinations are not used in this case, for the instrument should be silent when an unperforated part of the band passes the reading-comb and also when the band passes out of the instrument. Hence the combination of all of the holes is not used, as the musical note corresponding to such combination would in such case sound after the band was removed until the vacuum in the wind-chest was relieved.

Casing.—The instrument is in the form of a small rectangular box measuring about forty centimeters long, twenty broad, and twenty-five high, with a shelf 7, Figs. 2 and 3, in front, on which the band travels. From the front project the crank-handle 8 on the right and the stopping-handle 9 on the left. On the top is the expression-lever 10. In the interior are arranged the parts which act together to produce the sounds—on the one hand, the bellows and row of free reeds, with their pneumatic valves; on the other hand, the mechanism for moving and reading the bands, and finally, as principal intermediary

organ, the translator, which interprets every combination of holes and directs the wind on the proper reeds.

Bellows.—There are four wedge-shaped bellows 11, 12, 13, and 14, with a wind-chest 15, fixed on the same board 16, in the thickness of which are formed ducts 17, leading from the bellows to the wind-chest. The bellows are coupled in pairs 11 and 12 and 13 and 14, each pair worked by a rod 18, linked to cranks 19 and 20 at right angles on the working spindle 21. The bellows act by suction to draw the air through the instrument, and the combination of the four gives great continuity of action.

Wind-chest.—The wind-chest 15, also wedge-shaped, is fixed under the board 16 of the bellows and is held open by two strong springs 22, which determine the pressure under which the wind-chest collapses. This pressure may be regulated by turning the cylindrical bosses 23, on which the springs are wound and fixed.

Discharge.—A discharge-valve 24, opening automatically when the wind-chest quite collapses, allows for variation of the air demand, resists sudden elevations of pressure, and protects the bellows and wind-chest against excessive actions.

Collector.—Above the wind-chest is a closed compartment 25, the bottom of which is the bellows-board 16, and from this compartment lead the ducts to the bellows and the duct 26 to the valve-box and the duct 27 for feeding the translator. This compartment is called the "collector." Its upper side is the board 28 for the valves. The valve-box is a small compartment 29, placed above the board 28 and containing the pneumatic valves. The duct 26, leading to the valve-box, requires mention, as it has a special regulator for maintaining a certain difference of pressure between the valve-box and the collector. The duct, which is seen in the two sections, Figs. 27 and 28, is in the form of a pipe. Its opening 30 into the collector, directed upward, is furnished with a conical valve 31, which the air has to lift in passing from the valve-box 29 to the collector 25. On this account the pressure in the valve-box 29 is higher than in the collector 25, or, what comes to the same thing, the rarefaction which determines the suction of the bellows is less there.

Deadness.—To prevent the valve 31 from vibrating, its stem 32 carries a deadener consisting of a light disk 33, forming a piston, working in a cylindrical recess 34, obviously closed at the bottom. In the valve-box 29 hang thirty tubes 35, screwed in quincunx order through the upper wall, and these lead the wind into thirty reed-tubes 36, extending outside the valve-box 29. Under each tube is arranged a pneumatic valve 37, like a small bellows, the top of which, covered with skin, closes the tube or opens it, according to the pressures to which the bellows is subjected outside and inside. The external pressure, which is that in the valve-box, does not change; but the internal pressure is determined by the translator, with which the bellows-valve communicates by a channel 38, formed in the thickness of the board 28.

Air-opening.—This canal has an opening of very small area, by which when the translator does not interfere the pressure in the channel and bellows-valve is equalized with that of the atmosphere, the valve-bellows being distended and the reed-tube closed; but when by a certain combination the translator is influenced it puts the channel 38 of the valve-bellows 37 in communication with the collector 25, (this being its operation,) the pressure in the collector being, as stated above, under the influence of the regulator lower than that in the valve-box, the pneumatic valve collapses, opening the reed-tube, and the reed sounds.

It should here be noted that the leak through the small opening from the channel, which is quite effectual in restoring it to atmospheric pressure when this small space is cut off from the collector, is quite negligible in respect of the suction determined in it by the translator establishing its connection with the collector. This opening therefore renders double-acting valves unnecessary for working the bellows-valve.

The range of reed-tubes is entirely contained in a box 40, through the top of which are holes provided with slide-valves which have no particular function except to give expression.

I now proceed to describe the mechanism for drawing the perforated band and reading it.

Drawing.—The perforated band is drawn in the usual way between a pair of superposed rollers 41 and 42.

Direction of travel.—Contrary to the usual arrangements these rollers are placed at the left end of the passage for the band, which moves from right to left instead of from left to right. Owing to this arrangement the words of a song can be written on the band below the holes, the words moving from the eye in the direction for reading. The upper roller 41 is driven by an endless chain 43 from the bellows-spindle 21, mounted at the right, so as to be worked by the crank-handle 8 by the right hand of the operator.

Draw-rollers.—In the instrument described the draw-rollers present another specialty. The upper roller 41 has six grooves 44 in its middle part, and the lower roller 42 is like a bobbin, having two circular cheeks connected by a tubular sleeve 45, through which passes longitudinally a spindle 46, constituting the axis of the bobbin. The cheeks press the band against the ends of the upper roller, which are surrounded by caoutchouc bands 47 to increase adhesion. This arrangement allows the six feelers 48 (best seen in Figs.

23 and 24) to advance between the pressing-disks and to pass through the holes of the band into the grooves of the upper roller.

Feelers.—The feelers 48 are steel bell-cranks pivoted near the top. Under the feeling end 49 there is a branch 50, which passes below and very near the sleeve 45 of the lower roller 42. The vertical arms of the feelers actuate the translator-registers, as will hereinafter be described. The spindle 46 of the lower roller has its ends engaged in the arms of two brass bell-cranks 51, which can independently rock on pivots 52. Against the ends of the vertical arms of the bell-cranks 51 bears a bar 53, to which are attached six springs 54, each connected to one of the feelers 48, which constitute the reading-comb. These springs therefore have a double action. They press each of the feelers 48 against the perforated band, causing them to enter the holes, while they act altogether through the bell-cranks 51 on the lower roller 42, forcing its cheeks against the borders of the band, so as to insure its movement.

Starting and stopping—After what has been described it is easy to understand that in pressing down the spindle 46 in opposition to the strain of the springs the depression of the roller 42 stops the drawing action, and, moreover, the sleeve 45 as it descends depresses the branches 50 of the feelers, and thus pushes the feeling ends 49 below the passage in which the band travels. The band can then be moved any distance backward or forward by hand in order to pass from one part of the tune to another or to repeat. The upper roller turns on a projecting stud, as shown in Figs. 4 and 24, so that when the band is no longer pressed by the lower roller 42 and the feelers the upper roller can be removed from the instrument, even in the middle of a selection, by a simple side disengagement. The lowering of the spindle 46 is effected very simply. It has fixed on it at each end a disk 55, made with a flat portion, Fig. 4ª, so that when the spindle is partly turned in either direction by the external handle 9, fixed to it, either the flat portion or a part of the circular periphery of the disk is made to bear against the part of the frame above, the spindle 46 being thus raised or lowered and the rollers 41 42 engaged or disengaged, so as to be either in position for starting or for stopping, according to the position of the handle. It has been stated that the vertical arm 56 of each feeler actuates the translator-registers.

Translator.—The translator is the essential organ of the instrument and the basis of the invention, as it interprets the combinations and reduces the complexity of each to a simple action on a single one of the reeds. It is in the form of a compact block, a kind of elongated rectangular parallelepiped, lying below the passage for the band. It consists of a group of strips placed side by side and pressed together by ten bolts 57, five along the upper and five along the lower margin. Of these strips some of them, of cardboard, form five sheaths 58, 59, 60, 61, and 62 in Fig. 25, and between which can move five thin registers 63, 64, 65, 66, and 67, also of cardboard. The others, 68, 69, 70, and 71, of wood, are partitions interposed beneath the sheaths of the registers. These partitions have through them holes forming within the translator cells 72 of various sizes.

Sheaths.—Each sheath 58 to 62 consists of two sides kept apart by two narrow strips between their borders.

Registers.—The registers 63 to 67 move freely in the sheaths and extend at one end beyond them, so as to be actuated, as I shall hereinafter describe, by the vertical arms of the feelers.

The translator is bounded on both sides by thick boards 74 and 75, in which also are formed cells 76 and 77 and openings 78 and 79, Figs. 5, 6, and 29. In order that the nature of the translator may be better understood, I have shown in plan and horizontal sections, respectively, in Fig. 6 and Fig. 29, each of the pieces of which it consists, and in elevation in Figs. 7 to 22 such pieces in the order in which they are placed together in making up the whole. The sheaths 58 to 62, the two sides of each of which are identical, are supposed not to be taken apart. They are shown in elevation in Figs. 8, 11, 14, 17, and 20, respectively. The sheaths 58 to 62 and the registers 63 to 67 have narrow openings 80 through them. The sheath 62 and register 67, Figs. 20 and 21, have each a pair of holes; but these are farther apart in the register 67 than in the sheath 62, so that when one of the holes of the one is made to coincide with a hole 80 of the other the other hole of the sheath 62 is obstructed by an unperforated part of the register 67, and conversely. If the register be moved to and fro from these two positions, the holes through the sheath are alternately opened and closed. The sheath 61 and register 66, Figs. 18 and 19, have each two pairs of openings 80. Each sheath and register act together in the same way as 62 and 67. The interval between the two pairs of openings is greater in the register 66 than in the sheath 61, so that with a small movement of the register the even openings or the odd can be alternately opened. The sheath 60 and register 65, Figs. 14 and 15, have each four pairs of openings; the sheath 59 and register 64, Figs. 11 and 12, have each eight pairs; the sheath 58 and register 63, Figs. 8 and 9, have each 16 pairs. In each case a small movement of the register opens the even openings and closes the odd, and conversely.

Circulation.—On regarding the translator altogether, as shown in Figs. 6 and 29, the front board 74 has a recess 76 connecting the two openings of the sheath 62. Assume that compressed air were supplied to this recess covered by the sheath 32. Then according to the position of the register this air will pass

through the one or the other of the openings 80. Each of these opens into a separate cell formed in the partition 71, into the one or the other of which the air passes; but as the recess 76 has two outlets, so each of the two cells in the partition 71 has two outlets through the sheath 61. Then according to the position of the register 66 the air will pass through the even or the odd opening from the cell which it had entered. Thus it may be understood without further explanation that by simply moving the first two registers the wind can be directed to one of the four openings of the sheath 61. Each of these leads to a cell formed in the second partition 70, each of which cells has two outlets through the sheath 60. The movement of the register 65, combined with that of the first two registers, directs the air through one or other of the eight openings of the sheath 60.

Continuing the analysis of the translator, in which each partition has twice as many cells as the one before it and in which each cell has two outlets, but one inlet, the explanation given above can be readily applied to show how the combined action of the five registers can direct the air to any one of the thirty openings through the sheath 58. It may be recollected that this sheath might have thirty-two openings, sixteen pairs; but the first and the thirty-second, corresponding to combinations that cannot be used, do not exist. The first cell of the fourth partition has only one even outlet, and the last has only one odd outlet. The hinder board 75 has in its face thirty cells, which communicate by small vertical channels 79 with the passages 38, which lead to the pneumatic valves 37. The large recess 76 in the front board 74 communicates by a long slot 78 with the collector 25.

I have stated that the bellows are for vacuum, not for pressure. This in no way alters the reasoning as to the passage for air through the translator. All that has to be recollected is that the influence of each combination is translated by making communication between one of the thirty pneumatic valves with the collector.

I shall now explain how the feelers act on the registers of the translator.

Slides.—Between the extended boards of the translator are fitted six wooden slides 81, 82, 83, 84, 85, and 93, Figs. 23, 24, and 25, about four millimeters thick, all alike and placed side by side. Two metal pins 86 pass through slots of the six slides, these slots being of the width of the pins and at a suitable distance apart. The slides are thus guided to be moved longitudinally as far as the slots allow each independently. A spring 87 is attached at one end to the under side of each and at the other end to a cross-pin 88, fixed to the boards, drawing each back. A projection 89 on the upper edge of each engages it with the arm of a feeler. Owing to a greater strength of the springs 54 than of the springs 87 of the slides, as soon as a feeler passes through a hole of the band its arm pushes forward its slide. When the feeler is moved down by the unperforated part of the band, the slide returns to its position of rest. Each of the registers of the translator is attached to one of the slides, so that the movements of the feelers actuate the registers. The small movement of each slide is precisely that necessary for the register to move from the closing to the opening position of the openings which it governs. Such is the mechanism which translates into the sounding of a note the passage of a combination of holes over the feelers; but this mechanism has an addition of no use in principle, but of great practical advantage, or even indispensable.

If the apparatus had only the parts described, the sounding of a note would continue only during the passage of the holes over the feelers, short holes giving short notes and long holes giving continued notes. In a flowing melody the holes for one note should extend up to the beginning of those for the next note. The band would be cut in chequers, and if at first they could actuate the apparatus, they would soon be rendered useless. In order to avoid this objection, the translator has a linking arrangement which allows of the action of one combination being prolonged beyond the passage of the holes in the band. Each slide has at its end a small steel tooth 90 with a slope in front and a vertical face behind. The teeth of all the slides are alike and in an exact line when the slides are in their position of rest. A broad pawl 91, jointed on a cross horizontal pin 92, bears on the front slopes of the teeth. When a slide is pushed forward by the arm of a feeler, its tooth in passing lifts the pawl, but when the arm retreats the slide is held by the pawl. The same occurs to all the slides moved, and owing to this arrangement when a combination of holes in the band passes over the feelers, causing a note to sound, the note continues to sound after the holes have passed. Consequently the holes do not require to be elongated. A single pattern of hole serves for a note of any length.

Disengager.—In order to stop a note, it suffices to disengage the combination by lifting the pawl 91. This is effected by the sixth slide 93, which has a tooth longer than the others, so that its sloping face raises the pawl, but does not pass beyond it. The sixth feeler, the existence of which was mentioned without laying stress upon it at the beginning of this description, works the disengaging slide, and the row of holes 6 at the side of the active rows 1 to 5 is reserved for holes for causing the disengagement. It is not, however, to be thought that the intervention of the disengaging feeler must precede the sounding of each fresh note. The pawl is so formed that the mere advance of a slide which was not one of those previously advanced raises the pawl 91 and allows the

slides and registers which feelers do not keep forward to return to their position of rest. Thus one combination effaces another provided the fresh combination contains a feeler which was not in the former. When this is not the case, the disengager effects the change; but it is obvious that if it be desired to stop one note before sounding another, particularly for staccato passages, instead of linked notes the disengager must act for each note.

In the preceding description attention has been particularly called to the translator, the essential organ of the system. This translator might be made in forms different from that described. I shall explain some modifications which, it scarcely need be said, are quite within the spirit of my invention.

First modification, pneumatic.—Without any change in the translator, retaining its boards, sheaths, partitions, and registers, the openings through all these might be made in quite a different manner. To explain the economy of this distribution, I have shown a longitudinal horizontal section, Fig. 31, Fig. 32 showing the hinder board and Fig. 33 one of the sheaths, which are all alike. Figs. 34 to 38, inclusive, show the several registers. Fig. 39 shows the front board. I will assume that the translator is so made as to carry out the thirty-two combinations. In this new form the hinder board 94 is the same as in the previous arrangement and the front board 95 is the same as the hinder board 94, only while each channel 96 in the hinder board leads to a valve, as before, all the channels 97 in the front board communicate with the collector. Secondly, all the sheaths 98 and the partitions 99 have thirty-two openings 100, uniformly spaced with regard to the two boards 94 and 96. Thus if the registers are disregarded there would be thirty-two direct passages from the openings of the front board to the corresponding openings of the hinder board. The registers 101 to 105, inclusive, have also each thirty-two openings, half of these coinciding with the openings of the sheaths when the registers are in the position of rest, the other half coinciding with those of the sheaths when the registers are moved; but what distinguishes the registers is the distribution of the openings that may be termed "normal" and those which may be termed "displaced." In the first register 101 there are, counting from the left, sixteen normal then sixteen displaced openings. In 102 there are eight normal then eight displaced, again eight normal and eight displaced. In 103 there are four normal and four displaced, and so on. In 104 there are two normal and two displaced, and so on. In 105 there is one normal then one displaced, and so on. In these conditions it may be readily seen that according as register 101 is at rest or is moved only some one of the first sixteen or some one of the last sixteen valves can be actuated. When 101 is at rest, according as 102 is at rest or is moved, only one of the valves 1 to 8 or one of the valves 9 to 16 can be actuated. When the registers 101 and 102 are both at rest, according as 103 is at rest or moved, only one of the valves 1 to 4 or one of the valves 5 to 8 can be actuated, and so on. Thus reasoning it is readily understood that each combination actuates only one valve—that is to say, causes only one note to sound. I repeat that in this new translator the openings 1 and 32 of each element correspond to two combinations that cannot be used. Consequently there could be no reason for opening them. I would now observe that in this new form the translator may have a radical simplification without changing the action. The sheaths and partitions might be dispensed with, the registers working against each other, as shown in Fig. 40. The attachment of the registers and their connection to the feelers have to be arranged differently from those in the former construction; but this is a matter of detail which requires no further notice. I have called attention to the part played by the leak in the action of the pneumatic valve. Each valve has a channel of supply and a channel of exhaust. In the example which I have employed to explain my system the pneumatic translator acts on the supply of the valves by cutting it off or re-establishing it. It may be understood that the action of the translator might effect not the supply but the discharge, also that the translator might be applied either for supply or discharge in systems in which the sounds are caused not by exhausted but by compressed air. For instance, I show in Fig. 41 a translator acting by discharge of compressed air. The collector 106 communicates with the interior of each valve by a small hole 107 in the wall of the channel 101, communicating with the translator 109 through the passage 110, much larger than 107, which small hole 107 allows sufficient air to pass to dilate the valve-bellows 111 and close the bottom of the sound-pipe 112; but when the passage 110 is by the translator made to communicate with the outside the pressure in the valve-box 112 causes the valve-bellows 111 to collapse, opening the pipe, the air entering by 107 being too small in quantity to keep the valve-bellows distended. A similar hole 107 may be provided in the construction of Fig. 5, as shown.

I will now indicate a second modification of the translator, the economy of which is like that of the preceding modification, but the use of which leads to an interesting generalization of my system. It bears upon an electric translator, the registers of which are employed not to direct a current of air to operate valves and sounding-organs, but to direct an electric current by conductors for transmitting to suitable receivers at a distance the translation of a combination on a band. Before describing this electric translator I wish to show by an example the interest which it presents. Let us consider two

musical instruments universally known, one of those which can be applied to the keyboard of a piano and execute pieces by means of perforated bands—a melotrope, for instance—and the other an electric organ. Assume that on the band of the melotrope we reserve six of the lines of notes to write, in the manner of combinations, any melody, it being understood that in the instrument the organs corresponding to the lines which have changed their purpose are suppressed and that on the other lines of the band we write, in the ordinary notation, the accompaniment of the melody. Assume that above the passage for the melotrope-band we arrange an electric translator, the conducting-cable of which leads to the action of the electric organ. On now turning the melotrope-handle we should hear the melody executed on the organ with the accompaniment executed on the piano to which the melotrope is applied. Of course to render this application practical the electric organ employed might be sufficiently reduced in dimensions for its use. It should have bellows mechanism to supply either the melotropist or other performer, by means of pedals or a handle, one or several sets of thirty notes which could be substituted for each other by ordinary stops, and in order to give complete effect there should be mechanism for expression. Finally, for this simple organ performing melodies might be substituted any other instrument having strings, blades, pipes, &c., merely provided with an electric receiver like the electric organ, which latter is mentioned only as a concrete example to illustrate the utility of the device.

The electric translator is shown in horizontal section in Fig. 42, one of the side boards is shown by Fig. 43, and one of the registers by Fig. 44. Returning to the simplified modification of the pneumatic translator, the two sides 114 and 115 and the registers 116 to 120, inclusive, are made in ebonite, the sides somewhat thick, the registers thin. In the sides and registers for the openings are substituted metal rivets 130 with rounded heads of strictly regular thickness. The two rivets facing each other on the two sides are at a distance apart a little greater than the sum of the five register-rivets; but one of the rivets 121 on the sides is spring-mounted, as shown in Fig. 45. With this arrangement any combination is translated by the formation of a conducting-line of the five rivets introduced between a pair of side rivets, owing to the elasticity of one of the side rivets. All the rivets of the front side are connected to one of the poles of a battery. Every rivet of the rear side is connected by a conducting-wire to the receiver. It will be understood without further explanation how the registers, actuated by feelers with or without pawls, as in the original form described, translate by executing a melody in the electric musical instrument to which the other pole of the battery is connected.

Before leaving the translator I shall finally describe a last modification which might find an opportunity of being applied. Figs. 46 and 47 show five registers, 123 to 127, inclusive, made of thin strips of steel, one shown in Fig. 48, sliding side by side in grooves formed in any way in a block 128. These registers are actuated, as previously described, by combinations of feelers bearing on a band. Instead of having openings for the passage of air or rivets for conducting electricity these registers have on their upper edges simply V-notches arranged on each according to the laws set forth above. Without repeating the reasoning formerly employed, I repeat that in this translator every combination brings only one set of notches into line. Thirty blades 129 rest on the edges of the registers at suitable points. Each combination is translated by the drop of only one of the blades. This drop can be utilized either to work a valve or to make an electric contact, and it is evident that this translator, like the former, is capable of playing the part which characterizes this organ.

At the beginning of this description I avoided specific definition of the system of combinations, the application of which I had chiefly in view. This system flows from the mathematical definition of combinations, which gives a maximum of groupings with a minimum of articles. It is that which with a given width of band furnishes the greatest number of notes to be employed. It has seemed to me that five working lines giving practically thirty notes, theoretically thirty-two, give to an instrument for melody quite sufficient richness; but obviously there is no reason why the instrument should not be made with six working lines, giving practically sixty-two notes, theoretically sixty-four. In certain cases also the number of working lines might be reduced to four or three, giving practically fourteen or six notes. On the other hand, I do not mean to limit the application of my invention to the use of this system of combinations as the word is understood in the mathematical sense. Indeed, other systems of grouping of holes may be substituted which are capable of application like that which I have described, but of less advantage.

I have described at length herein some of the modifications by which the substantial results provided by my invention may be attained. I do not wish, however, to be limited to such modifications, as it is obvious that other and equivalent constructions may be adopted which will produce the results provided by my invention, either in whole or in part, and it is my intention to include such constructions in the following claims.

The device described as follows from what precedes is essentially a solo instrument; but

the simultaneous use of two, three, or more such devices might execute duets, trios, and quartettes. If the execution of such concerted pieces were of interest, there would be nothing more simple than to condense two, three, or more such devices in one instrument. This multiple instrument would naturally require bands wider than the simple instrument and repetitions of certain special parts; but it would present the advantage of being worked by one person and of having only one set of the organs that are common in respect of their functions, such as the bellows.

Having thus described the nature of this invention and the best means I know of carrying the same into practical effect, I claim—

1. In a musical instrument, the combination of a series of movable parts, means for moving each of said parts from a normal to a displaced position, whereby various positions of said parts relatively to each other may be obtained, a series of sound-producing devices and means controlled by the relative positions of said moving parts for operating the individual sound-producing devices, whereby the latter are individually selected and sounded according to the different permutations of the displaced and unmoved parts.

2. In a musical instrument, a controlling means comprising a series of moving parts arranged approximately parallel to one another, and each movable from a normal to a displaced position, and having differently-spaced operative portions, whereby said operative portions shall be put into different operative relations as different groups of said parts are displaced, and sound-producing devices in operative relation to said controlling means, whereby the latter are individually selected and sounded according to the different permutations of the displaced and unmoved parts.

3. In a musical instrument, a controlling means comprising a series of moving parts arranged approximately parallel to one another, and each movable from a normal to a displaced position, and having differently-spaced operative portions, whereby said operative portions shall be brought into alinement as different groups of said parts are displaced, and sound-producing devices in operative relation to said controlling means, whereby the latter are individually selected and sounded according as different operative portions are brought into alinement by the movement of different groups of said parts.

4. In a musical instrument, the combination with a series of sound-producing devices and a means for generating air-pressure, of a translating or controlling mechanism connected to such means, comprising a plurality of plates having passages formed through them, said passages being disposed at different intervals in different plates, and means for moving groups of such plates to positions in which their passages may successively establish communication between such pressure-generating means and the individual sound-producing devices.

5. In a musical instrument, the combination with a series of sound-producing devices, and a means for generating air-pressure, of a translating or controlling mechanism connected at one side to such means, and at its other side to said devices separately, and comprising a plurality of plates, each movable from a normal to a displaced position, and having passages formed through it, said passages being differently spaced in the different plates so that by the movements of different groups of said plates from their normal to their displaced positions a connecting-passage is formed across said plates from said means to each of said sound-producing devices separately, and means for so moving groups of said plates.

6. In a musical instrument, the combination with a series of sound-producing devices, means for producing a flow of air through such devices, and an actuating mechanism for each of such devices adapted to connect it with such means, of a translating or controlling mechanism comprising a plurality of registers having passages formed through them, differently spaced in the different registers so that by moving such registers singly or in groups communication is cut off from all of the sound-producing devices except the single one which it is desired to actuate, and means for so moving such registers.

7. In an automatic musical instrument, the combination of a traveling sheet, a feed-roll for said sheet, means for depressing said roll to stop the feed of said sheet, and a series of fingers each adapted to be engaged by a part moving with said roll when the latter is depressed, whereby to disengage said fingers from said sheet when the latter is stopped.

8. In an automatic musical instrument, a means for controlling the air-pressures in two connected compartments, comprising a weighted valve, a piston connected to said valve, and a cylinder in which said piston moves.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JULES CARPENTIER.

Witnesses:
EDWARD P. MACLEAN,
AUGUSTE MATHIEU.