

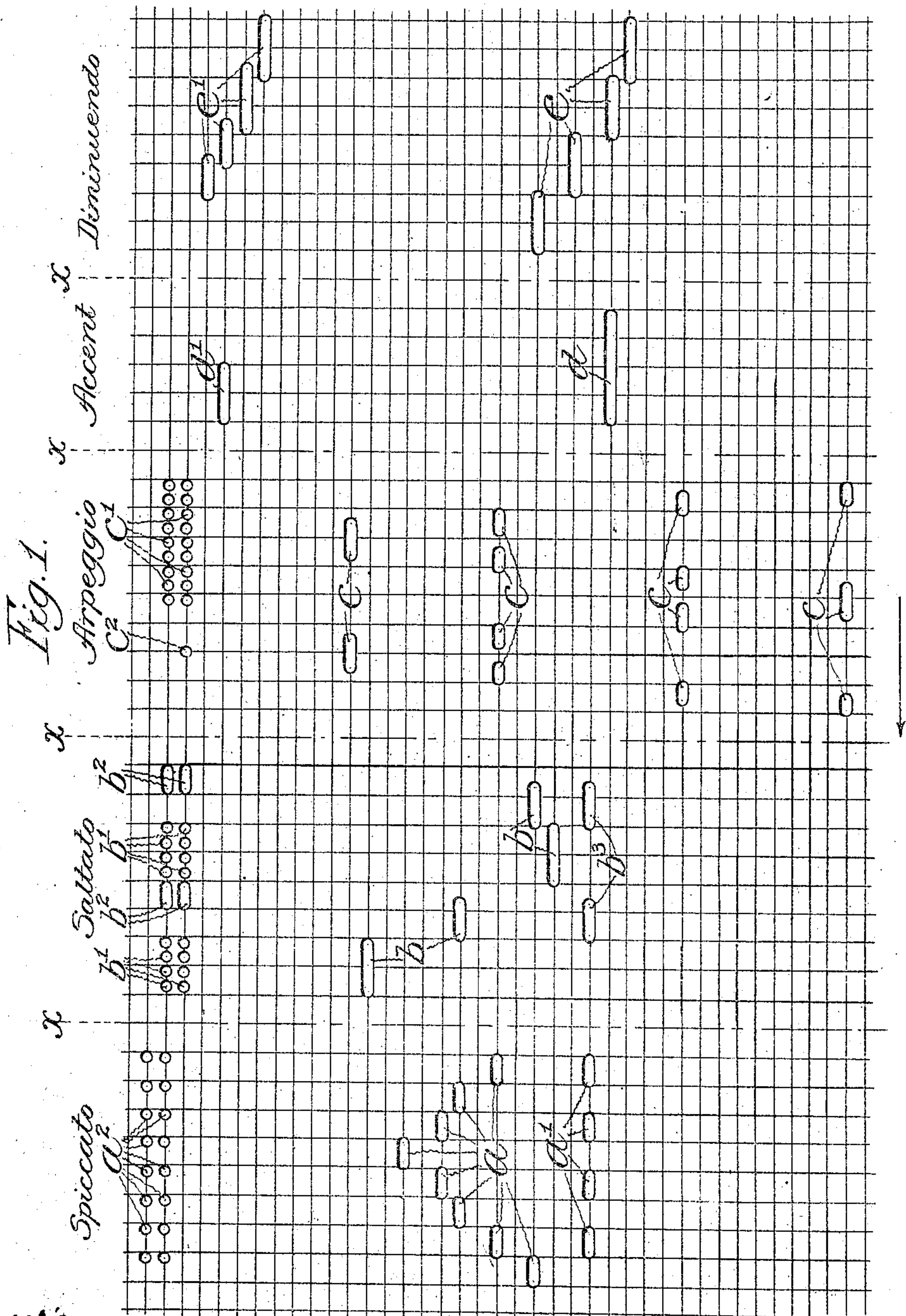
No. 897,021.

PATENTED AUG. 25, 1908.

H. K. SANDELL.
PERFORATED MUSIC SHEET.

APPLICATION FILED MAR. 12, 1906.

3 SHEETS—SHEET 1.



Witnesses:

W. D. Gaylord.
John Enders.

Inventor:

Henry K. Sandell,
By Dymforth, Dymforth & See,
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No. 897,021.

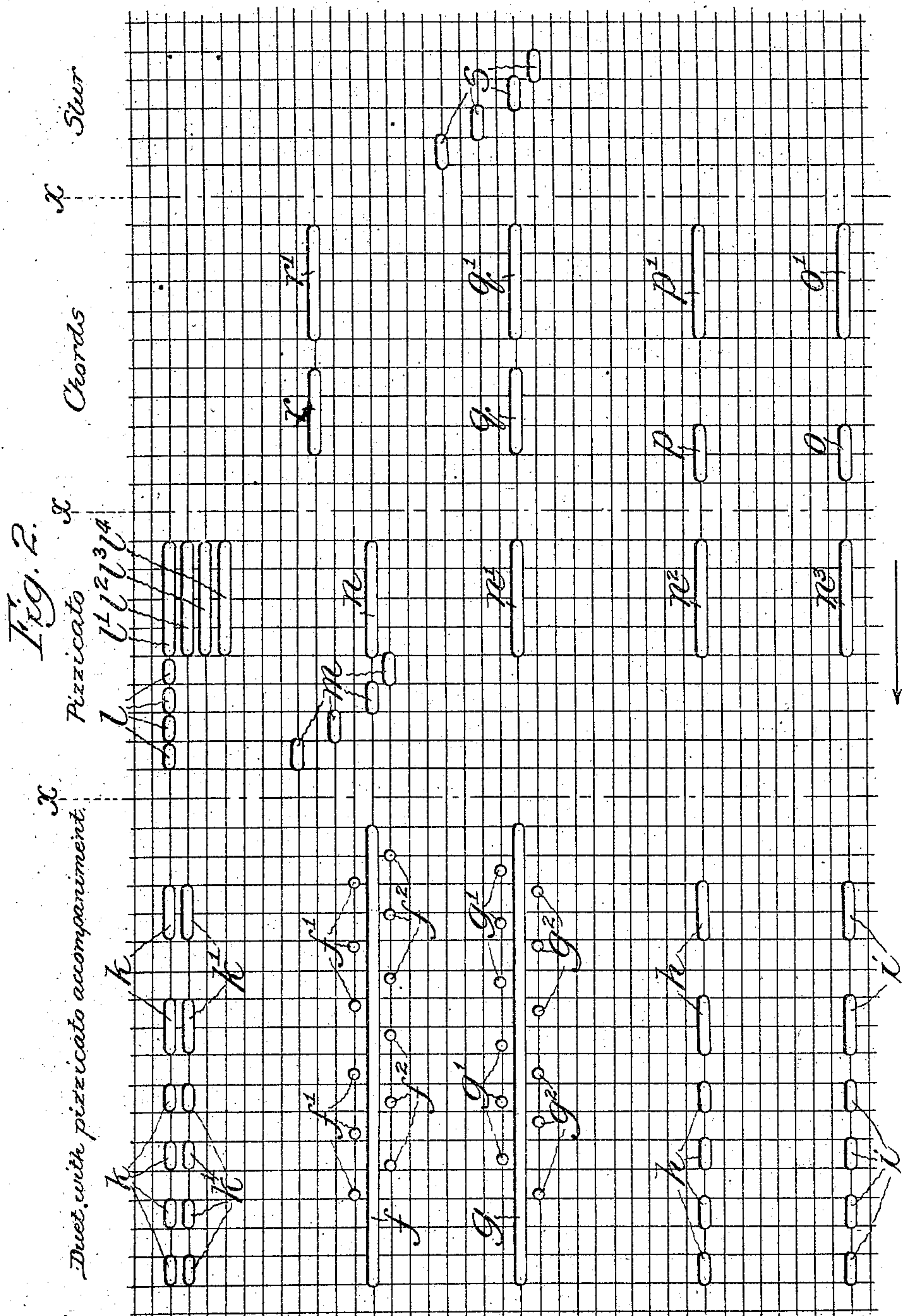
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3 SHEETS—SHEET 2.



Witnesses:

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John Enders.

Inventor:

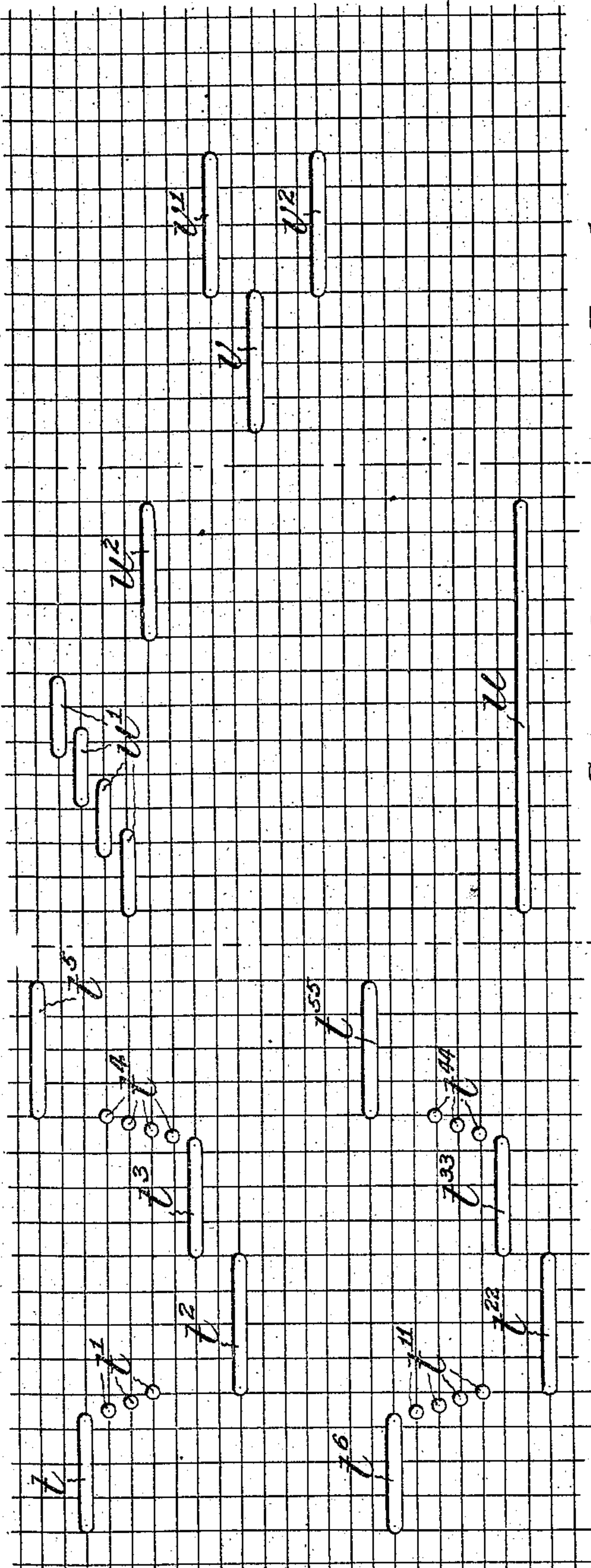
Henry K. Sandell,
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3 SHEETS—SHEET 3.



Legato

Crescendo

Portamento

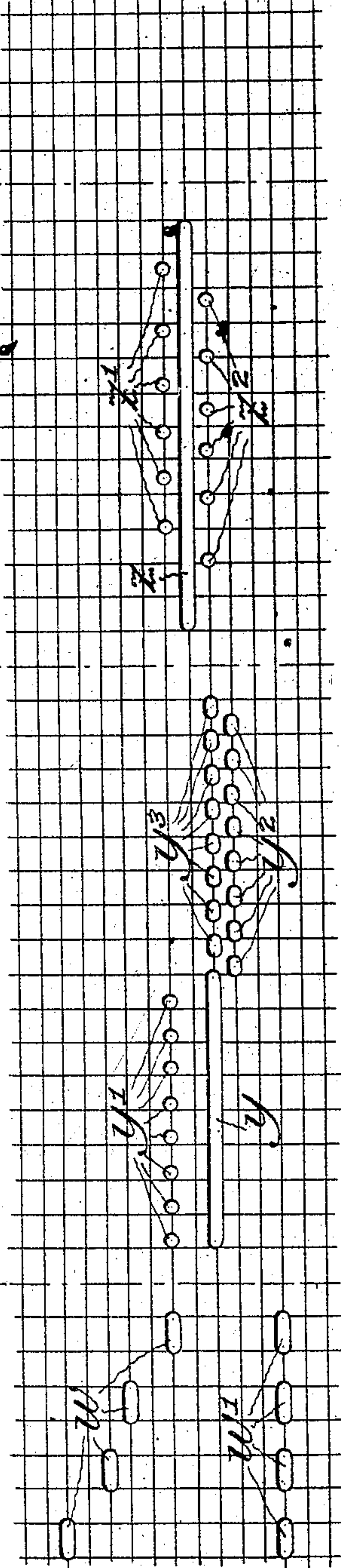
Fig. 3.

Shake

Fig. 4.

Trill

Staccato



Witnesses:

W. C. Gaylord.
John Enders

Inventor:

Henry K. Sandell.
By Dymfryn, Dymfryn & Co.,
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UNITED STATES PATENT OFFICE.

HENRY K. SANDELL, OF CHICAGO, ILLINOIS, ASSIGNOR TO MILLS NOVELTY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

PERFORATED MUSIC-SHEET.

No. 897,021.

Specification of Letters Patent.

Patented Aug. 25, 1908.

Application filed March 12, 1906. Serial No. 305,671.

To all whom it may concern:

Be it known that I, HENRY K. SANDELL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Perforated Music-Sheets, of which the following is a specification.

My invention relates to an improvement in the construction of perforated music-sheets of the class employed for reproducing, by automatically playing stringed instruments of the viol family, musical compositions according to which the perforations in the sheet are relatively disposed.

Although my improved construction of music-sheet is adaptable for playing any of various stringed instruments belonging to the family referred to, I have especially devised it for use with the self-playing violin shown and described in United States Letters Patent No. 807,871 dated December 19, 1905, and with devices forming features of improvement in the mechanism set forth in said patent and which features are shown and described in my pending application for Letters Patent, Serial Number 303,172, filed on the 27th day of February, 1906. Reference is had to the aforesaid patent and application, familiarity with the mechanisms of which and their functions and operations will facilitate understanding the present invention. The mechanisms referred to are, generally stated, the electro-magnet-actuated fingering and sounder devices in series, the electro-magnet-controlled means coöperating with the sounder-devices for moderating the loudness of tone produced by their action upon the violin-strings, all of which are disclosed in said patent, and the picker-finger devices, the sounder-depressing device and the sounder-reversing devices disclosed in said application.

Having invented the aforesaid mechanisms for electro-magnetic operation under the control of a perforated music-sheet caused to travel across an electrical contact-roller and contacts engaging therewith through the perforations to close, at intervals determined by the latter, an electric circuit for energizing the magnets, to cause the mechanisms actuated by them to perform their functions, it has devolved upon me to so construct a music-sheet as to adapt it to control these mechanisms in a manner to cause them to produce in the automatic

playing of the instrument, artistic effects similar to those introduced by skilled performers playing it in the ordinary way. These artistic effects relate to expression and interpretation in the rendition of the composition; and they involve the fingering and sounding of the strings to produce the effects which are known to musicians under the significations "spiccato", "saltato", "arpeggio", "accent", "diminuendo", "portamento", "crescendo", "legato", "staccato", "trill", "shake", "pizzicato", "chords" and "slur".

To this end my invention consists in a perforated music-sheet having the peculiar features of construction illustrated in the drawings and defined in the claims.

Each of the four figures in the accompanying drawings represents a portion of a music-sheet which may be of any required width and embrace a scale of any desired number of note-perforations to conform to the instrument to be played. The present illustrations, however, are narrowed to enable them to be represented within the prescribed dimensions of the drawing-sheets.

In the drawings, Figures 1, 2, 3, and 4 represent, each, by a plan view, a portion of a perforated music-sheet, and each portion has sections marked off by transverse broken lines, for convenience of illustration, and each section has represented upon it a different arrangement of perforations which I have devised for producing the effect in playing the instrument which is signified by the musical expression printed at the margin of that section. Thus, in each figure, the sections are arbitrarily defined, to assist in the explanation, by the broken transverse lines *x*. It will be understood, however, that the arrangement of the perforations for producing the different effects will be located in those parts of a music-sheet, as an entirety, where they are required for interpretation in the playing of the particular composition for which the music-sheet is cut.

The music-sheet represented in the drawings is intended as a pattern-sheet from which to copy, in cutting other sheets for use with the instrument, the arrangements of the perforations where they belong on such sheets, and it thus serves as a guide in preparing the latter for producing any of the effects desired where the same properly belong. And to facilitate the copying, the master-sheet or pattern-sheet illustrated is

marked off, by intersecting lines at right-angles to each other, into uniform rectangular spaces, by which to readily locate and measure the perforations; but the sheets on which the copies are made need not be provided with such spaces, but may be blank. The direction of travel of the music-sheet is indicated by an arrow on each figure.

Referring particularly to Fig. 1: The section of the sheet at the left-hand end of the figure is perforated for "spiccato" playing. This involves raising and lowering the sounder at each of a plurality of melody notes being played in succession, and reversing the sounder or bowing device, to move it back and forth on the string or strings in playing the successive notes, to produce a semi-staccato effect. The eight uniform perforations a control electro-magnets for depressing note-producing fingering-devices of said patent, and the row of four similar perforations a^1 , respectively in line with the second, fourth, sixth and eighth perforation a , counting from the left-hand end of the figure, control the reversing devices, described in said application, to reverse the sounders when actuated through the perforations a ; while the two parallel series of small circular perforations a^2 , near the margin of the sheet, the members of which are equally spaced apart, control two of the four electro-magnets, which are in a row behind, and are inclined relative to the sounder-magnets, for interposing a rock-bar in the path of the rotating sounder-shafts to raise the operating sounder from its string at the end of each note played by it, as described in said patent.

The next section in order, of the sheet, is perforated for "saltato" playing, by springing the bow or sounder on the string it is playing. The perforations b control fingering devices for producing musical notes. Near the edge of this section are provided two parallel rows of spaced perforations, each row consisting of a series of spaced small round holes b^1 , succeeded, after an interval, by an elongated hole b^2 , which is succeeded by another series of spaced holes b^1 , and the latter is succeeded, after an interval, by another hole b^2 . The holes b^1 and b^2 control the bowing by actuating the sounder-regulator of the aforesaid patent to raise each sounder from its string first after a succession of short, light engagements therewith through holes b^1 , then after a longer engagement therewith through hole b^2 , then like the first engagement through the next hole b^1 , and finally like the longer engagement through the rear hole b^2 . While the sounders are operating under the successive circuit-closures through the perforations b^1 b^2 , they are reversed in direction of rotation through the perforations b^3 , b^3 , while fingering-devices are being controlled, for depressing them, through

perforations b respectively coinciding, cross-wise of the sheet, with perforations b^3 .

The section in Fig. 1 denoted by the heading "Arpeggio" represents four rows of elongated perforations c , involving different lengths, all being perforations through which circuit-closures are made for depressing at predetermined intervals fingering-device magnets for producing musical notes on the strings of the instrument. The two rows of round and relatively small spaced perforations c^1 near the margin of the section, with a similar perforation c^2 in advance of the inner row control the electro-magnets provided for regulating, as aforesaid, the degree of depression against the strings of the sounders, to intermittently lift the latter.

The section in Fig. 1 denoted by the heading "Accent", contains an elongated perforation d for a musical note produced by closing through that perforation the circuit which controls a fingering-device magnet; and the elongated perforation d^1 near the margin of the sheet is provided for closing the circuit through the electro-magnet which controls the magnet, energizing of which effects simultaneous depression of the sounder-magnets and sounders to a lower plane for increasing the pressure of the latter against the strings for accentuation, in accordance with an improvement set forth in said application.

The section of Fig. 1 which is headed "Diminuendo", signifying, in music, a gradual diminution in the volume of tone, shows a series of fingering-device-controlling elongated perforations e , of equal length, with their adjacent ends successively overlapping one another; and near the margin of the sheet is shown a series of elongated perforations e^1 , with their ends overlapping like, but more extensively than in the case of the perforations e . A single perforation e would suffice, however. The two rear-perforations e^1 are of the same length as the perforations e respectively in line with them, and the two advance perforations e^1 are shorter and of equal length relative to each other. The circuits containing the aforesaid inclined row of electro-magnets, for regulating the loudness of playing by the sounders against the violin-strings, are closed through the perforations e^1 to gradually diminish the loudness of playing of the sounders of the musical notes determined by the fingering-devices controlled by circuit-closing contacts through the perforations e .

For playing simultaneously all or several of the violin-strings with "pizzicato" accompaniment for picking or twanging them, the arrangement of perforations is employed which is represented in Fig. 2 in the section of the sheet headed "Duet with pizzicato accompaniment." At f is shown a long perforation through which to close the circuit of

an electro-magnet of, say, an E-string finger-
ing-device, for producing a melody-note and
along opposite sides of this perforation are
rows of round, small perforations f^1 and f^2 ,
5 with the members of one row in staggered re-
lation to those of the other. A perforation
like that at f is shown at g , through which to
close the circuit of an electro-magnet of say
an A-string fingering-device for producing a
melody-note; and on opposite sides of this
perforation are arranged rows of small perfo-
rations g^1 and g^2 , like those adjacent to the
perforation f . At h is provided a series of
spaced elongated perforations through which
15 to close the circuit of, say, a D-string finger-
ing-device electro-magnet, and at i is pro-
vided a similar series of perforations through
which to close the circuit of, say, a G-string
fingering-device electro-magnet. Near the
20 margin of the sheet, adjacent to the last-
named heading, is a row of spaced perfo-
rations k , and parallel with the row k is a simi-
larly arranged row of like perforations k^1 ,
through which to close the circuit of the
25 electro-magnets controlling picker-device
magnets respectively of the D and G strings
described in said application. Each pair of
perforations k k^1 is in alinement, crosswise of
the sheet, with a pair of perforations, h , i , so
30 that in the travel of the sheet the perfo-
rations k , k^1 close circuits of the picker-device
electro-magnets to engage the pickers inter-
mittently with their strings while fingering-
device magnets for those strings are ener-
35 gized intermittently through the perfo-
rations h i . A fingering-device magnet for the
E-string and one for the A-string are mean-
time energized through the perforations f and
 g , while the circuits of respectively adjacent
40 fingering-device magnets are closed intermit-
tently through the perforations f^1 f^2 , and g^1
 g^2 , to vibrate those magnets and produce the
effect of a "shake" in playing, involving the
slurring action of the link-members of the
45 fingering-devices disclosed in said patent.

The section of Fig. 2 headed "Pizzicato"
contains a longitudinal row of holes l in posi-
tion to register with a contact which is con-
nected, as shown in said patent, with a mag-
50 net of a picker device; and at the rearmost
longer one of the holes l there extends a
longer perforation l^1 , parallel with which, in
different planes, extend similar perforations
 l^2 , l^3 and l^4 , in line with contacts controlling
55 the circuit-closures respectively for the mag-
nets of the picker-devices of the other three
strings. At m are shown melody-note perfo-
rations on different planes through which to
close the circuits of different fingering-device
60 magnets, of the E-string, and in advance of
and alining with one of these perforations m
is a longer perforation n ; and perforations n^1 ,
 n^2 and n^3 , like the perforation n , are pro-
vided in proper positions in the sheet for
65 closing the circuits by contacts of fingering-

device magnets with which the longer rear-
perforations respectively come into registra-
tion by the travel of the music-sheet. Thus,
while the respective fingering-devices are op-
erating under control of the contacts with
70 which the perforations m are successively
brought into registration, the picker-device
magnet for the E-string is energized succes-
sively through the perforations l and when
the perforations n , n^1 , n^2 and n^3 register with
75 contacts for energizing electro-magnets of all
the strings simultaneously, all the picker-de-
vice magnets are simultaneously energized
through the perforations l^1 , l^2 , l^3 , l^4 , thus pro-
ducing the pizzicato effect in playing. 80

The arrangement of the perforations dis-
closed in the section of Fig. 2 headed
"Chords" is for producing the effect of
broken-chord playing on the violin. To
this end a perforation o for a G-string con-
85 tact of a fingering-device magnet and a simi-
lar perforation p for a D-string contact are
provided in line with each other, transversely
of the sheet, and these overlap at their rear
ends the forward ends of two longer perfo-
90 rations q and r , respectively in line with con-
tacts that control A and E string fingering-
device magnets. Similar longer perfo-
rations o^1 , p^1 , q^1 and r^1 aline with and are in
rear of the perforations o , p , q and r , respec-
95 tively. Thus, when the perforations o , p en-
counter the contacts in their paths, the re-
spective fingering-devices simultaneously
pitch two of the notes in the chord to be
played, and these are succeeded by the con-
100 tacts which thereupon register with the per-
forations q and r causing fingering-devices on
the A and E strings to pitch only the two
higher notes of the chord; and all the notes of
the chord are then sounded when the perfo-
105 rations o^1 , p^1 , q^1 , r^1 register with their respec-
tive fingering-device-controlling contacts.

By successively overlapping at their rear
ends, according to the representation in Fig.
2 in the section headed "Slur", similar elon-
110 gated perforations s , in different paths for
encountering different fingering-device con-
trolling contacts in succession, and prevent-
ing cessation of the encounter of the most
advanced perforation with its contact until
115 the encounter of the next perforation in or-
der with its contact takes place, the transi-
tion of pitch by one fingering-device to the
next produces the effect of a slur.

The section of the sheet denoted "Porta-
120 mento", in Fig. 3, contains an arrangement
of perforations, all for controlling fingering-
device and sounder magnets according to the
aforesaid patent to produce the effect in play-
ing of gliding from one tone to another with-
125 out break. Thus an elongated perforation t
is provided to register, in the travel of the
sheet, with a contact controlling a fingering
device electro-magnet of, say, an E-string,
and from the rear end of this perforation 130

there extends inclinedly downward and backward a row of spaced small, successively overlapping perforations t^1 , of which three are shown, terminating coincidently with the forward end of an elongated perforation t^2 in a different plane from the perforation t^1 , and in position to register with a contact controlling the electro-magnet of a fingering-device of the E-string or of another string.

With the rear end of the perforation t^2 coincides the forward end of a similar perforation t^3 , in a different plane to register with a contact controlling a fingering-device electro-magnet, say of the E-string; and from the rear end of the perforation t^3 there extends upwardly and backwardly a row of spaced small, successively overlapping perforations t^4 , of which four are shown, terminating coincidently with the forward end of an elongated perforation t^5 , in a plane to register, in the travel of the sheet with a contact controlling the electro-magnet of a fingering-device for, say, the E-string, also. Thus, upon completion of the playing of the note through the perforation t other fingering-devices are intermittently and quickly actuated through the perforations t^1 to connect the first note with the note played through the perforation t^2 , at the end of which a note is played through the perforation t^3 and is carried, by energizing through the perforations t^4 other fingering-device magnets in succession, as in the case of the perforation t^1 , to the note played through the perforation t^5 . In this way no break occurs from one melody-note to the other. The described arrangement of perforations for "portamento" playing is shown duplicated for playing, say, the A-string, and the perforations in the duplicated set are denoted by reference characters t^6 , t^{11} , t^{22} , t^{33} , t^{44} and t^{55} to identify them with the respectively corresponding perforations in the first-described set thereof.

To produce the "crescendo" effect for which the intermediate section of the sheet in Fig. 3 is perforated, a long perforation u is formed in a path to encounter a contact controlling the magnet of a fingering-device, of, say, an E-string. Within the length of this perforation is provided, in a path to encounter contacts which control the electro-magnets of the aforesaid device for regulating the degree of loudness of playing of the rotary sounders, four similar perforations u^1 in successively adjacent planes, with their adjacent ends overlapping one another, the advance-end of the foremost alining, crosswise of the sheet, with the advance-end of the perforation u . A longer perforation u^2 , with its rear end coincident with that of the perforation u , is placed to register, in the travel of the sheet, with the contact which controls the electro-magnet of the aforesaid device for simultaneously depressing all the sounders. Thus, when the fingering-device controlled

through the perforation u begins to play, the strokes of the sounder-magnets are regulated to gradually increase the pressure of the sounders against the strings, by the circuit-closures through the perforations u^1 ; and thereupon the magnet of the sounder-depressor is energized through the perforation u^2 to lower the plane from which to depress the sounders against the strings and still further augment the loudness of playing for producing the desired crescendo effect.

The section of the sheet denoted "Legato", in Fig. 3, is perforated to produce smooth, connected playing between successive-notes. To this end the electro-magnet of a reverser-device of the before mentioned application is energized through a perforation v^2 while a fingering-device magnet is energized through the perforation v^1 , and after another tone has been produced by energizing a fingering-device magnet through the perforation v , the rear end of which slightly overlaps the coincident advance-ends of the perforations v^1 and v^2 . The reverser is out of action while the perforation v is traversing the contact of a fingering-device magnet, and the sounder-magnet in series with the said fingering-device magnet therefore then rotates in the normal direction, which is contrary to its direction of rotation under the influence of the reverser-device. Thus, the effect of reversing the bow-action is produced in the transition from one tone to the other.

The "staccato" effect in playing is produced by the arrangement of perforations in the sheet represented in the first section thereof in Fig. 4. Circuit-closures of fingering-device magnets occur through a series of spaced perforations w on different planes, with each of which alines, crosswise of the sheet, a perforation w^1 , through which a contact closes the circuit of a reverser-device magnet. Thus, in the brief interval of depression of a fingering-device magnet through a perforation w , and the attendant engagement with the string of a sounder, the magnet of which is, as explained in said patent, in series with the fingering-device magnets for that string, the direction of rotation of the sounder is reversed from the normal direction of rotation thereof, and the sounder-magnet is deenergized each time a perforation w clears a contact, thereby to abruptly terminate the musical note, while the note-playing through each perforation w ceases between successive perforations.

To produce the effect of the "trill", a long perforation y is provided in position to encounter, in the travel of the sheet, a contact controlling a fingering-device magnet, and adjacent to the perforation y is a row of small perforations, at equal intervals apart, the advance-perforation in which is coincident with the corresponding end of the long perforation. As the perforation y passes over a

contact controlling the circuit-closure of a fingering-device magnet, the perforations y^1 pass intermittently over a contact controlling an adjacent fingering-device magnet in the same row to actuate that fingering-device vibrantly while the note represented by the perforation y is being played by the respective sounder in series with the said fingering-devices. The result is a trill-effect in playing. Another, or additional, trilling effect is produced by providing two parallel longitudinal rows of spaced short perforations y^2 and y^3 , with the members of one row in staggered relation to those in the other row. When these pass over contacts controlling the electro-magnets of adjacent fingering-devices on the same string, the magnet-armatures are actuated to vibrate the fingering-devices against the string.

The effect of the "shake", with which term the last section of the sheet in Fig. 4 is headed, is produced by closing the circuit of a fingering-device magnet through a long perforation z , between rows of spaced small perforations z^1 and z^2 , the members of which are disposed in staggered relation, from one to the other, as shown. While the circuit-closure of one fingering-device magnet continues through the perforation z , the electro-magnets of two fingering-devices flanking that of the one device, are alternately energized at equal intervals, (between which, of course, they become deenergized in succession) to play against the string with the effect that is produced by a human performer in vibrating a finger against a string for the same purpose.

The pattern-sheet thus described affords a guide in cutting music-sheets, and the person laying out such a sheet need only copy the arrangement of perforations in any section to produce the described effect thereof in the desired place on the music-sheet undergoing construction.

What I claim as new and desire to secure by Letters Patent is—

1. A perforated music-sheet for mechanically-played musical instruments of the viol family, provided with an elongated note perforation of a string of one pitch, small note-perforations in rows along opposite sides of said elongated perforation, the members of

said rows being in staggered relation from one row to the other, a row of perforations at one side of said elongated perforation representing a note of a string of another pitch, and a row of perforations through which to control the action of a picker-finger against said last-named string, the perforations in said last-named row alining, each, with a different perforation in the rows of said string-note perforations, the whole affording an arrangement of perforations for duet-playing with pizzicato accompaniment.

2. A perforated music-sheet for mechanically-played musical instruments of the viol family, provided with a series of note-perforations successively arranged through which to actuate the fingering-devices of one string, note-perforations in rear of said series, alining with each other crosswise of the sheet and through which to actuate simultaneously fingering-devices of all the strings, a row of spaced perforations to one side of said first named series of perforations, with the advance end of each of which a perforation in said row coincides, and a series of perforations at the rear end of said row extending parallel and coinciding with each other and with said rear note-perforations and through which and the perforations in said row the picker-finger devices of the instrument are actuated to produce the effect of pizzicato playing.

3. A perforated music-sheet for mechanically-played musical instruments of the viol family, provided with an elongated perforation representing a note, and a row of spaced smaller perforations along each side of said elongated perforation, with the members of said rows in staggered relation to each other from one row to the other and through which to alternately energize electro-magnets of fingering-devices on opposite sides of the electro-magnet of the fingering-device which is energized through said elongated perforation, and produce the "shake" effect in playing.

HENRY K. SANDELL.

In the presence of—

W. B. DAVIES,
J. H. LANDES.