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(54) Titre : HARMONICA POLYCHROMATIQUE
(54) Title: POLYCHROMATIC HARMONICA

(57) **Abrégé/Abstract:**

An adjustable chromatic harmonica incorporating an adjustable mouthpiece where, for each mouth-hole, the player's breath may be selectively connected to one or more available reed cells. This is by means of a rotatable cup-shaped valve, with an opening or port in its side, being mounted in each mouth-hole such that the port can be registered by rotation with one of a group of surrounding air ducts, each of which is connected to one or more reed cells in the body of the harmonica. In some embodiments an apertured slide is interposed between the mouthpiece and the body. In some embodiments means are provided for rotating the valves in independent groups while the harmonica is being played. In embodiments where each group of mouth-holes can be independently adjusted, a large number of physical states is possible. Consequently, some embodiments have the capability of playing chromatic melodies and several common chord types in all twelve musical keys.



ABSTRACT

An adjustable chromatic harmonica incorporating an adjustable mouthpiece where, for each mouth-hole, the player's breath may be selectively connected to one or more available reed cells. This is by means of a rotatable cup-shaped valve, with an opening or port in its side, being mounted in each mouth-hole such that the port can be registered by rotation with one of a group of surrounding air ducts, each of which is connected to one or more reed cells in the body of the harmonica. In some embodiments an apertured slide is interposed between the mouthpiece and the body. In some embodiments means are provided for rotating the valves in independent groups while the harmonica is being played. In embodiments where each group of mouth-holes can be independently adjusted, a large number of physical states is possible. Consequently, some embodiments have the capability of playing chromatic melodies and several common chord types in all twelve musical keys.

DESCRIPTION

Field of the Invention

The invention relates to the harmonica and more specifically to the harmonica mouthpiece. Through the incorporation of a novel mouthpiece it is possible to construct harmonicas that overcome many limitations of the prior art.

Background Of The Invention

Harmonicas of conventional design have a number of openings or *ports* spaced along the front of the instrument, each communicating with a *reed cell*, which in turn communicates with a blow activated *reed* and a draw activated reed. The instrument is played by blowing or drawing one's breath through these ports, thereby causing the reeds to sound. These harmonicas can be grouped into two main groups.

The first group are those in which the ports communicate directly with the reed cells, and consists largely of harmonicas designed for playing in one musical key, so are referred to as *diatonic* harmonicas.

- US588920 (Jacob Hohner, 1897) - classic diatonic harmonica

The second group are those in which the ports communicate indirectly with the reed cells via a *mouthpiece*. The most common of this type of harmonica is the *chromatic* harmonica.

- US1752988 (Wm. J. Haussler, 1930) - classic chromatic harmonica

A typical chromatic harmonica has two *reed plates*, each of which has all of the reeds of a diatonic harmonica. These are each affixed to the top and bottom surfaces of a *comb* which has two rows of cells, the upper row communicating with the upper reed plate and the lower row communicating with the lower reed plate. Also, every cell is open to the front surface of the comb. The assembly is configured so that each such cell contains a blow and draw reed and each *chamber* of the mouthpiece is aligned with a pair of cells consisting of one upper and one lower cell. The mouthpiece incorporates a manually operable sheet metal *slide* along its back surface which, as it alternates between its two resting positions, allows the mouthpiece chambers to communicate alternatively with either the upper or lower set of cells. With one of the reed plates tuned a semitone higher than the other, the player can use the slide to access all of the notes in the chromatic scale. (Other arrangements of the reeds and slide perforations are common but the purpose and musical effect are the same.)

One limitation of a chromatic harmonica of standard configuration is that the player is limited to only the chords that are initially available on each of the two sets of reeds. All of the following patents describe harmonicas that use a mouthpiece incorporating slides to achieve a greater variety of chords. Apparently, of those listed below, only DE1255465 became a commercial product, the "Chordomonica", but it has since gone out of production. The slide is a common source of air leakage and designs with more than one slide are seldom brought to market.

- DE841257C (Friedrich Lochel, 1952) - uses individual vertical slide for each hole
- DE868097C (Hans Bibus, 1953) - uses 3 slides
- AT216318 (Narodni Podnik, 1961) - uses 4 slides
- DE1255465 (Cham Ber Huang, 1967) - uses 2 slides
- US3986427 (Gene L. Swain, 1976) - uses multiple slides

Another limitation of the standard chromatic harmonica is that, although it can play all the notes of the chromatic scale, it is set up primarily to be played in one key with the ability to play any *accidental* notes as required. Alternative tunings can be used that allow more symmetry between keys but at the cost of reducing the already limited selection of chords available. The following patent demonstrates this.

- GB2120442 (J. Okumoto, 1983)

Another limitation, shared with most harmonicas, is that in general, alternating exhalations and inhalations of breath are required to play a melodic passage, thus making it difficult to play some passages in a continuous and smooth manner. A harmonica that has all the notes in the chromatic scale available as blow notes (or as draw notes) would solve this problem. The following patent specifically addresses this concern but again at the cost of reducing the selection of chords.

- US3674910 (James G. McKenzie, 1970)

The idea of a chord playing harmonica is a reoccurring theme in the patent record. At least two (the "Chordomonica" mentioned above and the "Harmonetta" described in the patent below) have been successfully manufactured, but most are impractical, either because of their bulkiness, mechanical complexity, or the air

leakage that accompanies the increased number of slides. While the instrument described in the patent below is both chromatic in melody and chords, it is bulky and inconvenient to use for playing melodies.

- US2827818 (Hans Bibus, 1958)

Some harmonica designs have used rotating elements of various kinds to select notes or chords.

- US2655068 (L. A. Ruben, 1953)
- US2567888 (W. F. Meyers, 1951)
- US2256682 (T. Machino, 1941)
- US1714663 (O. Fahrni, 1929)

Summary Of The Invention

The invention is of a harmonica incorporating a mouthpiece that uses a rotatable cylindrical cup in each chamber of the mouthpiece. Depending on its angle of rotation, each cup directs the player's breath to specific mouthpiece sub-chambers which in turn communicate with specific cells in the harmonica comb, thereby causing specific reeds to vibrate and sound.

Note: Typically, each cell in the comb would communicate with both a blow reed and a draw reed, however configurations where each cell communicates with a single reed are not precluded.

Note: The term 'mouthpiece' is meant to indicate that portion of the harmonica that is in front of the comb and designed to receive the player's breath. It is discussed herein as if it were separable but it could be integral with the comb in some configurations.

Each cup is of a cylindrical shape, or other suitable surface of revolution, and centrally located in each mouthpiece chamber, with its axis perpendicular to the front face of the harmonica. It is hollow and sealed at the back (facing the comb) but open at the front (facing the player). This front opening is coextensive with a round port in the front of the mouthpiece chamber, so as to receive the player's breath.

The cup also has one or more openings (typically one opening) in its side through which the player's breath can flow. The portion of the mouthpiece chamber that is not occupied by the cylinder is divided radially into two or more sub-chambers, each of which is substantially aligned with and open toward one or two cells of the harmonica comb. The cup is rotatable to predetermined angles such that each opening in its side is aligned with and communicates with one of the sub-chambers. The cup and sub-chambers are designed to minimize air leakage while allowing the cup to be rotated manually with moderate force.

In those configurations where a sub-chamber is aligned with two cells rather than one, there is a slide (similar in function to those in prior art) at the interface of mouthpiece and comb, which, as it alternates between its two resting positions, allows one cell or the other to communicate with that sub-chamber.

The preferred method of rotating each cup is by means of a small diameter shaft keyed into its base and extending through to, and beyond, the back of the harmonica. In the preferred embodiments described herein the portion of each shaft that extends beyond the back of the harmonica has a miniature timing pulley attached which is engaged by an associated miniature timing belt. (However, any other means could be used such as a system of gears or small electric motors, for example.)

The detailed description section that follows includes descriptions of several configurations of mouth piece, cup and reeds, some of which incorporate a slide. Also included are descriptions of the incorporation of two of these configurations into two preferred embodiments.

Note that in the preferred embodiments described herein, the cups rotate in groups such that every third (or fourth) cup along the harmonica rotates together. These preferred embodiments represent harmonicas that overcome many limitations of the prior art, in that they:

- allow the playing of melodies in all keys with equal ease;
- allow the playing of a variety of chords in all keys with equal ease;
- allow the playing of melodies in all keys using only all blow notes or all draw notes; and
- achieve this in an instrument similar in size to existing harmonicas.

Description of the Drawings (provisional)

Figure 1 is an exploded view of the first preferred embodiment of the invention.

Figure 2 shows three cutaway details of the first preferred embodiment of the invention.

Figure 3 is a representative view of the first preferred embodiment of the invention.

Detailed Description Of The Invention

Various Configurations of Mouthpiece and Reeds

This purpose of the list of configurations is to assist the reader in understanding the function of the preferred embodiments and is not intended to represent the full range of possibilities or to be exhaustive in any way.

- Configuration allowing 2-way selection of reeds (as in a chromatic)
 - each mouthpiece chamber is divided into upper and lower sub-chambers by a horizontal division.
 - each rotatable cup has a single opening on its cylindrical wall and two resting positions where the single opening aligns with and communicates with one or the other of the two sub-chambers. Thus a 180-degree rotation is required to change positions.
 - The comb has two rows of cells open toward the mouthpiece, with each cell the full width of a mouthpiece chamber. Thus there are two reed cells facing each mouthpiece chamber, each one aligned with one of the two sub-chambers.
 - The upper row of cells communicates with an upper reed plate that has alternating blow and draw reeds mounted, so that each cell has both a blow and a draw reed. The lower row is configured likewise.
 - In summary, there are 4 reeds per mouthpiece chamber residing on two reed plates, and each reed cell has a blow and a draw reed.
- Alternative configuration allowing 2-way selection of reeds (as in a chromatic)
 - each mouthpiece chamber is divided horizontally and vertically to form four sub-chambers
 - each rotatable cup has two opposing openings on its cylindrical wall and four resting positions such that each opening aligns with and communicates with one of the four sub-chambers. Thus a 90-degree rotation is required to change position.
 - The comb has two rows of cells open toward the mouthpiece, with each cell one half the width of a mouthpiece chamber. Thus there are four reed cells facing each mouthpiece chamber, each one aligned with the one of the four sub-chambers.
 - Each row of cells communicates with the reeds from one reed plate, with each upper cell communicating with a blow reed and each lower cell with a draw reed.
 - Note that the cup is always in communication with two of the four sub-chambers cells, and thereby in communication with two reed cells, one containing a blow reed and one containing a draw reed.
 - Note that because the cup has two openings across from one another, a rotation of 180-degrees results in no change. So even though there are four positions there are, in effect, only two positions.
 - In summary, there are four reeds per chamber residing on two reed plates, and each cell has a single reed. (Because the cup has two openings each part of the mouthpiece is always in communication with both a blow and a draw reed.)
- Configuration allowing 3-way selection of reeds
 - Each mouthpiece chamber is divided radially to form three sub-chambers such that there is an upper left sub-chamber, an upper right sub-chamber and a lower sub-chamber. Each of the two upper chambers have a width that is half the width of the mouthpiece chamber. The lower chamber has a width that is the full width of the mouthpiece chamber.
 - Each rotatable cup has a single opening on its cylindrical wall and three resting positions where the single opening aligns with and communicates with one of the three sub-chambers. Thus a 120-degree rotation is required to change position.
 - The comb has an upper row of cells open toward the mouthpiece, with each cell one half the width of a mouthpiece chamber. The upper row of cells communicates with two upper reed plates, one containing blow reeds and one containing draw reeds such that every cell has both a blow reed and a draw reed.

- The comb has a lower row of cells open toward the mouthpiece with each cell the *full* width of a mouthpiece chamber. The lower row of cells communicates with one lower reed plate that has alternating blow and draw reeds mounted, so that each cell has both a blow and a draw reed.
- Thus there are three cells facing each mouthpiece chamber, two upper cells aligned with the two upper sub-chambers and one lower cell aligned with the one lower sub-chamber.
- In summary there are six reeds per chamber residing on three reed plates.
- Configuration allowing 4-way selection of reeds
 - Each mouthpiece chamber is divided horizontally and vertically to form four sub-chambers.
 - Each rotatable cup has a single opening on its cylindrical wall and four resting positions where the single opening aligns with and communicates with one of the four sub-chambers. Thus a 90-degree rotation is required to change position.
 - The comb has two rows of cells open toward the mouthpiece, with each cell one half the width of a mouthpiece chamber. The upper row of cells communicates with two upper reed plates, one containing blow reeds and one containing draw reeds such that every cell has both a blow reed and a draw reed. The lower row of cells is configured likewise.
 - Thus there are four cells facing each mouthpiece chamber, and aligned with its four sub-chambers.
 - In summary there are eight reeds per chamber residing on four reed plates.
- Configuration Used in the First Preferred Embodiment
 - Each mouthpiece chamber is divided radially to form three sub-chambers such that there is an upper left sub-chamber, an upper right sub-chamber and a lower sub-chamber. Each of the two upper chambers have a width that is half the width of the mouthpiece chamber. The lower chamber has a width that is the full width of the mouthpiece chamber.
 - Each rotatable cup has a single opening on its cylindrical wall and three resting positions where the single opening aligns with and communicates with one of the three sub-chambers. Thus a 120-degree rotation is required to change position.
 - The comb has two rows of cells open toward the mouthpiece, with each cell one half the width of a mouthpiece chamber. The upper row of cells communicates with two upper reed plates, one containing blow reeds and one containing draw reeds such that every cell has both a blow reed and a draw reed. The lower row is configured likewise.
 - For each mouthpiece chamber the upper-left sub-chamber is aligned with the upper-left reed cell and the upper-right sub-chamber is aligned with the upper-right reed cell. However, the lower sub-chamber is aligned with a pair of reed cells, namely the lower-left and lower-right reed cells together.
 - The mouthpiece incorporates a manually operable *slide* along the lower section of its back surface behind the lower sub-chambers which, as it alternates between its two resting positions, allows each lower sub-chamber to communicate alternatively with either the lower-left or lower-right reed cell.
 - In summary there are eight reeds per chamber residing on four reed plates. Each cell has a blow and a draw reed.
- Configuration Used in the Second Preferred Embodiment
 - Each mouthpiece chamber is divided radially to form three sub-chambers such that there is an upper left sub-chamber, an upper right sub-chamber and a lower sub-chamber. Each of the two upper chambers have a width that is half the width of the mouthpiece chamber. The lower chamber has a width that is the full width of the mouthpiece chamber.
 - Each rotatable cup has a single opening on its cylindrical wall and three resting positions where the single opening aligns with and communicates with one of the three sub-chambers. Thus a 120-degree rotation is required to change position.
 - The comb has an upper row of cells open toward the mouthpiece, with each cell one half the width of a mouthpiece chamber. The upper row of cells communicates with two upper reed

plates, one containing blow reeds and one containing draw reeds such that every cell has both a blow reed and a draw reed.

- The comb has a lower row of cells open toward the mouthpiece with each cell the full width of a mouthpiece chamber. The lower row of cells communicates with one lower reed plate that has alternating blow and draw reeds mounted, so that each cell has both a blow and a draw reed.
- For each mouthpiece chamber the upper-left sub-chamber is aligned with the upper-left reed cell and the upper-right sub-chamber is aligned with the upper-right reed cell.
- Note that although the lower reed cells and the lower sub-chambers are both the full width of a mouthpiece chamber, they are *not* aligned horizontally. The lower reed-cells are shifted along the harmonica by half their width, such that each cell straddles two neighbouring chambers, and consequently each lower sub-chamber straddles two neighbouring lower reed cells. (Note that there will be reed cells that extend beyond either end of the mouthpiece as a necessary result of this geometry. This does not affect or limit the function of the harmonica or invalidate this description.)
- The mouthpiece incorporates a manually operable *slide* along the lower section of its back surface behind the lower sub-chambers which, as it alternates between its two resting positions, allows each lower sub-chamber to communicate alternatively with either the reed cell that it is straddling on the left or the reed cell that it is straddling on the right.
- There are six reeds per chamber residing on three reed plates. Each cell has a blow and a draw reed.

Rotation of the cups

- When the cups rotate to different resting positions they direct the player's flow of breath to different reed cells thereby forming different musical notes. The cups can be rotated individually, be interconnected so that they rotate in unison, or be interconnected so that they rotate in groups, as exemplified by the two preferred embodiments presented herein.
- The preferred method of rotating each cup is via a small diameter shaft keyed into its base and extending through to, and beyond, the back of the harmonica.
- In the preferred embodiments described herein the portion of each shaft that extends beyond the back of the harmonica has a miniature timing pulley attached which is engaged by an associated miniature timing belt. (However, any other means could be used such as a system of gears or small electric motors, for example.)

Preferred Embodiments

- The First Preferred Embodiment (Figure 1 is an exploded view of this embodiment.)
 - The first preferred embodiment incorporates the configuration of comb, reeds and mouthpiece described above in the section 'Configuration Used in the First Preferred Embodiment'. The number of mouthpiece chambers chosen to illustrate this embodiment is nine.
 - The cups are interconnected to rotate in three separate groups, namely: the cups in chambers 1, 4 & 7 (as counted from the left); the cups in chambers 2, 5 & 8; and the cups in chambers 3, 6 & 9.
 - Each cup has small diameter shaft keyed into its base and extending through to, and beyond, the back of the harmonica. The extending portion of the shafts have miniature timing pulleys attached such that they can be driven by a system with three miniature timing belts, one for each group. The belts are driven by three driving pulleys at the right end of the harmonica. These driving pulleys are turned, via concentric axles, by three larger 'finger wheels' designed and located to be easily accessible to the player's hand. These wheels have detent stops that hold the system of belts, pulleys and cups in each predetermined position.
 - The slide is moved by a cam and gears, with the driving gear being located with the above mentioned 'finger wheels' and thereby easily accessible to be rotated by the player's hand.
 - The pitch of the reeds increases from left to right along the harmonica in a repeating pattern. For each mouthpiece chamber the lower-left blow reed is the lowest in pitch, the upper-left blow reed is one semitone higher in pitch, the upper-right blow reed is another semitone higher and the lower-right blow reed is yet another semitone higher.

- Every cell has both a blow reed and a draw reed with the draw reed being one full tone higher in pitch than the blow reed.
- This pattern repeats for each mouthpiece chamber such that each reed is four semitones higher than the reed in the corresponding position in the chamber immediately to the left. (Which means that they are an octave higher than the notes of the chamber three to the left.)
- Within the range of the harmonica, every note in the chromatic scale is available as both a blow note and a draw note.
- The cups of each of the three groups can be rotated to three different positions independently of the other groups. Thus, as a whole, the harmonica can be set to 27 different 'settings'. As well the slide has two positions, increasing the total to 54 settings, and thereby 54 combinations of notes. When the note combinations available using draw notes are added the result is a total of 108 combinations. (See example below.)
- The absolute pitch of the harmonica could be any reasonable note, but for the purposes of this description assume that the lowest blow note is a G note.
- That determined, and assuming that the slide is in its left position, blowing in the first port of the harmonica will produce G, G# or A depending on the position of the rotatable cup. Similarly the second port will produce B, C or C# and the third port will produce D#, E or F. Because the cups in these three chambers are in different groups and can be rotated independently, there are 27 possible combinations of these notes. They are:

| | | | | | | | | |
|---------|--------|--------|---------|--------|--------|----------|---------|---------|
| G-B-D# | G-B-E | G-B-F | G-C-D# | G-C-E | G-C-F | G-C#-D# | G-C#-E | G-C#-F |
| G#-B-D# | G#-B-E | G#-B-F | G#-C-D# | G#-C-E | G#-C-F | G#-C#-D# | G#-C#-E | G#-C#-F |
| A-B-D# | A-B-E | A-B-F | A-C-D# | A-C-E | A-C-F | A-C#-D# | A-C#-E | A-C#-F |

- Assuming that the slide is in its *right* position, blowing in the first port of the harmonica will produce G#, A or A# depending on the position of the rotatable cup. Similarly the second port will produce C, C# or D and the third port will produce E, F or F#. As above, there are 27 possible combinations of these notes. They are:

| | | | | | | | | |
|--------|--------|---------|---------|---------|----------|--------|--------|---------|
| G#-C-E | G#-C-F | G#-C-F# | G#-C#-E | G#-C#-F | G#-C#-F# | G#-D-E | G#-D-F | G#-D-F# |
| A-C-E | A-C-F | A-C-F# | A-C#-E | A-C#-F | A-C#-F# | A-D-E | A-D-F | A-D-F# |
| A#-C-E | A#-C-F | A#-C-F# | A#-C#-E | A#-C#-F | A#-C#-F# | A#-D-E | A#-D-F | A#-D-F# |

- Assuming that the slide is in its *left* position, *drawing* in the first port of the harmonica will produce A, A# or B depending on the position of the rotatable cup. Similarly the second port will produce C#, D or D# and the third port will produce F, F# or G. As above, there are 27 possible combinations of these notes. They are:

| | | | | | | | | |
|---------|----------|---------|--------|---------|--------|---------|----------|---------|
| A-C#-F | A-C#-F# | A-C#-G | A-D-F | A-D-F# | A-D-G | A-D#-F | A-D#-F# | A-D#-G |
| A#-C#-F | A#-C#-F# | A#-C#-G | A#-D-F | A#-D-F# | A#-D-G | A#-D#-F | A#-D#-F# | A#-D#-G |
| B-C#-F | B-C#-F# | B-C#-G | B-D-F | B-D-F# | B-D-G | B-D#-F | B-D#-F# | B-D#-G |

- Assuming that the slide is in its *right* position, drawing in the first port of the harmonica will produce A#, B or C depending on the position of the rotatable cup. Similarly the second port will produce D, D# or E and the third port will produce F#, G or G#. As above, there are 27 possible combinations of these notes. They are:

| | | | | | | | | |
|---------|--------|---------|----------|---------|----------|---------|--------|---------|
| A#-D-F# | A#-D-G | A#-D-G# | A#-D#-F# | A#-D#-G | A#-D#-G# | A#-E-F# | A#-E-G | A#-E-G# |
| B-D-F# | B-D-G | B-D-G# | B-D#-F# | B-D#-G | B-D#-G# | B-E-F# | B-E-G | B-E-G# |
| C-D-F# | C-D-G | C-D-G# | C-D#-F# | C-D#-G | C-D#-G# | C-E-F# | C-E-G | C-E-G# |

- Out of these 108 combinations there are 76 unique combinations. They include all 12 keys of triad versions of six different chords (diminished, major, minor, seventh, suspended fourth, and flat fifth) as well as four augmented-fifth chords.

- The Second Preferred Embodiment
 - The second preferred embodiment incorporates the configuration of comb, reeds and mouthpiece described above in the section 'Configuration Used in the Second Preferred Embodiment'. The number of mouthpiece chambers chosen to illustrate this embodiment is eight.
 - The cups are interconnected to rotate in four separate groups, namely: the cups in chambers 1 & 5 (as counted from the left) ; the cups in chambers 2 & 6; the cups in chambers 3 & 7; and the cups in chambers 4 & 8.
 - Each cup has small diameter shaft keyed into its base and extending through to, and beyond, the back of the harmonica. The extending portion of the shafts have miniature timing pulleys attached such that they can be driven by a system with four miniature timing belts, one for each group. The belts are driven by four pulleys at the right end of the harmonica. These driving pulleys are turned, via concentric axles, by four larger 'finger wheels' designed and located to be easily accessible to the player's hand. These wheels have detent stops that hold the system of belts, pulleys and cups in each predetermined position.
 - The slide is moved by a cam and gears, with the driving gear being located with the above mentioned 'finger wheels' and thereby easily accessible to be rotated by the player's hand.
 - The pitch of the reeds increases from left to right along the harmonica in a repeating pattern. For each mouthpiece chamber the lower-left blow reed is the lowest in pitch, the upper-left blow reed is one semitone higher in pitch, the upper-right blow reed is another semitone higher and the lower-right blow reed is yet another semitone higher. NOTE: Because the lower reed cells straddle two neighbouring mouthpiece chambers (as described above) The lower-left reed cell of each chamber is in fact the same cell as the lower-right cell of the chamber to the left.
 - Every cell has both a blow reed and a draw reed with the draw reed being one full tone higher in pitch than the blow reed.
 - This pattern repeats for each mouthpiece chamber such that each reed is three semitones higher than the reed in the corresponding position in the chamber immediately to the left. (Which means that they are an octave higher than the notes of the chamber four to the left.)
 - Within the range of the harmonica, every note in the chromatic scale is available as both a blow note and a draw note.
 - The cups of each of the four groups can be rotated to three different positions independently of the cups in the other groups. Thus, as a whole, the harmonica can be set to 81 different '*settings*'. As well the slide has two positions, increasing the total to 162 settings, and thereby 162 combinations of notes. When the note combinations available using draw notes are added the result is a total of 324 combinations. (See example below.)
 - The absolute pitch of the harmonica could be any reasonable note, but for the purposes of this description assume that the lowest blow note is a G note.
 - That determined, and assuming that the slide is in its left position, blowing in the first port of the harmonica will produce G, G# or A depending on the position of the rotatable cup. Similarly the second port will produce A#, B or C, the third port will produce C#, D or D#, and the fourth port will produce E, F or F#. Because the cups in these four chambers are in different groups and can be rotated independently, there are 81 possible combinations of these notes.
 - Assuming that the slide is in its *right* position, blowing in the first port of the harmonica will produce G#, A or A# depending on the position of the rotatable cup. Similarly the second port will produce B, C or C#, the third port will produce D, D# or E, and the fourth port will produce F, F# or G. Because the cups in these four chambers are in different groups and can be rotated independently, there are 81 possible combinations of these notes.
 - Assuming that the slide is in its *left* position, *drawing* in the first port of the harmonica will produce A, A# or B depending on the position of the rotatable cup. Similarly the second port will produce C, C# or D, the third port will produce D#, E or F, and the fourth port will produce F#, G or G#. Because the cups in these four chambers are in different groups and can be rotated independently, there are 81 possible combinations of these notes.

- Assuming that the slide is in its *right* position, drawing in the first port of the harmonica will produce A#, B or C depending on the position of the rotatable cup. Similarly the second port will produce C#, D or D#, the third port will produce E, F or F#, and the fourth port will produce G, G# or A. Because the cups in these four chambers are in different groups and can be rotated independently, there are 81 possible combinations of these notes.
- Out of these 324 combinations there are approximately 195 unique combinations. It can be shown that they include all of the common 4-note chords that are used in jazz and other modern music, in all 12 keys.

CLAIMS

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An adjustable harmonica comprising:
 - a. a body having a plurality of cells formed therein, each cell extending to the front of said body;
 - b. a plurality of tuned vibratable reeds disposed within said body, each reed being situated in an operative relationship to one of said cells in said body;
 - c. a mouthpiece adjoined to the front of said body,
 - d. said mouthpiece having a plurality of valve-chambers formed therein, each valve-chamber extending to the front of said mouthpiece, and
 - e. said mouthpiece additionally having a cooperating plurality of groups of ducts formed therein, such that for each valve-chamber and cooperating group of ducts, each duct in said group connects said valve-chamber to one or more of said cells in said body; and
 - f. a cooperating plurality of cup-shaped valves, one valve for each of said valve-chambers, each valve having a port formed through its side;
 - g. where each valve is rotatably mounted within said cooperating valve-chamber such that the open end of said valve is directed toward the front of said mouthpiece and such that said port of said valve is selectively registrable with each duct in said cooperating group of ducts, by rotation of said valve,

whereby a continuous air passage is selectively formed from the front of said valve-chamber, through said mouthpiece to one or more thereby selected cells.

2. An adjustable harmonica as defined in Claim 1, further comprising one or more movable apertured slides interposed between said mouthpiece and said body.
3. An adjustable harmonica as defined in Claim 1, further comprising means for rotating said valves.
4. An adjustable harmonica as defined in Claim 1, further comprising a system of cooperating components for rotating said valves.
5. An adjustable harmonica as defined in Claim 1, further comprising a system of cooperating mechanical components for rotating said valves.
6. An adjustable harmonica as defined in Claim 1, further comprising a system of toothed pulleys and toothed belts for rotating said valves.

DRAWINGS (More to follow in future submission.)

Fig. 1

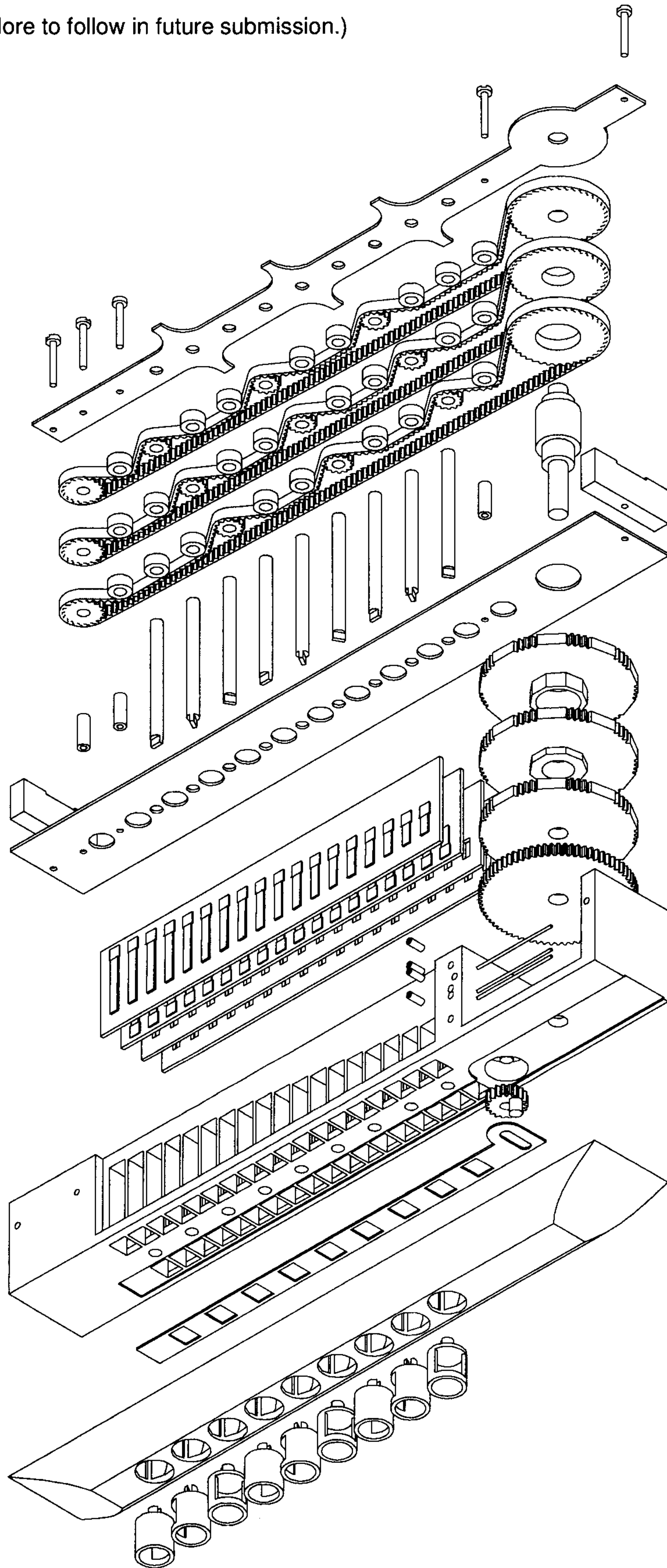


Fig. 2

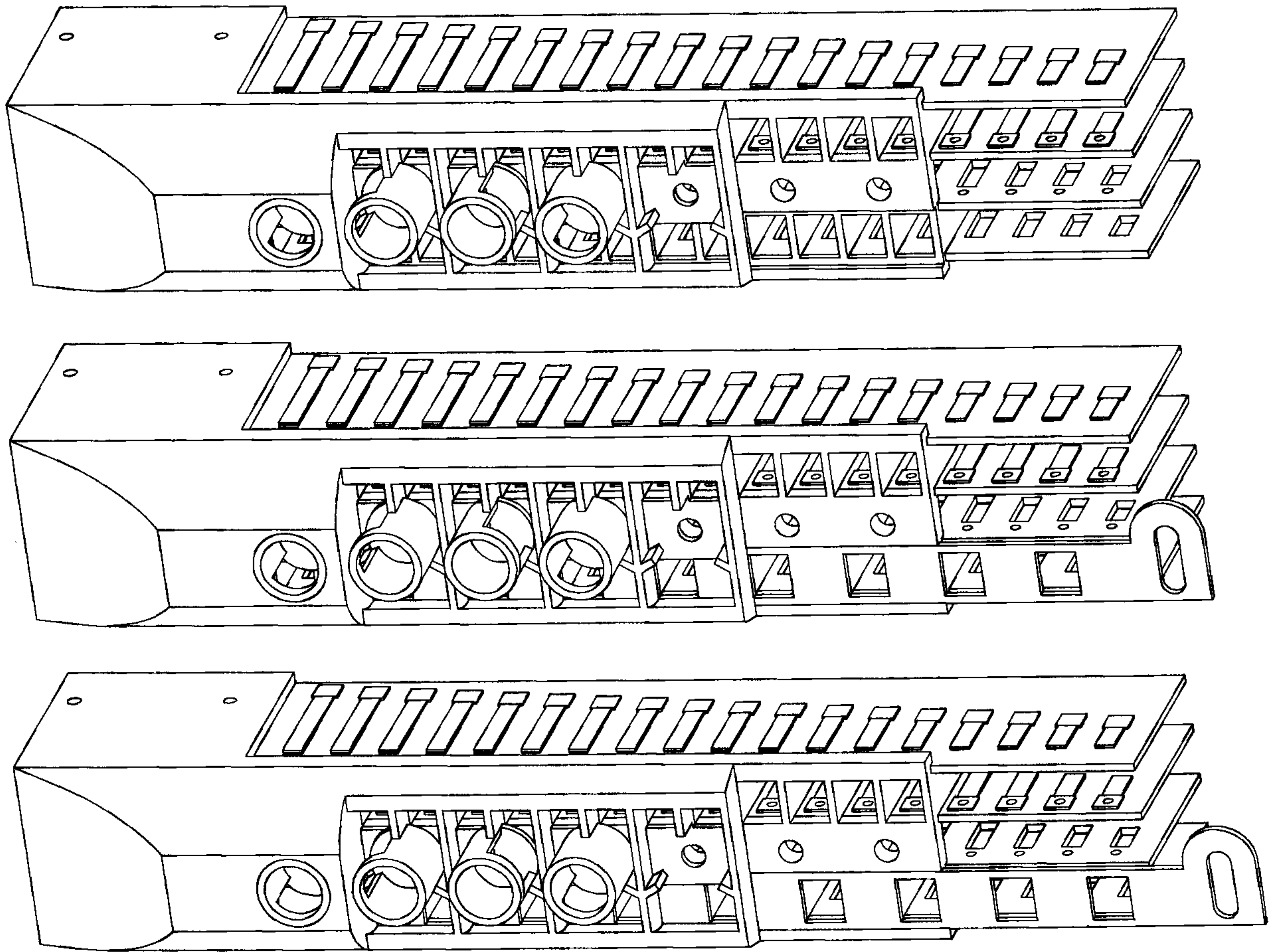


Fig. 3

