G. E. F. KASTNER.

Pyrophone.

No. 164,458. Patented June 15, 1875.

Fig: 1

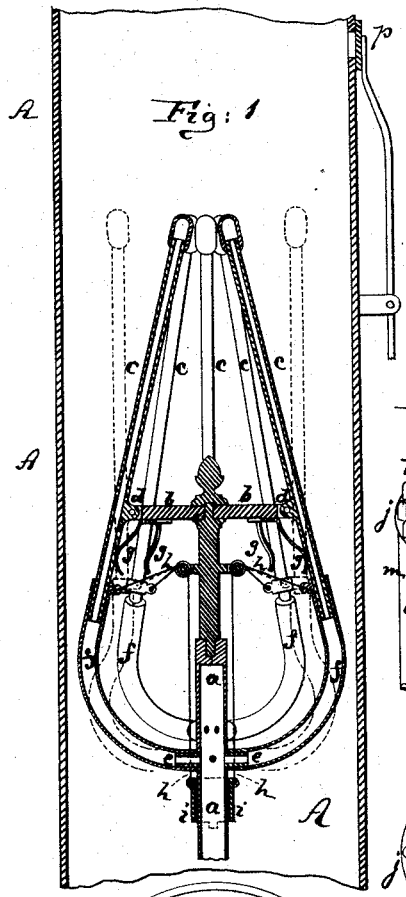



Fig: 3

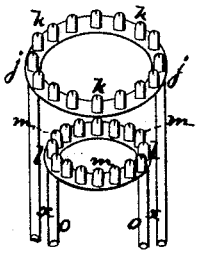


Fig: 4

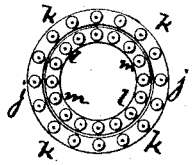
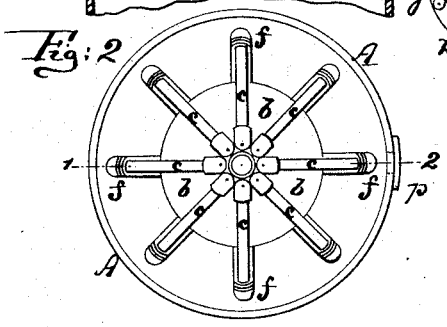


Fig: 2




Witnesses:

A. Moraga.

E. L. Webb.

Inventor:

Georges E. F. Kastner

by his attorney

A. V. Briesen

# UNITED STATES PATENT OFFICE.

GEORGES EUGÈNE FRÉDÉRIC KASTNER, OF PARIS, FRANCE.

## IMPROVEMENT IN PYROPHONES.

Specification forming part of Letters Patent No. **164,458**, dated June 15, 1875; application filed December 24, 1874.

*To all whom it may concern:*

Be it known that I, GEORGES EUGÈNE FRÉDÉRIC KASTNER, of Paris, France, have invented Improvements in the musical instrument known as the Pyrophone; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the annexed sheet of drawings, making a part of the same.

This invention relates to improvements in a musical instrument known as the pyrophone, in which musical sounds are produced by the vibration of flames of hydrogen gas within glass or other tubes.

It is well known that if a flame of hydrogen gas be introduced within a glass or other tube, and if it be so placed as to be capable of vibrating, there is formed around this flame—that is to say, upon the whole of its enveloping surface—an atmosphere of hydrogen gas, which, in uniting with the oxygen in the air of the tube, burns in small portions, each composed of two parts of hydrogen to one of oxygen, the combustion of this mixture of gases producing a series of slight explosions or detonations. If such a gaseous mixture, exploding in small portions at a time, be introduced at a point about one-third of the length of the tube from the bottom, and if the number of these detonations be equal to the number of vibrations necessary to produce a sound in the tube, all the acoustic conditions requisite to produce a musical tone are fulfilled. This sound may be caused to cease either, first, by increasing or reducing the height of the flame, and consequently increasing or diminishing its enveloping surface, so as to make the number detonations no longer correspond with the number of vibrations necessary to produce a musical sound in the tube, or, secondly, by placing the flame at such a height in the tube as to prevent the vibration of the enveloping film.

Another mode, which is that employed in the pyrophone, being the instrument invented by me, consists in the use of a double burner, producing two or more flames, the sum of whose detonations is equal to the number of vibrations necessary for producing a musical sound in the tube. The two branches of the burner are jointed so that they may be made to approach or recede from one another by means of a key and suitable mechanism, as in a piano. When no sound is to be produced the two branches, and consequently the two flames or their explosive atmospheres, are brought together, or nearly so, whereby there is an interference of the two flames, and the sound ceases; but by separating or isolating the flames their vibration will be re-established, and the sound will be produced in the glass or porcelain tube by which they are inclosed.

The following is the principle upon which the musical instrument known by the name of pyrophone is based, and which may be briefly described as consisting of a series of glass or other tubes, in which two or more separate flames of suitable size are introduced at a point about one-third of the length of the tube from the bottom, said flames vibrating in unison, and the sound continuing as long as the flames are separated, but ceasing immediately they are brought into contact.

As above mentioned, the sound is produced or caused to cease by separating or isolating the flames or bringing them together, this movement of the flames being effected through the agency of mechanism operated from a keyboard.

This mode, by producing an interference of the vibrating flames, is the one which I employ, by preference, as being the most practical; but I may obtain the same result by the method hereafter described, by which I am enabled to produce in the same tube not only its fundamental tone, but also the "sharp," semitones, and intermediate tones. To this end a hole is made in the surrounding tube at about one-third of its length from the top, and as the flames must be placed in the tube at about one-third of its length from the bottom, as before mentioned. This hole will be equidistant from the top of the tube and from the flames—that is to say, at the point at which is formed what is termed a "note." By uncovering this hole, by means of a key, for example, the sound will cease, as the flames will then be placed in the same conditions

with regard to the tube as if they had been displaced from the position which they must occupy in order to produce the sound, as before explained. Immediately the hole is closed the sound will be produced.

If, instead of the hole being located at one-third of the length of the tube, it be placed at half this distance, or one-sixth, the opening of the hole will no longer cause a cessation of the sound, but will produce a sharp or semitone higher than the fundamental sound of the tube.

The greater the size of the tube the greater should be the size of the flames, and vice versa. The smaller the flames the greater are the number of vibrations, and the more rapid and acute they become.

From this it will be understood: First, that, if in a glass tube, in which are one or more vibrating flames producing the fundamental tone of the tube, it be desired to produce the first harmonic of this tube, it is simply necessary to gradually diminish the size of the flames within a given limit, at same time lowering the burner and the flames to a point at one-sixth of the length of the tube, in order that the phenomena of interference may be produced under their normal conditions, according to the general principle before stated. Secondly. That if the division of the node and antinodes of the waves of air in the tube be varied, the same tube may be made to produce several harmonics. Thirdly. That if holes be made in the tube at proper intervals, the air in the tube instead of producing harmonics will produce vibrations in proportion to the flames, and if the dimensions of the flames be slightly increased or diminished, these vibrations will produce sounds intermediate of the harmonics. Thus, a tube having several holes may be made to constitute a kind of gas clarionet, the opening and closing of the holes therein, as well as the height and position of the flames, being governed by any suitable mechanism for establishing the required relations between the opening and closing of the holes, and the size and positions of the flames. Fourthly. In some cases, even without altering the position of the flames, a higher but less powerful tone may be obtained.

The holes may also be made in the lower third of the length of the tube instead of in the upper third of its length.

Another improvement consists in an improved arrangement of the burners, whereby they are adapted for burning ordinary illuminating gas instead of pure hydrogen gas, as before. There is, however, this difficulty in employing common gas, which it is known is a bicarburet of hydrogen more or less pure—that is to say, containing traces of arseniated and phosphoreted hydrogen, as well as a certain proportion of carbonic acid. Now, the carbon, especially that contained in the gas, is apt to prevent the slight explosions above referred to, as the oxygen of the air instead of combining with the hydrogen combines with the carbon, and the detonations are no longer produced.

It has, however, been found by experiment that the larger the flame the more carbon it contains; but that, if the size of the flame be diminished, the proportion of carbon contained diminishes also, but to a greater extent. Thus, if a flame of given size contain ten parts of carbon a flame half the size will not contain five parts, but only three or three and one-half parts of carbon; a flame one-fourth the size, one-half or one-fourth part only of carbon, and so on.

I therefore propose to employ burners having a number of nipples, each giving a very small flame—that is to say, a flame containing very little or no carbon; but in order to obtain the requisite amount of vibrating surface—that is to say, a number of detonations equal to the number of vibrations requisite to produce a musical tone in the tube—I have devised the improved construction of burner, which I will now describe.

The first improvement, therefore, consists in employing 2 6 7 8 9 10, or a greater or less number of branches or nipples, each furnishing a very small flame, the aggregate number of the vibrations of all these flames being equal to the number of vibrations of the air contained in the tube requisite to produce a singing sound therein. The cessation of the sound is caused both by bringing the whole of these small flames together, or by two's and two's, and the sound is produced on the separation of each of the flames.

The burners may be arranged and constructed in various ways—for instance, the burner may be composed of a number of separate and equidistant branches, jointed around a disk, terminating in separate nipples, which are moved away from or toward a common center, to produce or stop the sound, as required; or the burner may be two concentric ring-tubes, both furnished with the same number of nipples, the one ring being smaller than the other, so that it may be introduced within the larger, and when the two rings of nipples are in the same horizontal plane, the flames of the one will be brought close to those of the other, to stop the sound which is produced immediately the rings are separated. Holes or a continuous slit on top of the rings might be substituted for the nipples.

In order that my invention may be more readily understood, I have illustrated it in the accompanying drawings, in which—

Figure 1 shows, on an enlarged scale, a central vertical section, on line 1 2, Fig. 2, of a burner composed of a number of branches, which are disposed around a disk, and capable of being made to approach or recede from a common center. Fig. 2 is a plan of a burner.

A is the glass or porcelain surrounding-tube.

*a*, the gas-inlet pipe, surmounted by a supporting-disk *b*. *c c* are branch-tubes, in any suitable number, pivoted at *d*, around the disk *b*, and each terminating in a small nipple. Flexible couplings *f* connect the branch-pipes *c* with the radial supply-pipes *e* of the pipe *a*. *g* are springs, attached to the disk *b*, and serving to make the nipples at which the flames emerge converge toward the center when no sound is to be produced. *h* are cords, attached one to each branch *c*, and passing round guide-pulleys, and connected to a sliding collar, *i*, on pipe *a*. This collar is connected, by suitable mechanism, with one of the keys of a key-board, so that on pressing down the key, the slide *i* will be drawn down, the branch-tubes oscillated, as shown in dotted lines, and the circle of nipples expanded, so that the latter, being thus isolated from one another, the desired sound will be produced. *p* represents a damper closing one of the holes in the pipe A, hereinbefore more fully referred to.

Fig. 3 shows, in perspective, a burner composed of two concentric rings, *j l*, with nipples *k m*, and Fig. 4 shows a plan of the same. In these two figures the letters *x o* represent gas supply-pipes to rings *j l*, respectively. The rings *j l* are brought to the same level when the circles of nipples *k m* are to be brought together to effect the cessation of sound, and brought to different levels, as shown in Fig. 3, by means of a key and intermediate mechanism, before explained, when the sound is to be produced.

The improved compound burners or perforated tubes may be applied to chandeliers, gasoliers, stage-foot lights, and in gas-lighting apparatus generally, by substituting the same for the ordinary burners, or used in combination therewith, whereby both light and sound may be produced.

In the case of gasoliers, which are usually placed at the center of the ceiling, the assemblage or the isolation of the flames in the improved acoustic burners, or the opening and closing of the holes in the tube, and the shifting of the burners may be operated from a key-board in an adjoining room, having electrical connection with said burners.

I claim—

1. A musical instrument, composed of a tube, A, and of two or more burners, arranged therein, one or more of said burners being movable, substantially as and for the purpose herein shown and described.

2. The musical instrument, composed of the tube A, perforated, and of one or more burners within said tube, substantially as specified.

GEORGES EUGÈNE FRÉDÉRIC KASTNER.

Witnesses:
ROBT. M. HOOPER,
EMILE DUHAN.