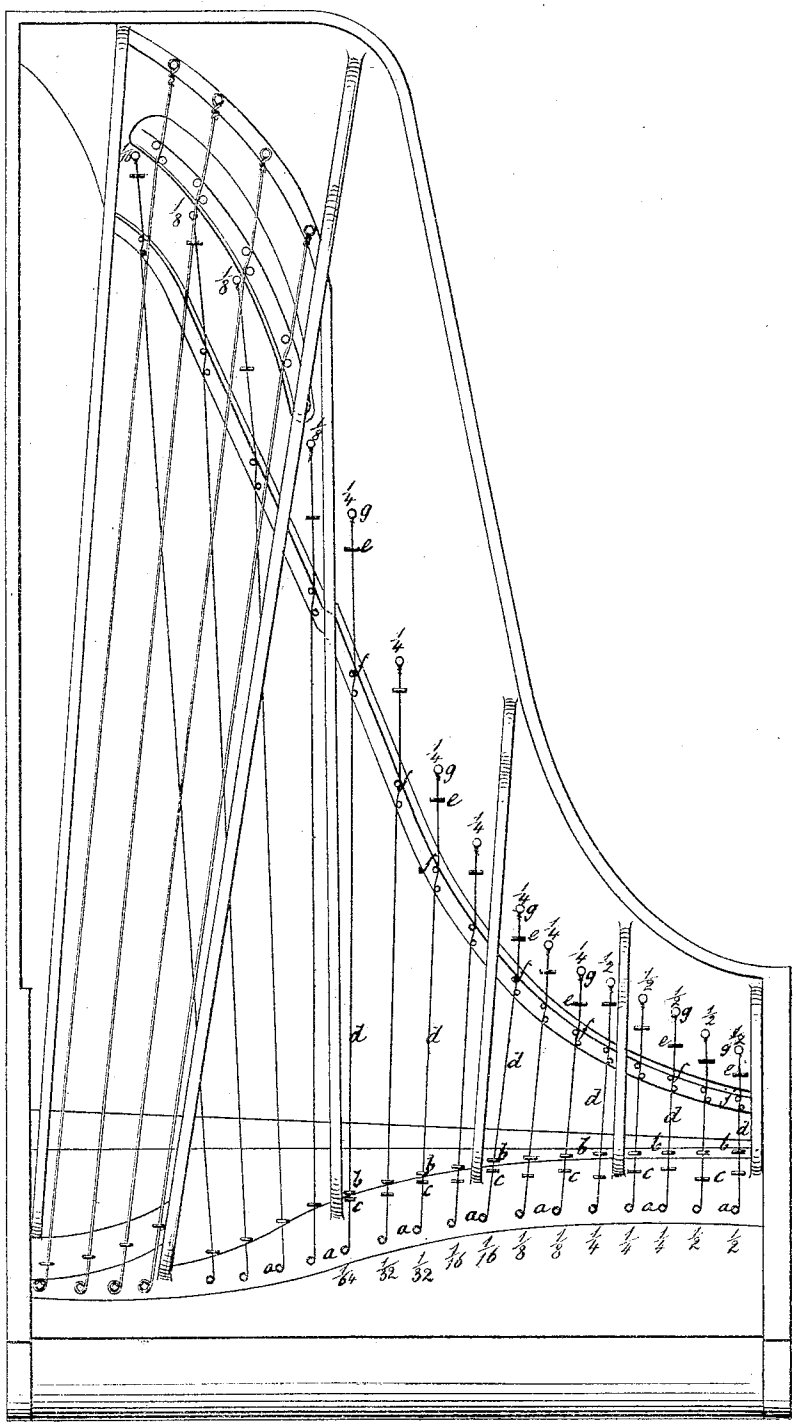
C. F. T. STEINWAY.

Improvement in Duplex Agraffe Scales for Piano-Fortes.

No. 126,848. Patented May 14, 1872.



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IMPROVEMENT IN DUPLEX AGRAFFE SCALES FOR PIANO-FORTES.

Specification forming part of Letters Patent No. 126,848, dated May 14, 1872.

To all whom it may concern:

Be it known that I, C. F. THEODOR STEINWAY, of the city, county, and State of New York, have invented a new and Improved Duplex Agraffe Scale for Piano-Fortes; and I do hereby declare the following to be a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawing forming part of this specification, which drawing represents a plan of a grand piano-forte with my improved scale.

My invention consists in bringing the vibrations of that portion of the string which is situated between the agraffe and the tuning-pin, in proportion to those of the main portion of the string, in such a manner that the tone produced by said agraffe section is brought in harmony with that of the main section, and thereby the purity and fullness of the tone of the instrument is materially increased; also, in bringing the longitudinal vibrations of that portion of the string which is situated between the sounding-board bridge and the hitch-pin in proportion to the vibrations of the main section of the string, so that the sounds due to these longitudinal vibrations are brought in harmony with the tone of the main section of the string, and the purity and fullness of the tone of the instrument is improved.

In order to enable others to understand my invention, I will here remark that the term "scale" of a piano-forte comprises the position of the strings side by side or above each other, their length and thickness and their tension; and my improvement is applicable to all stringed instruments in which the sounds are produced by the action of hammers.

If the bass tones of a stringed hammer instrument are sounded from octave to octave toward the treble a great difference appears in the effect of the various strings, according to their length, as far as the partial tones of the strings are concerned, which are due to the spontaneous subdivisions of said strings in halves, quarters, eighths, sixteenths, &c. The longest duration of the vibrations and the highest quality to subdivide in partial tones is found in the strings between the contra C and the small *c*. Within these limits each string subdivides itself by the blows of the hammer and by the transverse vibrations due to the same in a large number of "nodes," whereby the so-called harmonic overtones are produced, and whereby the fundamental tone is rendered rich and brilliant. At the same time this portion of the strings, particularly, produces, by the longitudinal vibrations, a number of unharmonic side tones, making a whistling sound, which disturbs the purity of the tone. Both these qualities disappear as the height of the tone increases, so that the limit of producing a pure fundamental tone is found at a^4, while it is in most cases desirable to obtain a clear tone from c^5; but the inherent firmness of the thick strings generally employed, and the great tension required on account of thickness prevents the string of the above-named c^5 to make the proper transverse vibrations due to the fundamental tone, and a division into partial tones is out of the question. In order to effect or promote the subdivision of the string and to produce the desired partial tones, I combine with that portion of the string which is situated between the tuning-pin *a* (see drawing) and the main agraffe *b* a secondary agraffe, *c*, which supports the string and is placed at a distance from the main agraffe corresponding to one of the above-named subdivisions of the main section *d* of the string—that is to say, at a distance equal to $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, or $\frac{1}{64}$ of the length of the main section, or to any combination of these fractions. The main agraffe *b*, which supports the string only at one point, allows the transverse vibrations to extend to that part of the string between the said agraffe and the tuning-pin, the vibration of this part being in a direction opposite to that of the main section of the string. By inserting the second agraffe *c* at a distance from the main agraffe equal to $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, or $\frac{1}{64}$ of the length of the main section of the string, the subdivision of the string into partial vibrations, and the consequent production of harmonic overtones is effected or promoted, and a clear, strong, and brilliant tone is obtained up to the highest note.

In the drawing I have marked opposite to each tuning-pin the proportion existing between the distance of the two agraffes and the length of the main section of the string.

By allowing the vibration of the string to extend beyond the main agraffe the durability of the string is materially increased, since by cutting off the vibration of the string at this point, as at present uniformly practiced, the cohesion of the metal is disturbed; and it is a fact that nine-tenths of all the strings which break in a piano-forte do so from this cause under the action of the hammer. By adding my second period of vibration the freedom of the motion of the string is promoted, and the danger that the same will break is materially decreased. The unharmonic tones, or the whistling sounds due to the longitudinal vibration of the strings, I avoid by supporting that portion of the string between the sounding-board bridge and the hitch-pin at distances from the outer bridge-pins equal to $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, or $\frac{1}{64}$ of the length of the main portion of each string, or to any combination of these fractions. By the sounding-board bridge the continuation of the transverse vibrations must necessarily be interrupted, owing to the width of the bridge supporting the string, whereby these vibrations are effectually stopped; but particularly with strings of great thickness, as generally used in piano-fortes of recent construction, the longitudinal vibrations of the strings extend to those portions which are situated between the bridge and the hitch-pins; and in order to avoid unharmonic tones due to these longitudinal vibrations I apply between the bridge and the hitch-pin *g*, under each string, a support, *e*, at a distance from the outer bridge-pin *f*, corresponding to $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, or $\frac{1}{64}$ of the length of the main section *d* of the string, or to any combination of these fractions.

In the drawing I have marked opposite to each hitch-pin the proportion existing between the distance from the support *e* to the bridge-pin and the length of the main section of the string. By these means the unharmonic tones due to the longitudinal vibrations of the strings are converted into harmonious tones, which being transmitted through the bridge to the sounding-board reach the ear and strengthen and enrich the fundamental tone of the string, instead of disturbing the purity thereof, as heretofore. The supports *c* and *e* may be made of metal, ivory, or any other material capable of resisting the pressure of the string.

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

1. The arrangement, in a piano-forte, of a series of successive strings, in each of which the vibrations of that portion situated between the agraffe and tuning-pin are brought in harmony with the vibrations of the main section of the string, substantially as described.

2. The arrangement, in a piano-forte, of a succession of strings, in each of which the longitudinal vibrations of that portion of the string situated between the extreme edge of the sounding-board bridge and the hitch-pin are brought in harmony with the vibrations of the main section of the string, substantially as described.

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