No. 656,603. Patented Aug. 21, 1900.

A. W. HARRINGTON.

TUBULAR BELL FOR CHIMING CLOCKS.

(Application filed June 27, 1900.)

(No Model.)

Fig. 1.

Fig. 2.

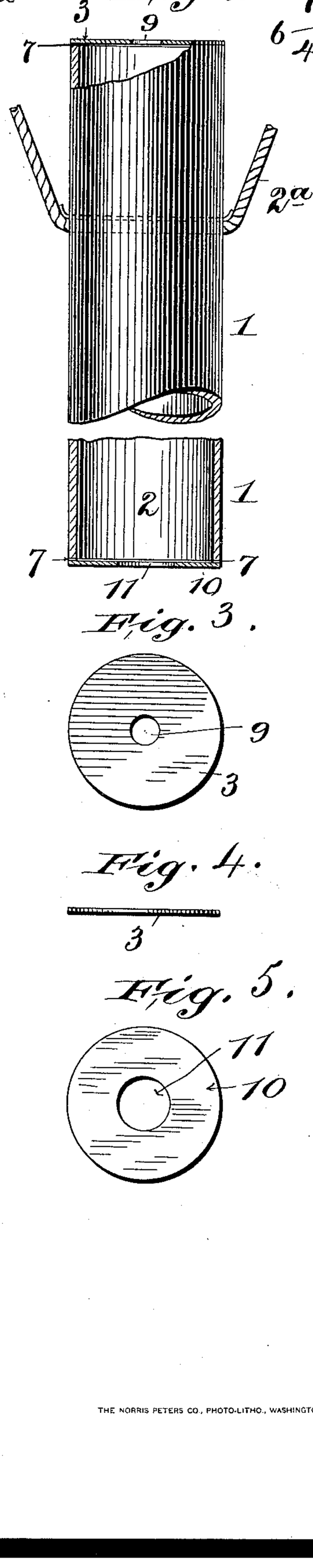

Fig. 6.

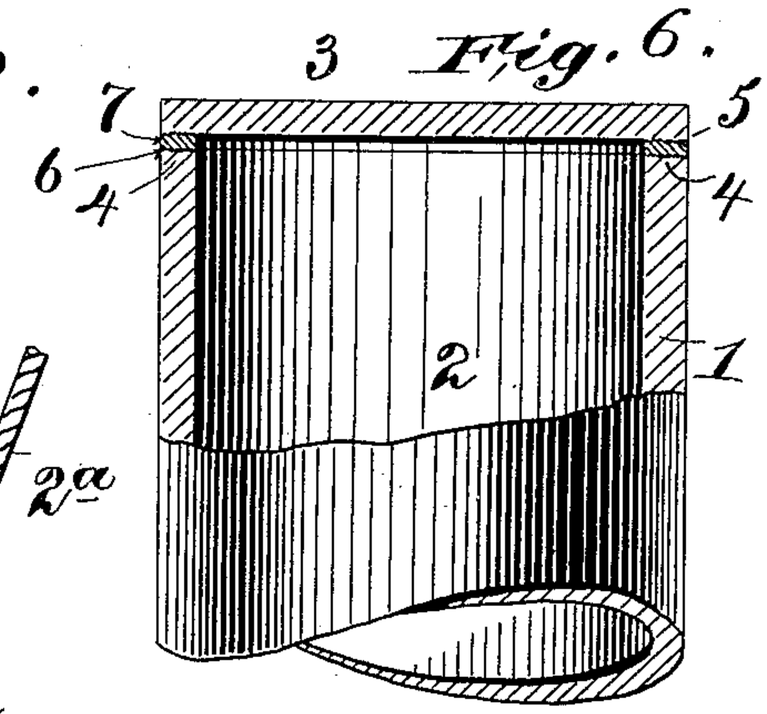

Fig. 3.

Fig. 7.

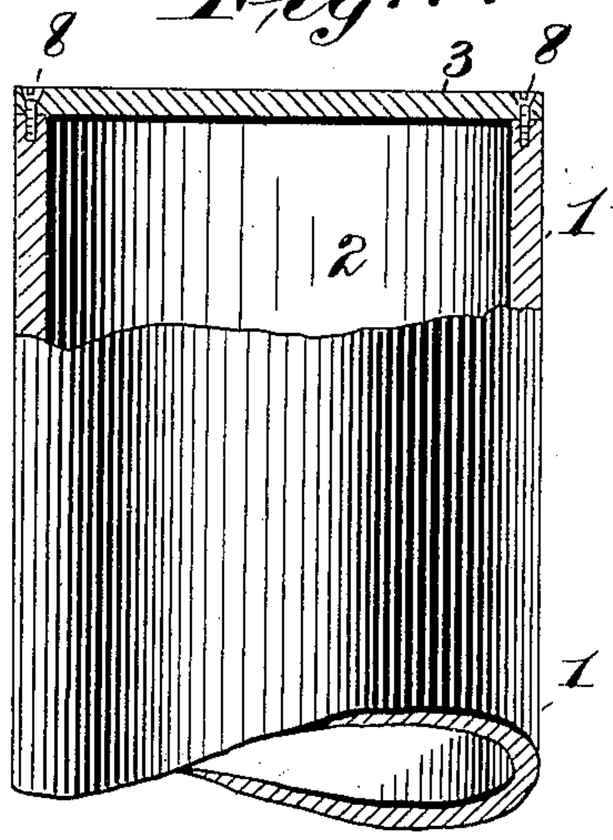

Fig. 4.

Fig. 5.

WITNESSES

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TUBULAR BELL FOR CHIMING CLOCKS.

SPECIFICATION forming part of Letters Patent No. 656,603, dated August 21, 1900.

Application filed June 27, 1900. Serial No. 21,768. (No model.)

To all whom it may concern:

Be it known that I, ALLEN W. HARRINGTON, a citizen of the United States, residing at the city of New York, (Flushing,) county of Queens, and State of New York, have invented certain new and useful Improvements in Tubular Bells for Chiming Clocks, of which the following is a specification.

This invention relates to improvements in tubular bells employed in chiming clocks; and it has for its object to improve their construction, whereby both musically and economically superior results will be obtained.

It has been discovered in the employment of these hollow tubes that they present certain defects and that certain essentials are requisite for the attainment of superior results. The tube must be of thin metal irrespective of its internal diameter or length. The tube must be struck by the sounding-hammer adjacent the end of the tube nearest the point of suspension; that owing to the excessive vibration which is set up in the walls of the tube by the impact of the hammer thereon a sort of whistling sound is emitted which overshadows and impairs the purity of the tone. A desideratum in tubular bells for chiming clocks is that the sound should be muffled, so as to produce the effect upon the ear of the sound traveling and coming for long distance, and for this purpose and also for the purpose of giving greater strength and rigidity to the tube itself certain stiffening and muffling devices have been employed with the object of limiting or arresting the maximum vibration of the metal of the tube and strengthening it. Many of these essential features or principles were known to the art prior to my invention, and others, including those which I have above recited, have resulted from my investigations leading to the materialization of the present invention. It has also been ascertained that although the pitch of the tone produced by the vibration of the metal of the tube does not depend upon nor is it affected by the column of air contained within the tube the venting of the tube of its contained vibrating column of air is an essential desideratum to the production of proper tones both as to quantity and quality. To avoid these difficulties, pins or plugs of various diameters in cross-section have been secured in the tube at one or more points in its length, diametrically crossing its bore, more especially at the point where the tube is to be struck by the hammer, the connections of the pins or plugs in the tube involving the boring of holes in the tube and the riveting of the pin thereto. This diametrical pin or plug by connecting the opposite walls of the tube interferes with its proper action, and said pin is liable to be loosened by the action of the hammer upon it, the tone of the bell is greatly impaired, and it will not emit the clear musical tone which it was intended to produce. Further, it has been ascertained that the breaking of the continuity of the metal of the tube by boring the same for the reception of the pin in a measure affects the sound. A form of muffler is disclosed by the prior art wherein a stiffening device completely filling the bore of the tube has been employed, or such employment has been modified by removing segmental portions of the stiffener adjacent its outer periphery and closely adjacent the inner periphery of the tube. In this latter construction, in either of its forms, the necessary emission of the vibrating column of air from the end of the tube in which the stiffener is employed is prevented, or if such emission is permitted at the inner periphery or side of the tube while at its center it is checked the column of vibrating air is caused to roll and its free and ready emission is disadvantageously hindered.

To improve upon the deficiency of the above-mentioned device, a metallic ring or rings having greater peripheral area than diameter in cross-section have been secured at either or both ends of the tube, so that the greater peripheral dimension of the ring will lie against the internal or external surface of the tube, leaving the annular end of the tube free. The rings have been placed, as above described, about the tube, either on the inside or outside, or both, by forcing or shrinking the ring onto the tube, making a close mechanical connection. While this latter construction in any of its variations produces measurably superior results over the pin-and-plug construction previously described, yet it is open to the objection that a mechanical connection of this form is liable

to derangement, owing to changes of temperature producing differences in expansion and contraction, especially if two kinds of metal are employed, one for the tube and another for the rings, or vice versa, whereby this mechanical connection may become sufficiently loose for the disturbance of the intimate connection which is necessary for the protection and maintenance of purity of tone, the muffling of the tube, and economy of manufacture.

Further objections may be cited in regard to the before-mentioned forms. In the first form, where the diametrical pin or internally-located plug has been employed, there is considerable difficulty in securing a rigid and lasting connection between either the plug or pin and the tube on account of its position and the attendant difficulty of working at the inside of the tube; and, as before stated, the emission of the vibrating column of air being along the longitudinal center of the bore of the tube the diametrically-located pin or plug muffles the tone, and checks the emission of the air-column, thereby lessening the volume of the sound and aiding rather than checking the whistling of the tube. In the stiffening device wherein rings or collars are employed, rigidly placed upon the inside or outside of the tube end, while measurably superior to the preceding structure in point of result offers serious mechanical objections, since to sufficiently stiffen the tube the collar must be thick enough to increase the total diameter of the tube, thus requiring increased space between the tubes, which when applied to the mechanical striking apparatus of a clock renders it neccessary to go to increased expense of production in the mechanical appliance and makes the application of even power and regularity of blows exceedingly difficult. With my invention these mechanical difficulties are overcome, the external diameter of the tube is not increased, the quality of the tone and its pitch is not impaired, the contained volume of vibrating air is given free opportunity to emit from the bore of the tube without hindrance from the longitudinal center, the volume of tone is increased, the whistling of the tube is obliterated, the tube is amply stiffened, and the connection of the stiffening device is so located as to be in a position whereby it may be firmly and easily secured and where it can be constantly watched to determine the original defects.

In carrying out the broad features of my invention I secure to the annular end of the tube a circular diaphragm or disk, (the peripheral form of the diaphragm depending upon the shape of the tube in cross-section,) preferably making the diaphragm of the same material as that composing the tube and causing the union between the diaphragm and the annular end of the tube to be made preferably by molecular union as distinguished from the mere juxtaposition of metal to metal.

Another feature of my invention resides in forming an aperture in the diaphragm in alinement with the longitudinal center of the tube, so as to allow of emission of the air-column therefrom.

I have further discovered, I believe, a new law in the movement in the column of air within the tube, and although I have no means for determining the correctness of my theory the results of trials with the device constructed in the manner now to be described has proven to me for all practical purposes that I am correct. I have discovered that the column of air in the tube when set in vibration by impact upon its walls divides transversely and moves from said point of impact through the tube in opposite directions toward the respective ends—that is to say, the column of air does not move bodily and solidly in one direction, but is divided at the point of contact into two oppositely-acting sets of vibrations moving in opposite directions, each toward its respective end or opening of the tube.

In devices of this kind the tube for many reasons is suspended closely adjacent its upper end, and the impact of the hammer upon the tube takes place at a point closely adjacent the end of the tube and between the end of the tube and its point of suspension or at that end of the tube. In this arrangement the column of air set in vibration is of considerable less extent at the striking end of the tube than at the other end, the column of air below the point of suspension of the tube being of much greater extension than that above the point of suspension. The impact of the hammer therefore being made at a point above the suspension of the tube vibrates the column of air above the point of contact, which is the smaller one, upwardly and the larger volume of air downwardly toward the lower opening of the tube, so in order to establish an equilibrium in the movement of the two columns of air I form the aperture in the diaphragm of the stricken end of the tube comparatively small and the aperture in the diaphragm in the lower end of the tube, which I employ when the best results are to be obtained, comparatively large, so that the vibration of the longer column of air may be unimpeded, and by slightly restraining the vibration of the upper or shorter column of air allowing both columns to vibrate practically in unison.

My invention therefore can be said to reside, first, in the diaphragm, either perforated or not, having one of its horizontal faces secured upon the annular end of the tube; secondly, establishing a molecular union between the diaphragm and the annular end of the tube; thirdly, forming an aperture through the diaphragm, in alinement with the longitudinal center of the tube, irrespective of the size of said aperture, and, fourthly, securing a diaphragm at each annular end of the tube, irrespective of its mode of attach-

ment, but preferably by molecular union, in which diaphragm apertures of various sizes are formed, depending upon and approximation of the impact-point thereto.

My invention further resides in the novel details of construction and combination of parts hereinafter described, and further pointed out in the claims.

In the drawings forming parts of this specification, Figure 1 is a side elevation of a tube embodying my improvements. Fig. 2 is a broken side elevation, partly in section and enlarged. Fig. 3 is a plan view of one of the diaphragms, specifically the upper one. Fig. 4 is a side elevation of one of the diaphragms, whether perforated or not. Fig. 5 is a plan view of a lower diaphragm. Fig. 6 is an enlarged side elevation, partly in section, showing the preferred method of securing the diaphragm to the end of the tube; and Fig. 7 is a like view showing another method.

Similar numerals of reference indicate corresponding parts throughout the several views.

In the drawings, 1 is the tube of conventional construction, having a longitudinal bore 2 open at the ends except for the interposition of the diaphragm or diaphragms, the tube being provided with apertures in its wall for the passage of a preferably non-metallic supporting device 2^a of conventional construction. The point of impact of the striking-hammer is preferably adjacent the upper end of the tube and between the point of support 2^a and its extreme top.

As will have been ascertained from the foregoing statement, my invention may be practiced in several ways. First, as to the preferred embodiment I proceed as follows: I form a diaphragm, such as 3, either apertured or not, and of a thickness preferably thinner than the wall of the tube, as illustrated in Fig. 2. This diaphragm I secure upon the annular end 4 of the tube, which tube is thereby increased in length by the addition in thickness of the diaphragm plus its securing means, as hereinafter described, as distinguished from inserting a pin or plug within the bore of the tube and extending it through its walls. In the preferred embodiment of my invention, as illustrated in Figs. 1, 2, and 6, I roughen the surface of the diaphragm, which is to be approximately in line with the wall of the tube when secured in place, and also roughen the exterior surface of the annular end of the tube, as shown by the wavy lines 5 6 in Fig. 6. Solder is then placed upon the annular roughened surface of the diaphragm and the tube laid thereon placed under proper pressure until the parts are firmly united, leaving an annular ring 7 of solder between the annular end of the tube and the inner annular contracting surface of the diaphragm. In this way a thorough molecular union will be established between the stiffening-diaphragm and the body of the tube, thereby producing a structure which will not be open to the objections of the previously-described constructions and which will have all the requirements which have heretofore been stated to be necessary to the production of a proper tone and efficient stiffening of the tube with a subsequent elimination of the whistling heretofore referred to. Furthermore, when the disk is apertured access to the interior of the tube for finishing the connection or for any other purpose can readily be had. Instead, however, of establishing a molecular union between the annular end of the tube and the diaphragm some of the advantages of my invention can be realized by securing the diaphragm to the annular end of the tube by screws 8 or otherwise, (illustrated in Fig. 7;) but as this form of connection requires considerable thickness of tube-wall to produce an efficient and lasting attachment and which also requires considerable skill and time for its attachment, and because the results are not as good as those obtained by the method illustrated in Fig. 6, I prefer the latter, but illustrate the former in order to properly elucidate the scope of my invention. It will be understood that both Figs. 6 and 7, so far as thickness of material is concerned, are arbitrary and diagrammatical.

In both of the preceding forms the diaphragm has been illustrated as an imperforate one. To further improve upon this, (either of the constructions previously described,) I form in the center of the diaphragm 3 preferably a circular aperture 9, which when the diaphragm is secured to the end of the tube will have its center in alinement with the longitudinal center of the tube, and I further prefer that this opening shall be of less diameter than one-half of the diameter of the diaphragm. This diaphragm is secured upon the end of the tube most nearly adjacent its point of support 2^a and the point of impact of the hammer, so that the shorter column of air normally lying between the point of support and the upper end of the tube may vibrate through the aperture of the disk. I have further ascertained that the general results are materially improved by securing a like diaphragm 10 to the lower end of the tube farthest removed from its point of support, and as to the lower diaphragm I prefer that the opening 11 be made larger than the upper diaphragm, as shown in Fig. 5, so that the vibrations of the longer column of air may have ready egress from the tube without hindrance and leave it simultaneously with that of the shorter column of air at the upper end of the tube. The size of the openings in these diaphragms in order to produce these results should, as near as may be, be proportioned to the column of air, to the length of the tube, to its diameter, and the thickness of the walls. Their sizes are largely a matter of calculation; but as an example I would state that I have found in tubes one-sixteenth-inch diameter of the wall, one-and-one-quarter-inch diameter, between three and

six feet in length, both inclusive, and a distance of one and five-sixteenths inches between the point of support and the top of the tube and a distance between the point of support and the lower end of the tube varying with the length of the tube within the above limits, with three-sixteenths of an inch for the diameter of the opening in the lower diaphragm, would produce the best results. Of course for tubes of other lengths, diameters, and series other measurements control.

By the foregoing it will be apparent that the benefits of my invention can be obtained in several ways without departing from the essential spirit thereof, which consists in securing the diaphragm, either perforate or imperforate, to the annular end of the tube by either mechanical or molecular union, the latter form of attachment being a preferable one.

Having described my invention, I claim—

1. In a musical sounding apparatus of the class described, a suspended tube adapted to be struck by a hammer and caused to vibrate to produce by its vibration a musical sound of a certain pitch, combined with one or more stiffening devices secured upon and transversely disposed relatively to the annular end of the tube, substantially as described.

2. In a musical sounding apparatus of the class described, a tube adapted to be struck by a hammer, and caused to vibrate to produce by its vibration a musical sound of a certain pitch, combined with a perforated diaphragm secured upon the annular end of the tube, substantially as described.

3. In a musical sounding apparatus of the class described, a suspended tube adapted to be struck by a hammer, and caused to vibrate to produce by its vibration a musical sound of a certain pitch, combined with a perforated diaphragm secured upon the annular end of the tube, substantially as described.

4. In a musical sounding apparatus of the class described, a suspended tube adapted to be struck by a hammer, and caused to vibrate to produce by its vibration a musical sound of a certain pitch, combined with perforated diaphragms secured upon the annular ends of the tube and exterior to its bore, the aperture in the diaphragm most closely adjacent the point of support of the tube being of lesser diameter than that of the diaphragm more removed from the point of support, substantially as described.

5. A tubular bell having a metallic disk or diaphragm secured at its longitudinal surface to the annular end of the tube, and exterior to the bore, substantially as described.

6. A tubular bell having its annular end fitted very firmly to the longitudinal surface of the metallic disk or diaphragm, substantially as described.

7. A tubular bell having a metallic diaphragm at its annular end, said metallic diaphragm fitting in intimate and molecular contact therewith, substantially as described.

8. A tubular bell having a metallic diaphragm secured to the annular end of the tube exterior to its bore, and transversely thereof, said metallic diaphragm fitting in intimate molecular contact with the said end of the tube, substantially as described.

9. A tubular bell having an annular end, and a metallic diaphragm having an annular portion of its longitudinal surface secured to the annular end of the tube, in intimate, solid and molecular contact, substantially as described.

10. In a tubular bell, the combination with the annular end of the tube, and a transversely-disposed diaphragm, of the intervening solid and annular connection, substantially as described.

11. In an article of the class described, the combination of the tube having the exterior of its annular end roughened, a diaphragm having a roughened surface adjacent its periphery, and a solid annular connection interposed between the said roughened surfaces, firmly connecting the tube and diaphragm together, substantially as described.

12. The combination with the tube, of the diaphragm transversely disposed in relation to the tube, an aperture formed in said tube, and a molecular connection established between the annular end of the tube and the surface of the diaphragm, substantially as described.

13. The combination with the tube, and means for supporting the same located adjacent its upper end, a transversely-disposed diaphragm secured to the annular end of the tube by molecular union, and a diaphragm likewise disposed and secured to the lower annular end of the tube by molecular union, both of said diaphragms being centrally apertured, the upper diaphragm having a smaller aperture, substantially as described.

14. The combination with a tube, of a plurality of stiffening devices intercepting the bore of said tube, and openings formed in said stiffening devices of varying diameter, substantially as described.

15. The combination with the tube, of a plurality of stiffening devices secured to said tube by molecular union, and intercepting the bore of said tube, and openings in said stiffening devices of varying diameter, substantially as described.

Signed in the city, county, and State of New York this 25th day of June, 1900.

ALLEN W. HARRINGTON.

Witnesses:

JOSEPH L. LEVY,

CHAS. G. HENSLEY.