March 20, 1951 L. C. FORREST 2,545,878

DENT REMOVER WITH FLEXIBLE SHAFT AND VIBRATING MEANS

Filed Oct. 19, 1946 2 Sheets-Sheet 1

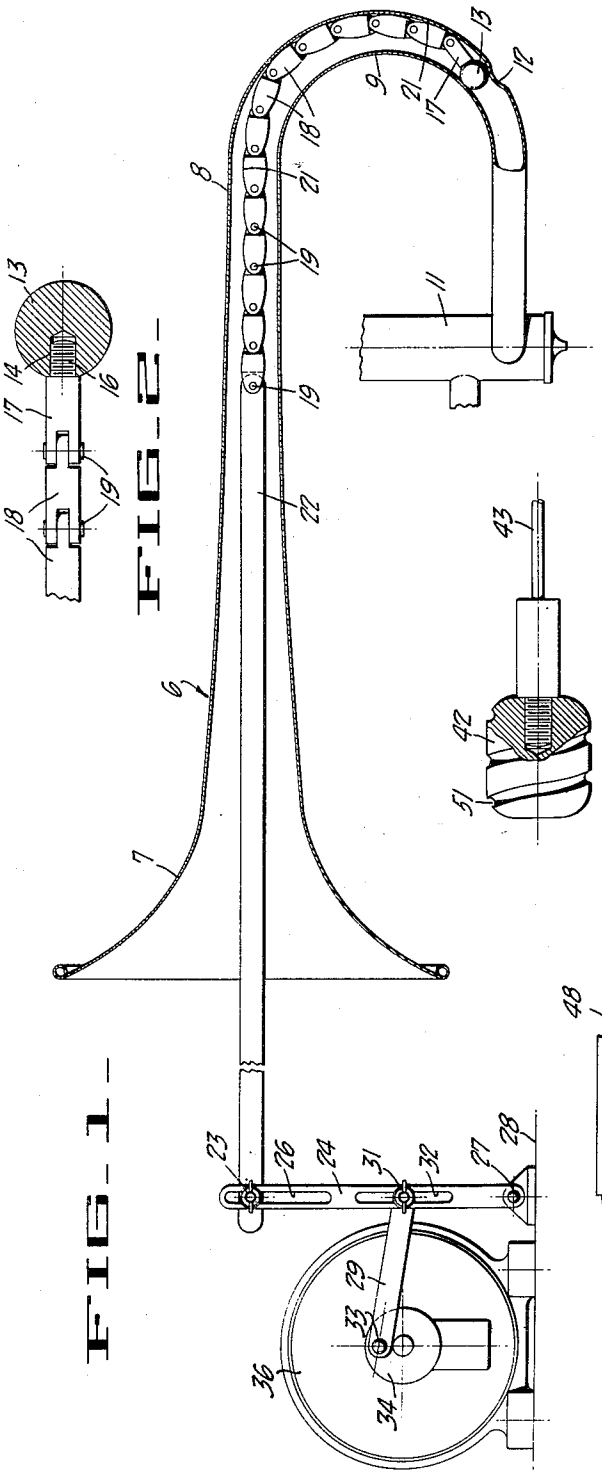


FIG. 1.

FIG. 2.

FIG. 4.

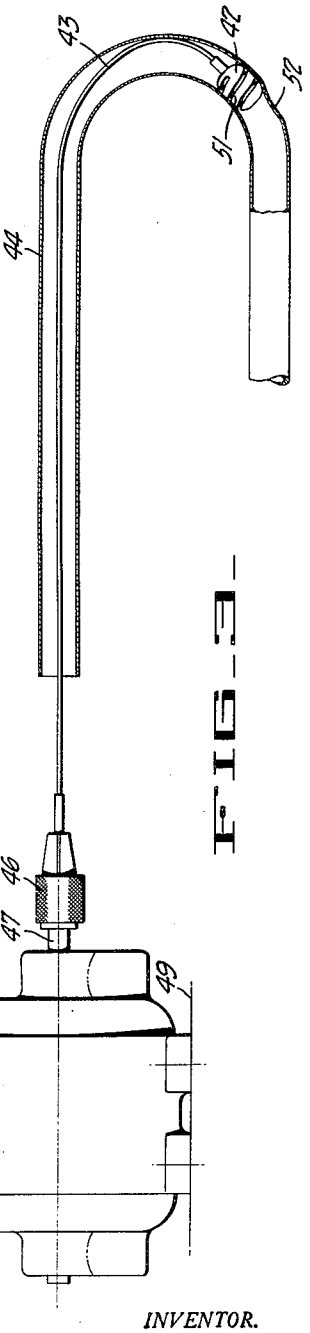


FIG. 3.

INVENTOR.
Londell C. Forrest
BY Marcus Lothrop

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2 Sheets-Sheet 2

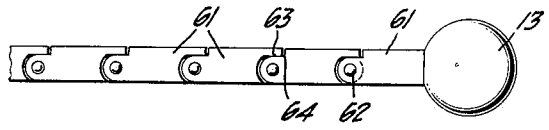


FIG_5_

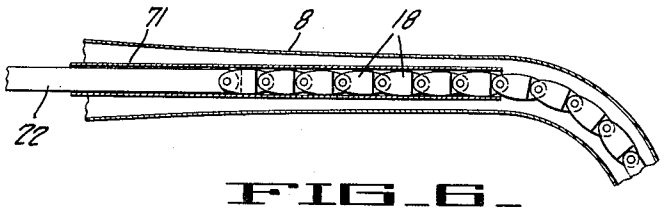


FIG_6_

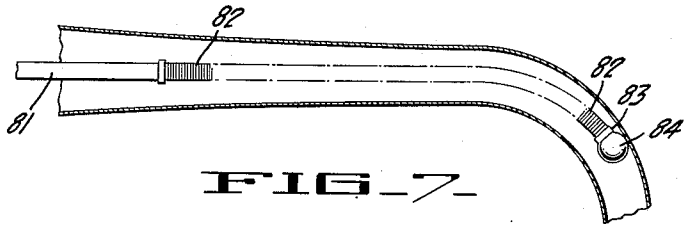


FIG_7_

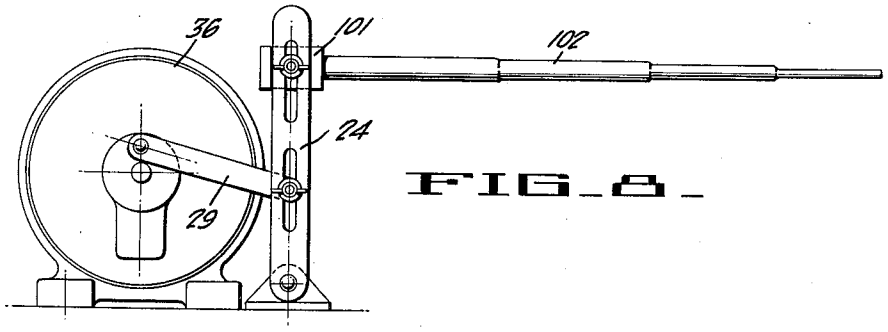


FIG_8_

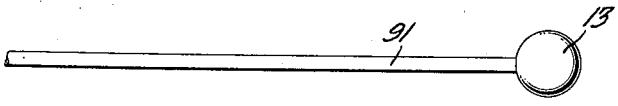


FIG_9_

INVENTOR.
Londell C. Forrest
BY Marcus Lothrop

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DENT REMOVER WITH FLEXIBLE SHAFT AND VIBRATING MEANS

Londell C. Forrest, Berkeley, Calif.

Application October 19, 1946, Serial No. 704,373

3 Claims. (Cl. 153—80.5)

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My invention relates to means for removing irregularities in tubing and is especially concerned with means for removing dents or depressions in relatively thin-walled, curved and tapered or curved and uniform tubes especially of the nature encountered in many musical instruments such as cornets and trombones.

One of the common difficulties in connection with instruments of this type is that in a curved portion of the tubing an indentation or depression is accidentally produced which not only mars the appearance of the instrument but is often detrimental to the tone and performance characteristics. Several schemes have been heretofore proposed and employed for the purpose of removing such internal dents, among others is one involving the forcing of a succession of balls of gradually increasing diameter through the partially obstructed tube portion. This is a tedious and sometimes a difficult operation.

It is an object of my invention to provide an improved means for removing dents from tubes particularly curved tubes and especially curved tubes having a taper.

Another object of the invention is to provide a means for facilitating and expediting the removal of dents from tubular or hollow members.

A further object of the invention is to provide a dent remover which can readily be utilized in connection with tubes or hollow vessels of rather widely varying size without the necessity of painstakingly adjusting the mechanism.

Other objects together with the foregoing are attained in embodiments of the invention disclosed in the accompanying drawings, in which

Figure 1 is for the most part a side elevation of a dent remover constructed in accordance with my invention, a portion of the musical instrument being shown in cross section to disclose the interior.

Figure 2 is a detail of a portion of the dent removing mechanism, a part of the ball being shown in cross section and the scale being enlarged.

Figure 3 is a view similar to Figure 1 but disclosing a modified form of dent remover in accordance with my invention.

Figure 4 is a detail similar to Figure 2 of the modified form of the invention.

Figure 5 is a side elevation of a modified form of flexible shaft construction.

Figure 6 is a fragmentary view, for the most part in cross section, showing a shaft arrangement provided with an additional guide tube.

Figure 7 is a fragmentary view showing a portion of a tube in cross section together with a modified form of flexible shaft.

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Figure 8 is a side elevation of a modified form of dent remover.

Figure 9 is a detail showing in side elevation a modified form of shaft and ball arrangement.

In its preferred embodiment my dent remover is especially designed for use in connection with a tube having a curve and includes a ball which is receivable within the tube and is connected to an exterior driving instrumentality by means of a flexible shaft generally rigid in a longitudinal direction but bendable laterally to engage the tubing wall so that upon operation of the shaft the ball is forced through the tubing and during its progress displaces the tubing wall material to remove the dent.

While the dent remover of the invention can be embodied in a number of different forms depending especially upon the particular type of instrument or vessel with which it is to be utilized, I have successfully employed it in the form shown in Figures 1 and 2, for example, wherein it is useful in removing dents from a wind instrument such as a cornet 6. The cornet includes a bell portion 7 and a tube 8 having a gradually diminishing area or tapered cross section as it recedes from the bell and additionally is provided with a curve 9 between the bell and a valve 11, for example. There is illustrated an identation 12 which is to be removed.

The structure of my invention includes a ball 13 of metal or comparable hard material provided with a radially extending threaded recess 14 engaged with a threaded stud 16 projecting from the end of a link 17. The link 17 is specially formed but is otherwise part of a shaft comprised of a plurality of comparable links 18 each fastened to the others by a pivot pin 19 so that the resulting shaft is substantially inflexible longitudinally but is flexible laterally. The links 18 between the successive pivot pins 19 are provided with a smooth, swelled or arcuate contour 21 to afford good bearing surfaces adapted slidably to engage the interior of the wall of the tube 8 so that bearing pressures are well distributed over a large area to prevent deformation of the wall even when a considerable force is exerted.

The endmost one of the links 18 is connected by a pin 19 to an inflexible shaft 22 designed to extend through the horn tube 6 and to be secured at its outer end by an adjustable pivot fastening 23 to a rocking lever 24. The lever is provided with an elongated slot 26 for this purpose and its rocking motion is established by a pivot con-

nection 27 to a suitable base 28. The lever 24 is rocked by a pitman 29 at one end secured by an adjustable pivot fastening 31 to an elongated slot 32 in the lever 24 and at its other end connected by a wrist pin 33 to a plate 34 rotated by an electric motor 36 or other suitable source of high speed rotation. Thus, the rotary motion of the pin 33 is translated for the most part into a longitudinal oscillation.

With this arrangement when the motor is energized and the pitman 29 is operated, the shaft made up of the solid portion 22 and of the links 18 is longitudinally vibrated or has motion with its components principally along the tube and at a relatively rapid rate so that the ball 13 is longitudinally oscillated. The operator presses the cornet toward the motor. The force is transmitted to the ball in any position thereof inasmuch as the links bear against the wall of the tube and are therefore effective motion transmitters. The ball 13 acts as a hammer beating with small amplitude but with high frequency and considerable force upon the indentation 12. The ball gradually pounds from the inside outwardly until the dent is substantially flush with the remaining and correctly formed adjacent portions of the tube. When the dent is tapped out, the ball and shaft are withdrawn and the motor 36 is stopped. In some severe instances the operation is repeated with successive balls of increasing diameter until the dent is hammered out.

Because of the relatively flexible connection 23, the operator can easily hold the horn or tube in his hand while the hammering operation is going on and by twisting it, advancing it and retracting it can hammer the indentation outwardly from various advantageous positions, producing a satisfactory final appearance.

Although the structure is illustrated in Figure 1 as being in contact with the outer wall of the tube, in some instances the withdrawing action of the flexible shaft is more readily employed and in that instance the links 18 are in contact with the interior shorter radius surface of the horn. Whether the force exerted is one of compression or one of tension, the hammer ball 13 is repeatedly driven against the deformed material to eradicate the discontinuity in the surface.

A somewhat similar arrangement having somewhat the same mode of operation is disclosed in Figures 3 and 4 and has been successfully employed particularly in tubes having a constant or fixed interior area or cross sectional dimension as distinguished from a tapered tube. In this instance the ball 42 is secured to the end of a flexible shaft 43 extending through the horn tube 44. The shaft is secured within a rotary chuck 46 disposed at the end of the spindle 47 of an electric motor 48 mounted on a suitable base 49. The ball 42 is provided with a helical or peripheral groove 51 and is designed to be approximately of the interior diameter of the tube 44 and of a greater diameter than the tube portion 52 reduced by the indentation.

In the operation of this structure when the motor 48 is energized, the shaft 43 is rotated and bears against the interior of the wall of the tube 44 and thus transmits its rotational force to the ball 42. The direction of rotation initially is such that the ball 42, due to the engagement of its helical portion with the tube wall, is advanced through the constricted portion 52 and in passing therethrough expands the tube into approximately its original configuration. If the expansion is sufficient the ball 42 is readily retracted. If retraction is difficult, the direction of motor rotation is reversed, the shaft 43 is likewise reversed, and it makes contact with the other interior surface of the tube 44. The reverse rotation being imparted to the ball 42, the helix is effective to "unscrew" the ball from the tight portion of the tube so that the ball is easily withdrawn from the interior.

Under some circumstances it is advisable to provide a flexible shaft capable of transmitting longitudinal motion but restricted in its flexibility, or at least so restricted in one direction of bending. For that reason the terminal ball 13 is, as disclosed in Figure 5 provided with a plurality of assembled links 61 held for relative pivotal rotation by pins 62 and adapted to be joined in the same fashion as before, or in a similar fashion, to the shaft 22. In this instance, the links 61 are formed with flat surfaces 63 and 64 so that when the assembled links are properly positioned the surfaces 63 and 64 come into abutment with respect to each other. When in contact the flat surfaces preclude motion of the flexible section in one lateral direction although they permit complete lateral motion in the other direction. This is of use in preventing rubbing of the flexible section of the shaft against certain portions of the interior of the tube.

As another means of rendering parts of the flexible shaft inflexible under certain circumstances, I disclose in Figure 6 an arrangement in which the structure is substantially identical with that shown in Figures 1 and 2 but in which prior to the installation of the ball 13 at the end of the flexible shaft, a rigid tube 71 is slipped over the shaft 22 as well as the various links 18. This tube 71 is considerably shorter than the assembled length of the shaft and fits readily within the tube 8 of the horn. It is propelled along the shaft until it overlies a sufficient number of the links 18 to render that portion substantially inflexible in either direction without interfering with the flexibility of the remaining links.

As a still further modification in Figure 7 there is illustrated an arrangement in which the shaft 81 instead of being connected to a number of articulated links is terminated by connection with a helical coil 82 having the capability of flexing in all lateral directions and being provided at its extremity with a fitting 83 for engagement with a ball 84 identical with the ball 13, for example. In this structure a whipping motion is sometimes induced in the coil 82 so that a relatively small ball 84 may be utilized. Most often balls of successive diameter are introduced and operated in sequence for finally providing the desired interior diameter.

Sometimes the dent is in a position so that no curve-accommodating flexibility is needed. In that instance, as shown in Figure 9, I provide the ball 13 with a substantially rigid shaft 91 which is however of a springy material so that a little yield or give in a lateral direction is normally possible.

In the Figure 8 disclosure there is provided a rigid connection 101 between the rocking lever 24 and a step tapered beating shaft 102 so that lateral as well as longitudinal motion components are available at the vibrating extremity of the shaft to effectuate the restoration to their former shape of the metal tube walls being interiorly hammered.

I claim:

1. A dent remover for use in a curved musical instrument tube comprising a ball receivable within said tube; a laterally flexible, longitudinally rigid shaft connected to said ball and receivable within said tube; and means connected to said shaft for rapidly vibrating said shaft and said ball longitudinally.

2. A dent remover for use in a curved musical instrument tube comprising a ball receivable within said tube; a shaft connected to said ball, said shaft being longitudinally rigid but flexible transversely to bear against said tube; and means connected to said shaft for rapidly vibrating said shaft along the wall of said tube and said ball along said tube.

3. A dent remover for use in a curved musical instrument tube comprising a ball receivable within said tube; a plurality of links joined to each other and to said ball, said links having bearing surfaces adapted slidably to engage the wall of said tube; and means for moving said ball to and fro within said tube by sliding said links along the wall of said tube.

LONDELL C. FORREST.

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