

(No Model.)

2 Sheets—Sheet 1.

L. K. FULLER.
METHOD OF MAKING TUNING FORKS.

No. 483,513.

Patented Sept. 27, 1892.

Fig. 1.

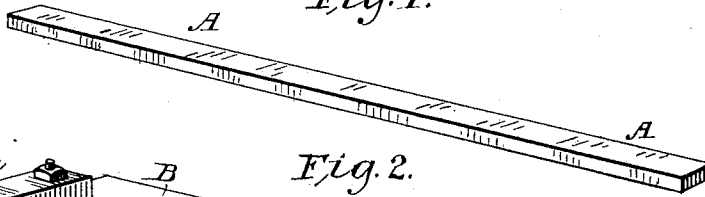


Fig. 2.

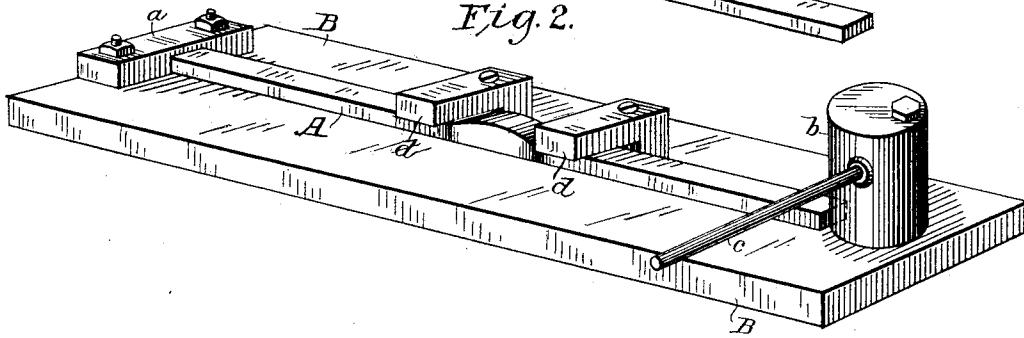


Fig. 3.

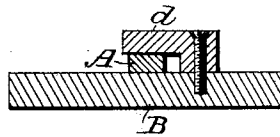


Fig. 4.

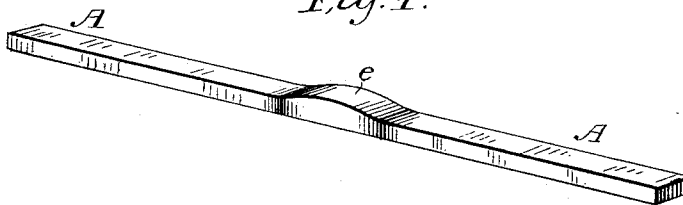


Fig. 5.

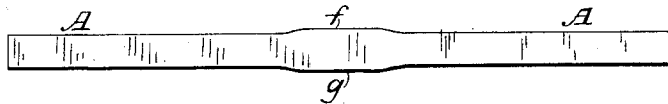
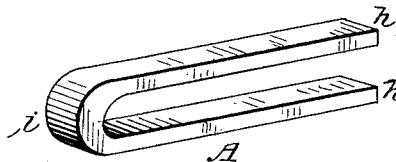


Fig. 6.



Witnesses

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2 Sheets—Sheet 2.

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Fig. 7.

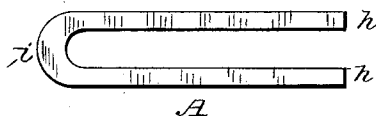


Fig. 8.



Fig. 9.

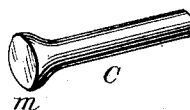


Fig. 10.



Fig. 11.

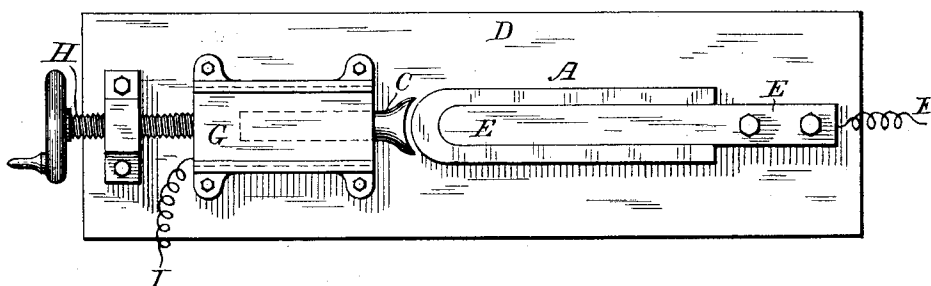


Fig. 12.

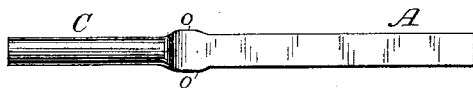
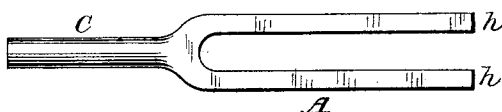


Fig. 13.



Witnesses

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UNITED STATES PATENT OFFICE.

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ESTEY ORGAN COMPANY, OF SAME PLACE.

METHOD OF MAKING TUNING-FORKS.

SPECIFICATION forming part of Letters Patent No. 483,513, dated September 27, 1892.

Application filed April 4, 1892. Serial No. 427,743. (No model.)

To all whom it may concern:

Be it known that I, LEVI K. FULLER, of Brattleborough, in the county of Windham and State of Vermont, have invented certain new and useful Improvements in Methods of Making Tuning-Forks, of which the following is a specification.

The manufacture of accurate high-class tuning-forks is, as is well known, attended with many difficulties. A tuning-fork, to be of value for professional musicians and for manufacturers of musical instruments, should be of such minute accuracy that at a given temperature its deviation from a theoretical standard should be inappreciable. For example, an A fork of the present standard pitch (known as "International pitch") should give exactly four hundred and thirty-five double vibrations in a second at 20° centigrade, (68° Fahrenheit.) A variation of one vibration in a second is distinctly noticeable to an untrained ear and would render the fork unfit for the purposes of persons like the manufacturers of musical instruments. Exact accuracy is what is necessary to meet the present requirements. A variation of one-tenth of a vibration per second from the standard may be now regarded as the maximum permissible variation, and the aim of the makers of tuning-forks to meet present demands is to produce forks giving absolutely-correct pitch. This is a problem of great difficulty. Slight changes in temperature are sufficient to appreciably change the pitch of a tuning-fork, and unequal distribution of the metal of which the fork is composed, lack of homogeneity in the metal, and lack of continuity of the metal all affect the pitch, tone, and resonance. Consequently the production of tuning-forks of absolute pitch is difficult and expensive. Heretofore fine tuning-forks designed to give absolutely-correct pitch have been invariably made by forging them from a single bar of steel. Other methods have been adopted for making cheap and inferior forks, but fine forks have been produced only by forging. To make a tuning-fork by forging requires the services of very skillful workmen, and to thus produce the fork in its preliminary shape and to finish it are tedious and laborious operations.

Now the object of the present invention is to produce tuning-forks of uniform size and absolutely-correct pitch and tone with the minimum of material and labor. The new method of production consists in forming the handle of the fork of a separate piece of steel from the prongs of the fork and then uniting the handle and fork-prongs in such a manner as to render the handle homogeneous with the fork-prongs, with no break in the continuity of the metal, the union of the handle and the fork-prongs being so effected that the subsequent finishing of the fork and bringing it in correct tune are facilitated.

The improved method of construction is illustrated in the accompanying drawings, wherein—

Figure 1 is a perspective view of a blank or bar of steel of proper dimensions for making the prongs of a single fork. Fig. 2 is a perspective view, and Fig. 3 is a sectional view, of a suitable upsetting-press for forming the center of the blank preparatory to bending the same. Fig. 4 is a perspective view of the blank after being operated upon in the press. Fig. 5 is a plan view of the same. Fig. 6 is a perspective view of the blank after having been bent to provide the fork-prongs. Fig. 7 is a side view of the fork-prongs after their connecting-bend has been turned to a true circle on its outer face. Fig. 8 is a perspective view of a section of a steel blank of proper dimensions for making the handle of a tuning-fork. Fig. 9 is a perspective view of the handle-blank after one end has been enlarged by upsetting. Fig. 10 is a side view of the handle-blank after its enlarged end has been brought to a true circle. Fig. 11 is a plan view of proper instrumentalities for welding the handle-blank and fork-prongs together. Fig. 12 is a plan view of the fork after the handle-blank and fork-prongs have been welded together. Fig. 13 is a side view of the finished fork.

In the manufacture of tuning-forks by the present improved method a bar of steel is rolled out to the desired width and thickness (which dimensions are determined by the pitch and tone of the fork intended to be made) and is then cut into suitable lengths. Each blank A (see Fig. 1) thus produced is

of proper dimensions for forming the prongs and their uniting-bend for one tuning-fork. The blank A is then formed with an enlargement at its center. This enlargement is formed by an upsetting-press, such as is shown in Figs. 2 and 3. This press consists of a bed-plate B, having a fixed platen *a*, a presser *b*, eccentrically mounted on the bed-plate and provided with an operating-handle *c*, and two overhanging confining-guides *d d*, fixed to the bed between the platen *a* and presser *b*. The blank A is placed beneath the guides *d d*, with one end resting against the platen, the opposite end near the presser *b*, and its central part between the confining-guides *d d*. The central portion of the blank A between the confining-guides *d d* is then heated sufficiently to soften the steel. The heating may be performed by electricity or by a gas or other flame. When the central part of the blank is sufficiently heated, the blank is compressed endwise by the presser *b*. This endwise pressure effects the upsetting of the central heated part of the blank A, thereby producing a central enlargement. The confining-guides *d d* prevent any upward arching or springing of the blank during the upsetting operation. The central enlargement or expansion takes place in three directions only, upwardly and on both sides laterally, downward expansion being prevented by the blank resting throughout its length upon the bed B. The blank A after being thus upset is shown in Figs. 4 and 5, *e* being the upward enlargement, which renders the center of the blank thicker than the ends, and *f g* being the lateral enlargements, which render the center of the blank wider than the ends. The blank A is then again heated slightly at the center and is bent into the form shown in Fig. 6, wherein *h h* are the ends of the blank, which are of the original dimensions of the blank and constitute the prongs of the fork. The bend *i*, connecting the two prongs *h h*, occurs where the enlargements *e f g* were formed on the blank, and the blank is bent so that the enlargement *e* is on the outside of the bend *i*. The outer convex face of the bend *i* is then milled, ground, filed, or otherwise turned to the arc of a true circle, as shown in Fig. 7. The handle of the tuning-fork is likewise made from a rolled steel bar or rod, which is rolled down to the desired dimensions and is cut into proper lengths. The handle may be either rectangular in cross-section or circular. I prefer to employ a circular handle made from steel wire, having a diameter substantially equal to the width of a prong of the tuning-fork. The blank C for such a handle is illustrated in Fig. 8. The blank C is then heated at one end and is then upset, so as to form an enlargement *m* at one end. This enlargement is then made concave and in the arc of a circle corresponding to and exactly concentric with the arc of the convex face of the bend *i* of the fork-prongs by milling, grinding, filing,

or otherwise turning. When thus concaved, as shown in Fig. 10, the handle-blank will exactly fit upon the convex bend of the fork-prongs. The handle-blank is then welded to the fork-prongs. Preferably the welding is performed by electricity, and a suitable apparatus for this purpose is illustrated in Fig. 11.

D is a bed-plate carrying a fixed metallic block E, which is connected by conductor F with one pole of an electric generator, and G is a movable metallic block capable of being moved by a screw H or otherwise, which is connected by conductor I with the opposite pole of the electric generator. The blocks G and E are suitably insulated from each other—as, for example, by having bed-plate D made of non-conducting material. The movable block G has a hole in it to receive the handle-blank C, and the fork-prongs are placed in position straddling the fixed block E and in close contact therewith. The electric current is then turned on, and an arc is established in the usual way by first bringing the meeting faces of the handle-blank and fork-prongs together and then separating them slightly. The arc thus formed by its intense heat melts the meeting curved faces of the handle-blank and fork-prongs. The handle-blank is then forced against and held in contact with the fork-prongs until the union between the two is intimately effected. After the welding is completed the fork appears in a plan view, as shown in Fig. 12, with two ridges *o o* on opposite faces in the line of the welded joint. The surplus metal constituting these ridges is then filed off or otherwise removed, and the fork is then polished, finished, and brought to correct tune.

The purpose and object of forming the enlargements at the bend of the fork-prongs and on the meeting end of the handle will now be appreciated. In welding two pieces of metal together more or less of the metal is inevitably wasted, and a scale is formed at the welded joint which must subsequently be removed, thus involving further waste of the metal. Consequently if no enlargements were formed on the prong-bend and on the handle-blank and they should be united by welding there would be formed depressions in the metal at the joint. This would be a fatal defect in the tuning-fork, since it would prevent the vibrations being properly transmitted from the prongs through the handle to the resonance-box or other sounding device, and, furthermore, the fork would be mechanically weakened. To complete a fork so formed would necessitate the grinding down of the entire fork to the dimensions required by the depressions at the union of the prongs and handle. This would be an expensive operation and would disturb the proper proportions of the fork, on which its tone and pitch depend. Consequently it would be impracticable to make, with any certainty or precision, forks with welded handles which

would give a predetermined pitch, since the wasting of the metal at the joints is a variable factor, and in any case the expense connected with finishing forks so made would be a serious obstacle to the adoption of such a method. Consequently the old method of forging the fork with its handle from a single piece of metal has been uniformly adhered to in the manufacture of fine forks; but by the present improved method it becomes practicable to weld a separately-formed handle to separately-formed fork-prongs, because both the handle and the fork-prongs are formed with a surplus of metal at the line of juncture. This surplus of metal is ample to compensate for the waste of metal in the welding process, forming a ridge which can be readily dressed down, so that any scale resulting from the welding can be removed without cutting into the body of the completed fork. The surplus metal only occurs at the welded joint, so that there is but a small quantity of metal to be removed, which can be done cheaply and expeditiously. By this method of manufacture it becomes possible to make forks of exactly correct pitch and tone with great accuracy, economy, and rapidity. The exact dimensions of the finished prongs and of the handle are determined in advance by the dimensions of the steel blanks A and C, and these dimensions are not altered or affected during the subsequent operations, except to the slight extent required for pitch correction. The extent of foreshortening of the blanks A and C during the upsetting operation after being determined once experimentally becomes subsequently a known quantity, and the extent of movement of the presser of the upsetting-press is fixed correspondingly. Consequently the exact lengths to which the blanks A and C should be cut are known. By bringing the curved surfaces of the meeting faces of the handle and fork-prongs into exact parallelism before the welding operation a perfectly-uniform and homogeneous weld is secured, and after the welding is performed it is impossible to distinguish the line of welding. Forks made by this new method have been purposely broken across the welded joint, and in every case there has been no break in the continuity of the metal, and it has been impossible to identify the line of welding. Consequently the tone and pitch of the vibrating prongs are accurately and correctly transmitted through the handle to the resonance-box or

sounding-board, which would not be the case if there were any break in the continuity of the metal, such as would result from an imperfect weld or by attaching the handle by riveting, screwing, or similar attaching means.

I claim as my invention—

1. The method of manufacturing tuning-forks, which consists in upsetting a blank of steel of the proper dimensions for forming the prongs of a tuning-fork, whereby said blank is enlarged at its center, and then bending said blank to form the prongs with the enlarged central part of the blank at the bend connecting the prongs, upsetting one end of a handle-blank, thereby enlarging the same, uniting the enlarged end of the handle-blank to the bend of the fork-prongs by welding, and then removing the surplus metal at the welded joint, substantially as set forth.

2. The method of manufacturing tuning-forks, which consists in making the fork-prongs and handle separately, uniting them by welding, and prior to the welding operation enlarging the meeting portions of the handle and fork prongs, convexing the meeting face of the fork-prongs in the arc of a circle, and concaving the meeting face of the handle in a corresponding arc, substantially as set forth.

3. The method of manufacturing tuning-forks, which consists in heating the central portion of a blank of steel of the proper dimensions forming the prongs of a tuning-fork, upsetting said blank, whereby said blank is enlarged at its center, bending said blank at the center to form the fork-prongs with the enlarged central part of the blank at the bend connecting the prongs, and convexing the outer face of the bend of the fork-prongs to the arc of a circle, heating and upsetting one end of a handle-blank, thereby enlarging the same, concaving the enlarged end of said handle-blank to the arc of a circle corresponding to the arc of the convexed bend of the fork-prongs, uniting the curved portions of the fork-prongs and handle-blank by welding, and removing the surplus metal at the welded joint, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses:

LEVI K. FULLER.

Witnesses:

WALTER H. CHILDS,
J. E. HALL.