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2,670,962

PHONOGRAPH NEEDLE

Filed April 20, 1950

Fig. 1.

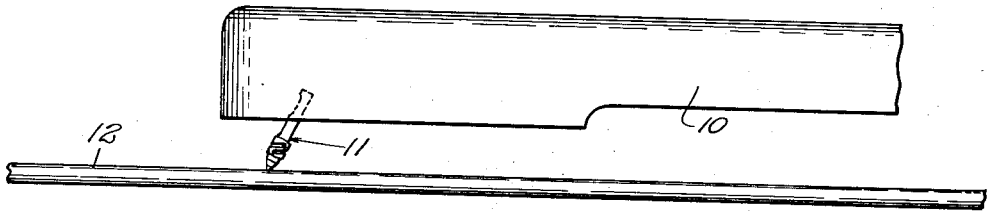


Fig. 2.

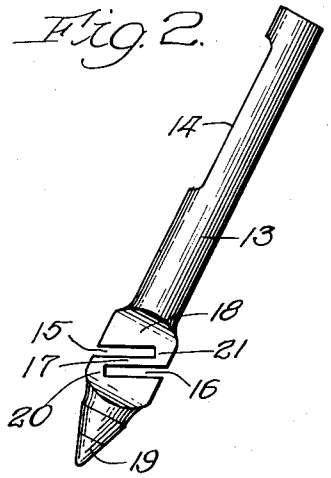


Fig. 3.

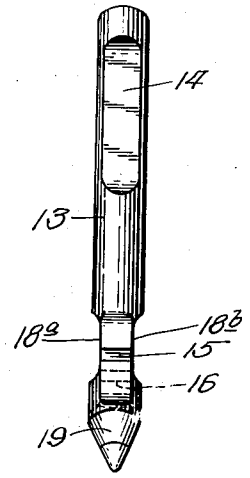


Fig. 4.

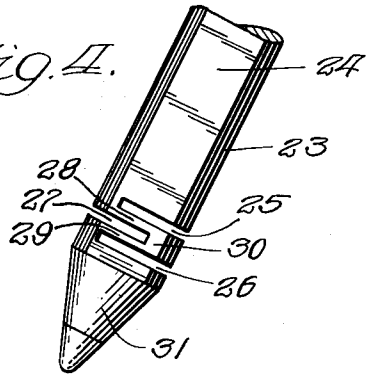
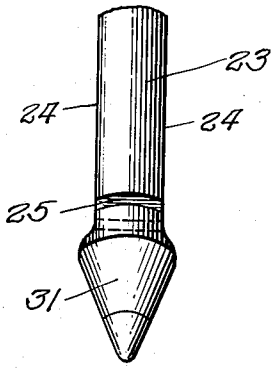


Fig. 5.



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PHONOGRAPH NEEDLE

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Application April 20, 1950, Serial No. 157,009

13 Claims. (Cl. 274—38)

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This invention relates to a phonograph needle, and more particularly to a phonograph needle having a flexible section for improving the compliance of the needle, said needle being constructed to protect the flexible section against breakage.

One feature of the invention is that it provides an improved phonograph needle; another feature of the invention is that it provides a phonograph needle having a flexible section for providing a substantial amount of vertical and horizontal compliance and having means for protecting the flexible section against breakage; a further feature of the invention is that the flexible section is formed by a plurality of closely spaced slots extending partially through the shank of the needle generally transversely of the longitudinal axis thereof; still another feature of the invention is that at least one of said slots is on the opposite side of said shank from another of said slots, the slots overlapping to form at least one flexible connecting strip therebetween; yet a further feature of the invention is that the slots may be cut at an angle to the axis of the shank so that the connecting strip is substantially parallel to the record surface when the needle is mounted in operating position; yet another feature of the invention is that the slots may be cut in a widened portion of the shank to increase the length of the connecting strip, said widened portion being flattened to reduce its mass having a width no greater than twice the width of the shank above the widened portion; and still an additional feature of the invention is that the slots and the flexible connecting strips are relatively narrow, preferably having a minimum thickness of the order of 0.006 inch and a maximum thickness of the order of 0.01 inch.

Other features and advantages of this invention will be apparent from the following specification and from the drawings, in which:

Fig. 1 is a fragmentary side elevation of a tone arm carrying a needle constructed in accordance with the invention, the tip of the needle engaging the surface of a record.

Fig. 2 is an enlarged side elevational view of the needle of Fig. 1 removed from the tone arm;

Fig. 3 is a side elevational view of the needle of Fig. 2 looking from the left thereof;

Fig. 4 is a fragmentary side elevational view of a modified form of needle; and

Fig. 5 is a side elevational view of the needle of Fig. 4 looking from the left thereof.

In the reproduction of sound from a phonograph record, particularly from a laterally cut record in which the undulations representing the

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sound to be reproduced project into the record groove from the side walls thereof, a needle having vertical compliance or yieldability (speaking of the parts in the position in which they are illustrated in the drawings and in the position which they conventionally assume during operation) will eliminate much of the undesirable scratching which is ordinarily transmitted through the amplifying and transducing apparatus of phonographs which employ a rigid needle. In addition, a needle having such vertical compliance will also lessen so-called "needle talk" and other surface noises which reach the ear directly from the needle without being transmitted through the amplifying system associated with the phonograph. To achieve satisfactory vertical compliance, the needle which transmits vibrations to the crystal or other translating device must have a flexible portion which is thin compared to its length in a plane substantially transverse to the axis of the shank of the needle. It is desirable to provide means to protect such a flexible portion from breakage or deformation in the event the needle is dropped onto the record surface or receives other shocks. I have heretofore invented phonograph needles having a guard device which is part of the needle structure and which serves to protect the needle against such breakage or deformation, needles of this character being disclosed and claimed in my co-pending applications Serial No. 20,327 filed April 10, 1948, now U. S. Patent No. 2,553,882, Serial No. 42,162 filed August 3, 1948, and Serial No. 56,856 filed October 27, 1948.

In the past other attempts have been made to provide phonograph needles having vertical compliance by offsetting the record engaging tip of the needle at the end of a relatively long spring member which extends a considerable distance from the axis of the shank of the needle. A disadvantage of such an arrangement is that when the record engaging tip is spaced a considerable distance from the shank a change in the angle of the tone arm causes a substantial change in the angle at which the needle tip engages the groove of the record, which may result in considerable distortion of the sound reproduced. For example, in a phonograph having an automatic record changer the records are usually stacked one on top of the other during operation, and the height of the record surface changes with regard to the pivotal mounting point of the base of the tone arm, and consequently when only one or two records are on the turntable the angle of the needle tip with respect to the record surface

will be considerably different than when ten or twelve records are on the turntable. Furthermore, such an arrangement locates the center of gravity of the needle a considerable distance from the shank, and the needle has an undesirable action in responding to certain forces, the inertia effects of this arrangement causing sluggishness.

Another desirable feature in a phonograph needle is a considerable degree of horizontal compliance, particularly in the direction of the record groove. Prior to my inventions needles which provided a "bumper" to protect the flexible portion against breakage had only limited horizontal compliance because the extension or foot which provided the bumper added considerable additional mass to the needle; and other needles having a flexible portion in the form of a horizontally extending loop, while providing more horizontal compliance, have had undesirable features in that forces in the direction of needle travel develop torque in the needle.

I have devised and am herewith disclosing and claiming an improved phonograph needle which possesses desirable advantages of vertical and horizontal compliance together with means for protecting the flexible section without any of the disadvantages noted above, and which is further advantageous in that the needle is so constructed that it has no portions which extend outwardly away from the shank and the mass of the needle is no greater than that of an ordinary rigid needle having no flexible section.

Referring now to the drawings, in Fig. 1 a tone arm **10** carries a needle generally designated at **11** in a chuck (not shown), and the needle rides in a groove upon the surface of a phonograph record **12**. The needle is responsive to undulations in the groove and transmits them as vibrations to a crystal or other translating device. In conventional operation the vibrations are translated into electrical variations, are amplified, and are reproduced by means of a speaker or other transducer. In Figs. 2 and 3 the needle of Fig. 1 is shown enlarged and removed from the tone arm chuck. The needle comprises an elongated shank and a terminal tip portion **19**. The shank has an upper relatively rigid portion **13**, which is generally cylindrical in shape and a flattened portion **14** which extends on the upper end of the shank along one side for a substantial portion of the length of the shank. This flattened portion serves to indicate the front side of the shank so that the needle may be properly positioned in the tone arm chuck, and in addition the flattened portion cooperates with the holding end of a set screw or other holding device on the tone arm so that the needle may be held immovably in the tone arm chuck.

The shank also includes a lower flexible portion formed by a plurality of closely spaced narrow parallel slots **15** and **16**, each extending more than half way through the shank generally transversely of the longitudinal axis thereof. The slots are cut on opposite sides of the shank and are cut in the direction of the record groove when the needle is in operating position, and a flexible connecting strip **17** is provided between the slots. Preferably, the slots are cut in front and rear walls of a widened portion **18** having flattened side walls **18***a* and **18***b*. As shown in Fig. 3 the distance between the flattened sides is less than the width of the shank above the widened portion, and as shown in Fig. 2 the distance between the front and rear walls of the widened portion is no greater than twice the width of the shank above the widened portion. Each slot has a thickness of the same general order as the thickness of the connecting strip **17**, and I prefer that each slot and the strip each have a minimum thickness of the order of 0.006 inch and the maximum thickness of the order of 0.01 inch. In the needle of Fig. 2 the slots may each be 0.008 inch thick and the strip **17** may be 0.0115 inch thick. I prefer that the slots be cut at an angle of between 65° and 75° to the axis of the shank so that the connecting strip is substantially parallel to the record surface when the needle is mounted in operating position. In most conventional tone arms the needle extends at an angle of approximately 21° to the record surface. This construction also provides a relatively long connecting strip **17** without adding to the mass of the needle. I also prefer that the bottom slot **16** be shorter than the top slot **15** so that the portion shown at **20** in Fig. 2 is thicker than the portion shown at **21** in said Fig. 2. With this construction, upon abnormal flexure of the needle (as for example if the tone arm is dropped) the relatively thick portion **20** will prevent the tip **19** of the needle from being bent out of line with the axis of the shank. In the event the tone arm is dropped the upper slot **15** closes momentarily at its outer end and the thin flexible strip **17** is put under tension like a spring connected to the portion **21**. When the abnormal pressure is released the flexible strip returns to its normal position as shown.

A needle constructed in accordance with the invention possesses excellent vertical compliance because of the flexible strip **17**. Satisfactory lateral compliance is also present in the needle because of the flexible strip, and consequently the needle tracks properly in the record groove and has a relatively high output. Compliance to horizontal forces in the direction of the record groove is obtained due to the relatively thin portion **21**, and the good overall compliance of the needle insures a low level of surface noise and needle talk. In addition, the normally spaced portions at the outer ends of the slots which are adapted to abut in the event the needle is dropped or is subjected to other abnormal pressure, provide means for guarding against breakage or deformation of the flexible strip without adding any mass or bulk to the needle. In fact, a needle constructed in accordance with this invention will have less mass than an ordinary rigid needle because a small part of the needle is removed when the slots are cut. A needle constructed in accordance with the invention will provide good pickup at desired audio-frequencies and will attenuate frequencies in excess of 6,000 cycles per second.

Referring now to Figs. 4 and 5, the shank **23** of the needle may have flattened sides **24** near its lower tip extremity **31**, and a lower flexible portion is formed by a spaced pair of parallel slots **25** and **26**, each extending more than half way through the shank from one side thereof generally transversely of the longitudinal axis thereof. A center slot **27** extends from the other side of the shank between the pair of slots to provide two spaced parallel flexible connecting strips **28** and **29**. Preferably, the bottom slot has a rounded end facing in a direction counter to the direction of record travel, and the center slot **27** preferably is shorter than the upper and lower slots to provide a relatively heavy solid portion **30** which may act as a bumper in the event the needle is dropped. In this needle, as

well as in the needle of Fig. 2, the flattened portion is not necessary but by providing such a flattened portion better lateral compliance is achieved. The needle of Figs. 4 and 5 has the same advantages as the needle of Fig. 2 but I prefer the needle of Fig. 2 because it is more simple to manufacture.

While many variations may be made in the dimensions of the needle, I have found that a suitable needle may have a shank with a diameter of $\frac{1}{8}$ inch, and the flattened portion 18 of the needle of Fig. 2 may have a width of 0.09 inch at its widest part. In the needle of Fig. 2, the portion 21 may be 0.025 inch thick and the portion 20 may be 0.030 inch thick. The widened portion 18 near the tip end of the needle may be of the order of $\frac{1}{8}$ inch long and may be of the order of 0.030 inch wide.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. A phonograph needle of the character described comprising: a straight elongated shank having an upper relatively rigid portion and a lower flexible portion formed by a plurality of closely spaced narrow parallel slots, at least some of which extend more than half way through said shank generally transversely of the longitudinal axis thereof, at least one of said slots being on the opposite side of said shank from another of said slots to provide at least one flexible connecting strip therebetween; and a terminal tip portion extending from the bottom of said shank.

2. Apparatus of the character claimed in claim 1, wherein said slots are cut at an angle of between 65 degrees and 75 degrees to the axis of said shank and said connecting strip is substantially parallel to the record surface when the needle is mounted in operating position.

3. Apparatus of the character claimed in claim 1, wherein said slots are cut in front and rear walls of a portion of the shank having flattened side walls, the distance betwen the flattened sides being less than the width of the shank above said portion, and the distance between said front and rear walls being no greater than twice said width.

4. Apparatus of the character claimed in claim 1, wherein said slots are equally spaced from each other, each slot and each connecting strip having a minimum thickness of the order of 0.006 inch and a maximum thickness of the order of 0.01 inch.

5. A phonograph needle of the character described, comprising: a straight elongated shank having an upper relatively rigid portion and a lower flexible portion formed by a plurality of closely spaced narrow parallel slots each extending more than half way through said shank generally transversely of the longitudinal axis thereof, at least one of said slots being on the opposite side of said shank from another of said slots to provide at least one flexible connecting strip therebetween and said slots being cut in front and rear walls of a widened portion of the shank having flattened side walls, the distance between the flattened sides being less than the width of the shank above said flattened portion and the distance between said front and rear walls being no greater than twice said width, each slot having a thickness of the same order as the thickness of said connecting strip; and a terminal tip portion extending from the bottom of said shank, the mass of the needle being substantially equally distributed about its longitudinal axis.

6. A phonograph needle of the character described, comprising: an elongated shank having an upper relatively rigid portion and a lower flexible portion formed by a pair of parallel slots each extending more than halfway through said shank from opposite sides thereof generally transversely of the longitudinal axis thereof to provide a flexible connecting strip having a minimum thickness of the order of 0.006 inch and a maximum thickness of the order of 0.01 inch, one of said slots being cut in the direction of record movement; and a terminal tip portion extending from the bottom of said shank.

7. Apparatus of the character claimed in claim 6, wherein the shank is straight and the lower slot is shorter than the upper slot to prevent bending of said terminal tip.

8. Apparatus of the character claimed in claim 6, wherein the shank is straight and said slots are cut at an angle of between 65 degrees and 75 degrees to the axis of said shank and said connecting strip is substantially parallel to the record surface when the needle is mounted in operating position, and wherein the thickness of each slot is substantially equal to the thickness of the connecting strip, the mass of the needle being substantially equally distributed about its longitudinal axis.

9. A phonograph needle of the character described, comprising: an elongated shank having an upper relatively rigid portion and a lower flexible portion formed by a spaced pair of parallel slots each extending more than half way through said shank from one side thereof generally transversely of the longitudinal axis thereof, and a center slot extending from the other side of said shank between said pair of slots to provide two spaced parallel flexible connecting strips; and a terminal tip portion extending from the bottom of said shank.

10. Apparatus of the character claimed in claim 9, wherein the center slot is shorter than said pair of slots to provide a relatively large intermediate portion interconnecting said flexible strips.

11. A phonograph needle of the character described, comprising: a straight elongated shank having an upper relatively rigid portion and a lower flexible portion formed by a spaced pair of parallel slots each extending more than half way through said shank from one side thereof and generally transversely of the longitudinal axis thereof and a center slot extending from the other side of said shank between said pair of slots to provide two spaced parallel flexible connecting strips, said slots being cut in front and rear walls of a portion of the shank having flattened side walls, the distance between the flattened sides being less than the width of the shank above said portion, and the distance between said front and rear walls being no greater than twice said width, and said slots being equally spaced from each other, each slot and each connecting strip having a minimum thickness of the order of 0.006 inch and a maximum thickness of the order of 0.01 inch; and a terminal tip portion extending from the bottom of said shank, the mass of the needle being substantially equally distributed about its longitudinal axis.

12. A phonograph needle of the character described, comprising: a straight, elongated shank having an upper relatively rigid portion and a lower flexible portion formed by a plurality of slots extending partially through said shank generally transversely of the longitudinal axis thereof, at least one of said slots being on the opposite side of said shank from another of said slots and said slots overlapping to form at least one flexible connecting strip therebetween, the mass of the needle being substantially equally distributed about its longitudinal axis; and a terminal tip portion extending from the bottom of said shank.

13. Apparatus of the character claimed in claim 12, wherein said slots and said strip each have a minimum thickness of the order of 0.006 inch and a maximum thickness of the order of 0.01 inch.

FREDERICK C. HOLTZ, JR.

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