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W. H. HUTTER

2,473,374

PHONOGRAPH NEEDLE

Filed April 26, 1945

Fig. 1

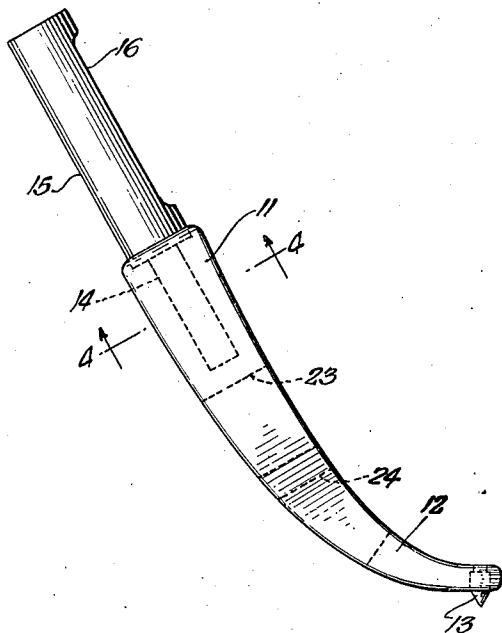


Fig. 2

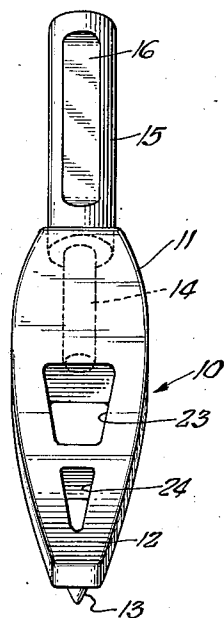


Fig. 3

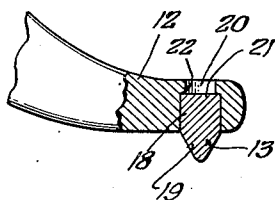
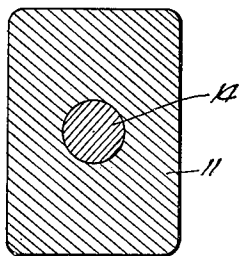


Fig. 4



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PHONOGRAPH NEEDLE

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Application April 26, 1945, Serial No. 590,329

1 Claim. (Cl. 274—38)

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This invention relates to phonograph needles, and in particular to those manufactured from a plastic material.

The present application is a continuation in part of my copending application Serial No. 529,269, filed April 3, 1944, now abandoned, which relates to plastic phonograph needles.

The advantages of a plastic needle over a needle fabricated from metal or other substances having a comparatively high stiffness and density, are set forth in detail in that application. Stated generally, the advantages are better tracking, less needle resonance within the audible range, lower needle point impedance, and greater latitude of design.

Where a cartridge has been designed specifically for use with a plastic needle, the dimensions of both the needle and the cartridge can be controlled to give the desired stiffness, low mass, and high output. An example of such cartridge is shown in my copending application, Serial No. 561,061, now Patent No. 2,451,221, issued October 12, 1948. A high voltage output is dependent in large measure upon the type of coupling between the needle and the vibration transmitting member, and as shown in that application, the proper coupling may require a special type of chuck and a specially shaped needle.

But when a cartridge has been designed to accommodate the usual metal needle, additional limitations are imposed on the design of a plastic needle.

It is an object of this invention to provide a plastic needle which is adapted for use in conjunction with the usual pick-up chuck which employs set screw needle clamping means.

I have found that superior performance may be obtained by increasing the stiffness of a plastic needle at the point where the needle is engaged by the chuck of the pick-up. Such needle may be used to advantage in a set screw type chuck, and the voltage output is considerably increased over the voltage output of the needle shown in the aforementioned copending application Serial No. 529,269.

The desired localized stiffness may be obtained by providing a metal insert of limited length in the upper end of a plastic needle. This construction provides the desired low mass, and the desired distributed compliance and damping of a plastic needle together with the high output which results from a comparatively tight coupling.

It is a further object of my invention to provide a plastic needle adapted for cooperation with

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the usual pick-up chuck which has an interior diameter no greater than that necessary to receive the usual metal needle.

Another object is to provide a phonograph needle having a long wearing, hard record engaging point at one end; a metallic portion at the other end which is adapted to be gripped by the clamping means of a chuck, and an intermediate portion separating the two end portions, said intermediate portion being fabricated from a plastic material having improved vibration transmitting characteristics.

A further object is to provide in a phonograph needle of the so-called plastic type, an improved construction for mounting the record engaging point in the plastic needle.

A still further object is to provide an improved needle construction which will absorb the vertical vibrations of the record engaging point, but which will transmit faithfully the lateral vibrations thereof to its associated parts; also to provide means for increasing the vertical compliance and reducing the mass of the needle beyond that indicated by the shape and dimensions of the needle without substantially increasing the lateral compliance.

Other objects, features and advantages will become apparent as the description proceeds.

With reference now to the drawings, in which like reference numerals designate like parts,

Fig. 1 is a side elevation of a needle embodying a preferred form of this invention;

Fig. 2 is a front view of Fig. 1;

Fig. 3 is an enlarged section of the lower end of the needle showing a means of securing the record engaging point with respect to the plastic needle; and

Fig. 4 is a section along line 4—4 of Fig. 1.

With reference now to Figs. 1 and 2, the reference numeral 10 designates generally the main body portion of a phonograph needle, which body portion is formed of a suitable organic plastic, such as those generally referred to as synthetic resins, or cellulose base plastics. As an example of materials from which this body portion may be formed, I have found that vinyl, cellulose acetate, cellulose nitrate, cellulose acetate butyrate, ethyl cellulose and methyl methacrylate, urea, diamine, polystyrene and vinylidene work satisfactorily.

The body portion 10 comprises a shank 11 and a forwardly bent end portion 12 of reduced dimensions. A record engaging point 13 is mounted at the extremity of the forwardly bent end portion 12, as will be hereinafter described.

The upper portion of the shank 11 is stiffened

by a metallic insert 14, which is preferably molded into the shank. The upper portion of the metallic insert 14 preferably projects beyond the end of the shank, as indicated by the reference numeral 15, and this projecting portion is adapted to be inserted within the chuck of the usual pick-up. The projecting portion may be of slightly greater diameter, and may be provided with a flat or slabbed portion 16 which is engaged by the set screw of the usual chuck.

Although with certain types of plastic material the stiffening member or metal insert could be wholly received within the plastic shank, I have found it preferable to have the metal insert project from the end of the shank for the reason that the bore of the usual chuck is generally of a diameter which would preclude the insertion of a plastic shank which is extended to the same length as the insert. Furthermore, the set screw might inadvertently be screwed up too tightly, thereby deforming or fracturing certain types of plastic material.

The manner of mounting the point is shown in Fig. 3. The point 13 comprises a cylindrical member 18 which is provided with a conical tip 19. The end portion 12 of the needle is provided with a bore 20 which is of a diameter slightly smaller than the diameter of the cylindrical member 18. The pointed cylindrical member is then inserted into the bore from the upper surface of the needle, and it can be forced through the bore, due to its conical tip 19, into the position shown in Fig. 3. As the flat end 21 of the cylindrical member 18 is pushed beneath the surface of the plastic the resilience of the plastic causes the bore to contract to a certain extent, as indicated by the reference numeral 22. This small amount of contraction I have found is sufficient to prevent the point from creeping upwardly within the bore 20. Thus a secure mounting for the point is provided.

As an example, I have found that the point, including the cylindrical member 18 and the integral conical tip 19, may be formed from a sapphire, and the plastic body portion of the needle formed from a diamine plastic such as that known as nylon. The diameter of the cylindrical member may be .018 inch and the diameter of the bore .015 inch. Diamine plastic is quite tough and resists satisfactorily the shear that is created by the needle pressure which acts on the contracted portion 22 of the bore.

The construction shown in Fig. 3 is particularly well adapted for use in connection with sapphire points, because of the small dimensions of the sapphires that are available at reasonable costs. It will be understood, however, that this construction is equally well adapted for use with metal points.

The plastic body portion 10, or shank of the needle, may be made from any organic plastic material which has desirable vibration transmitting properties. Such materials, in general, can be defined as those having a density of less than 2.0 grams per cubic centimeter and a Young's modulus of less than 10×10^{10} dynes per square centimeter. I have found that a needle constructed in accordance with my invention is substantially free from needle resonance at frequencies within the audible range, and furthermore, it contributes materially to low impedance of the pick-up as a whole. The length of the metal member is somewhat less than three-eighths of an inch, and the diameter of the projecting portion thereof is approximately one-

eighth of an inch. Thus to whatever extent the mass of the whole needle is increased by the use of the metal member, the actual increase in the moment of inertia of the needle about the longitudinal axis of the chuck and its associated parts is comparatively small. Thus the acoustical properties such as the impedance and the resonance frequency are of the same order as that of a needle which is fabricated entirely from a plastic. More specifically, the low generalized stiffness resulting from the use of a plastic needle is combined with a comparatively high localized stiffness to produce the desired tight coupling.

As an example of the latitude of design which is afforded by the use of a plastic needle having stiffening means associated therewith, I have shown a needle with a forwardly bent end portion 12 of gradually tapering dimensions, this construction affording increased compliance with respect to vertical vibrations of the point. The width, or lateral dimension, is greater than the thickness of the needle. These proportions also serve to increase the vertical compliance of the needle.

The generalized stiffness and the generalized mass of the needle are determined by the Young's modulus and the density of the materials used, and also by the dimensions and shape of the needle. After the needle has been designed to give the proper compliance in one direction, in this instance in the horizontal direction, I have found that the vertical compliance may be increased and the mass still further reduced by providing apertures 23 and 24 in the body portion 10 of the needle. These apertures which are symmetrical with respect to the longitudinal axis of the needle, do not materially increase the lateral compliance, due to the fact that the amount of stiffness contributed by the material which is close to the neutral plane of the needle, is comparatively small.

Furthermore, there being a lesser amount of material at the lower end of the needle, the moment of inertia or generalized mass is reduced to a greater extent than the reduction in the actual mass would indicate. Thus, the expedient of providing apertures in the lower part of the needle, permits a still further latitude of design. For instance, the reduction of mass at this point permits a greater increase of mass at other points, without lowering the resonance frequency. In this particular instance the added mass is in the form of a stiffening member, or insert, and also in the increased lateral dimensions, which provides increased lateral stiffness.

Furthermore, the point 13, instead of being a sapphire point, may be fabricated from tungsten, or from steel, the steel being tipped with a suitable hard alloy, such as osmium-platinum alloy. If a sapphire point is used it is preferred to have a rough ground sapphire, inasmuch as the roughened surface provides a bond which is a little more secure. Similarly a metallic point can be provided with a slightly roughened surface. In certain instances, the point is coated with a suitable lubricant such as a solvent, or a plasticizer, or a cement before it is forced into the bore of the plastic needle.

The stiffening member, or insert 14, may be of any substance having a stiffness substantially greater than that of the plastic needles, although a metal is preferred. More specifically, I have found that light weight metals or alloys work satisfactorily, such as aluminum or magnesium,

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The foregoing description and the accompanying drawings are deemed to be illustrative only, and my invention is to be limited only by the appended claim.

I claim:

A phonograph needle formed from an organic plastic material having comparatively low stiffness and mass comprising a shank portion and a lower portion, said lower portion being curved forwardly, the width of said shank portion being greater than the thickness thereof in order to provide greater stiffness in a lateral direction than in a vertical direction, a stiffening member received in only the upper part of said shank portion to provide a localized stiffness, and a record engaging point mounted in the end of said curved lower portion, said curved lower portion being provided with an aperture passing through the needle in the direction of its thickness to offset the increase in generalized mass effected by the greater width of the needle, and by the stiffen-

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ing member, the major part of that portion of the needle which is formed from organic plastic material being free from the stiffening effect provided by said stiffening member.

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