Oct. 26, 1948. W. H. HUTTER 2,452,304

PHONOGRAPH NEEDLE

Filed Aug. 19, 1947

Fig. 1

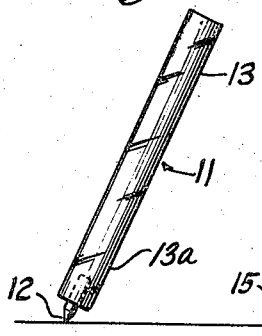


Fig. 2

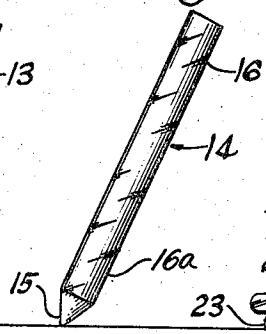


Fig. 3

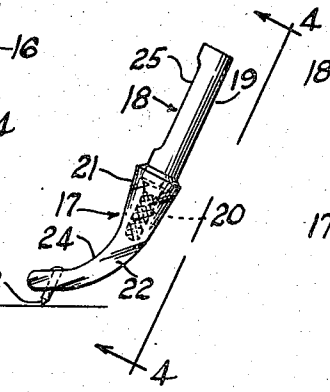


Fig. 4

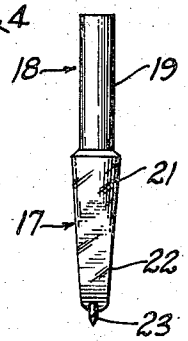


Fig. 5

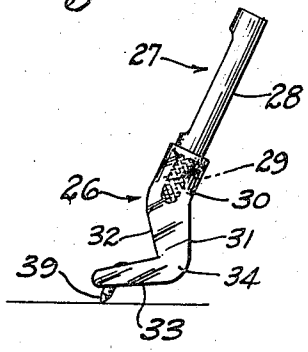


Fig. 6

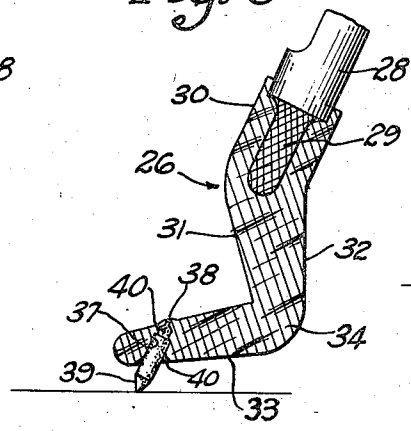


Fig. 10

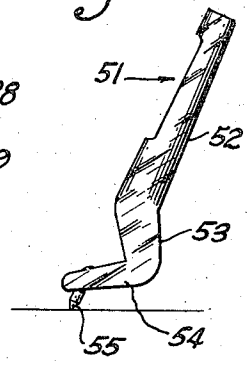


Fig. 7

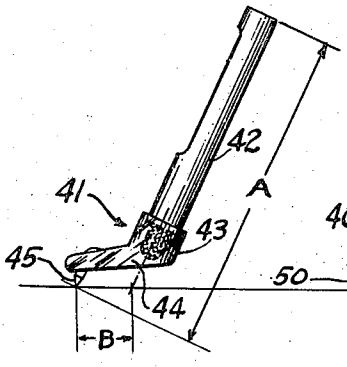


Fig. 8

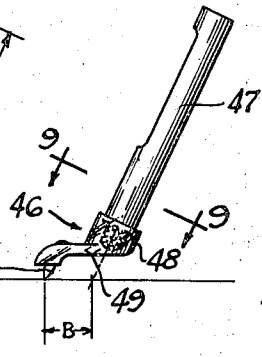
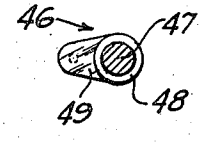


Fig. 9



INVENTOR.
William H. Hutter
BY
Zabel and Gritzbaugh
Attorneys

Patented Oct. 26, 1948

2,452,304

UNITED STATES PATENT OFFICE

2,452,304

PHONOGRAPH NEEDLE

William H. Hutter, Wheaton, Ill.

Application August 19, 1947, Serial No. 769,476

8 Claims. (Cl. 274—38)

1

This invention relates to improvements in phonograph needles.

It is an object of this invention to provide a phonograph needle of superior fidelity of tone reproduction. One criterion of fidelity of tone reproduction is the wave shape of the signal voltage as observed on an oscillograph. If a needle is played on a frequency record in which the groove is modulated in the form of a sine curve, any departure of the wave shape from a sine curve indicates a corresponding lack of fidelity at that particular frequency.

This distortion of the wave shape is considered to be attributable to various causes. For instance, a given needle may have insufficient compliance to enable it to follow the record groove. Another cause of distortion appears to be the resonance of the tone arm, and other acoustical resonances, such as crystal resonance or system resonance.

Another criterion of fidelity of tone reproduction is the absence in the frequency response curve of peaks that are attributable to acoustic characteristics of the needle. These peaks indicate the presence of an increased signal strength at certain frequencies, which is an undesirable factor in musical reproduction, and are considered to be attributable to resonance.

A further object of my invention is to provide a phonograph needle having the proper compliance in combination with sufficient mechanical strength to enable it to be subjected to the usage which is often encountered in record changers, in which the needle and tone arm are dropped through a distance of one to several inches on successive records.

Another object of this invention is to provide a needle which is relatively free from needle scratch. The term "needle scratch" refers to the extraneous noise transmitted through the needle, the pickup, the amplifier and the speaker, and is considered as being due to the presence of hard particles or other surface irregularities in the record which impart an irregular movement to the needle over that imparted to the needle by the groove. Although these irregular movements are of much smaller magnitude than the motion of the needle which is caused by the modulation of the groove in sound passages of medium volume and medium frequency, the ratio of noise to signal increases considerably in passages of less volume and of higher frequency. Under such conditions, the needle scratch is more readily observed audibly but at all times it is considered to be objectionable.

A further object is to provide a needle which

2

is relatively free from needle talk. The term "needle talk" refers to the sound produced by the needle in the air directly, due to its vibration. This sound is sometimes the musical sound produced by the needle point following the modulations of the groove but at other times it is a noise which can be attributable to a chattering of the needle due to its inability to follow the groove or due to the presence of tone arm resonance or system resonance.

I have found that the above objects can be attained by fabricating the needle, either in its entirety, or in part, from certain organic plastic materials, such as a certain type of nylon.

Fig. 1 is an elevation showing one embodiment of my invention;

Fig. 2 is a elevation showing a modified form of the needle shown in Fig. 1;

Fig. 3 is an elevation showing another embodiment of my invention;

Fig. 4 is a view taken along line 4—4 of Fig. 3;

Fig. 5 is an elevation showing a modified form of the needle shown in Fig. 3;

Fig. 6 is an enlarged elevation, partially in section, of a portion of the needle shown in Fig. 5;

Fig. 7 is an elevation of still another embodiment of my invention;

Fig. 8 is an elevation of a modified form of the needle shown in Fig. 7;

Fig. 9 is a sectional view taken along line 9—9 of Fig. 8; and

Fig. 10 is an elevation of a still further embodiment of my invention.

With reference now to the drawings, Fig. 1 shows a straight phonograph needle comprising a chuck engaging portion 13, a stylus portion 12, and a connecting portion 13a which connects the stylus portion and the chuck engaging portion. The portions 13 and 13a are both formed from nylon and are integral with each other, and together comprise an elongate body member designated generally by the reference numeral 11. The stylus portion 12 is in the form of a separate stylus member and projects from the lower end of the connecting portion 13a, to which it is suitably secured. The chuck engaging portion 13 is adapted to be received within the usual chuck of a phonograph pick-up.

The stylus portion 12 may be formed of sapphire, or of a suitable metal or metal alloy, so as to provide a hard, long wearing stylus capable of playing several thousand records. The stylus is in the form of a cylinder terminating in a conical portion, the apex of which may be somewhat rounded, the rounded apex having a radius from

.0025 to .0030 inch. The lower portion of the nylon body member is provided with an axial bore of sufficient depth to receive the upper portion of the stylus 12, which is secured in the bore by a suitable cement.

A modified form of the Fig. 1 needle is shown in Fig. 2. The Fig. 2 needle comprises a body member 14 of nylon, having a record engaging stylus portion 15, also of nylon, which is integral with the nylon body member, instead of being in the form of a separate stylus member. The needle of Fig. 2 is good for only a few plays, but may be manufactured at considerably less cost than the needle of Fig. 1. The upper portion 16 of the body member 14 is adapted to be received within the usual chuck of a pickup. The lower portion serves to connect the chuck engaging portion 16 and the stylus portion 15 and constitutes a connecting portion 16*a*. In order to achieve better wearing qualities of the stylus 15, it is considered preferable to form the needle from a nylon which includes a suitable filler, such as aluminum powder.

Figs. 3 and 4 illustrate a further embodiment of this invention. The needle shown therein comprises a nylon body member 17 having a metal shank 18. The metal shank 18 comprises a portion 19 which is adapted to be received within the usual pickup chuck, and a portion 20 of reduced diameter which is embedded in the upper portion 21 of the nylon body member 17. The nylon body member 17 is preferably injection molded, and the shank 18 takes the form of an insert, the nylon being molded around the portion 20 and the lower extremity of portion 19. The portion 20 may be knurled, as indicated in the drawings, in order to provide a more secure association of the parts.

That portion of the nylon body member 17 which is below the end of the portion 20 of the metal shank is all nylon, and can be referred to as the nylon connecting portion 22. The portion 20 of the metal shank serves to stiffen the upper portion 21 of the nylon body member, but the lower nylon connecting portion 22 is relatively compliant both flexurally and torsionally. Toward the lower end of the nylon connecting portion 22, a stylus 23 is inserted which projects from the under surface thereof. It will be observed that this needle is characterized by a bend, indicated generally by reference numeral 24, the bend being formed in the nylon connecting portion 22.

The portion 19 of the metal shank 18 may be slabbed as indicated by the reference numeral 25 in order to provide proper orientation of the needle when the slabbed portion 19 is engaged by the set screw of the pickup chuck. It will be observed that the nylon body member 17 throughout the greater portion of its length is tapered both in thickness and width. The cross section of the upper portion 21 of the nylon body member is generally circular and it merges into the rectangular cross section of the nylon connecting portion 22.

In the embodiment shown in Figs. 5 and 6, instead of being provided with a gradual bend, as in Figs. 3 and 4, the nylon body member 26 is provided with an abrupt bend designated generally by the reference numeral 34. The needle of Figs. 5 and 6 is provided with a metal shank 27 which is similar to the metal shank 18 of Figs. 3 and 4. The metal shank 18 comprises a slabbed portion 28 adapted to be received within the usual pickup chuck, and a knurled portion 29 of reduced diameter which is embedded within the upper portion 30 of the nylon body member 26. The remainder of the nylon body member may be identified generally as the nylon connecting portion 31, but the abrupt bend 34 divides the nylon connecting portion 31 into a substantially vertically disposed part 32 and a substantially horizontally disposed part 33. The upper portion 30 is of generally circular cross section; the horizontally disposed part 33 is of generally rectangular cross section; and the circular cross section of one merges into the rectangular cross section of the other in the vertically disposed part 32. The nylon connecting portion 31 is tapered both in length and width. The abrupt bend 34 serves to increase the flexural compliance of the nylon connecting portion 31 in a vertical plane.

As shown in Fig. 6, the substantially horizontally disposed part 33 is provided with a bore 37 which partially intersects the upper surface of the horizontally disposed member 33 to provide an aperture 38 of smaller diameter than the bore. A record engaging stylus 39 is secured in the bore 37 by a suitable cement 40, and the dimensions of the bore and of the stylus, and the manner of associating the two securely, are substantially the same as pointed out in connection with my copending application Serial No. 696,701, filed September 13, 1946. In general, the bore is of somewhat smaller diameter than the diameter of the cylindrical portion of the stylus 39. The cylindrical portion is forced into the bore, and the resilience and toughness of the nylon, assisted by the cement 40, cause the cylindrical portion to be gripped very firmly. The nylon body member 26 is preferably injection molded around the metal shank 27.

The needle shown in Fig. 7 comprises a nylon body 41 and a metal shank 42. The nylon body member 41 comprises an upper portion 43 in which a reduced knurled portion of the shank 42 is embedded, and a nylon connecting portion 44 which is substantially horizontally disposed, and which approximates in dimensions and shape, the dimensions and shape of the horizontal part 33 of the needle of Figs. 5 and 6. A stylus 45 is secured in the forward end of the nylon connecting portion 44, in much the same manner as pointed out in connection with the needles of Figs. 5 and 6.

Figs. 8 and 9 illustrate a needle somewhat similar to the needle of Fig. 7, insofar as dimensions and operating characteristics are concerned. This needle comprises a nylon body member 46, and a metal shank 47, the lower reduced portion of which is embedded in the upper portion 48 of a nylon body member 46. The nylon connecting portion 49 which is subjected to the flexural and torsional vibrations caused by the engagement of the needle stylus 50 with the record groove, is of less thickness than the nylon connecting portion 44 of Fig. 7.

The needle of Fig. 10 is similar to the needle of Figs. 5 and 6, with the exception that instead of the metal shank 27, the upper portion or chuck engaging portion 52 of the needle is formed from nylon, and is integral with the remainder of the needle. The nylon body member is designated generally by the reference numeral 51 and includes, in addition to the chuck engaging portion 52, a substantially vertically disposed part 53, and a substantially horizontally disposed part 54. A stylus 55 is inserted toward the forward or outer end of part 54 in the same manner as

pointed out in connection with the preceding figures.

It is obvious that there can be considerable variation in the dimensions and shapes of the needles from that shown in the drawings, although the dimensions and shapes shown have been found to be satisfactory when account is taken of the fact that the drawings (except for Fig. 6) are scaled to about four times the actual size. For instance, the needle of Fig. 1 is about 5/8 of an inch long and .070 inch in diameter.

It will be apparent that the desirable characteristics which flow from the use of nylon in a phonograph needle are obtained when at least a portion of the nylon body member comprises a connecting portion: that is, a compliant unstiffened portion which can be subjected to flexural or flexural and torsional strains. The length ratio of the nylon connecting portion to the needle as a whole can vary anywhere from about one to eight up to unity. For instance, in Fig. 7 the length of the centroidal axis of the needle as a whole is designated by the reference character A, and is approximately 3/4 of an inch; whereas, the length of the centroidal axis of just the homogeneous portion is designated by the reference character B, and is approximately 1/8 of an inch. Thus the length ratio is approximately one to six.

The corresponding dimension B in the needle of Fig. 8 is approximately $\frac{3}{32}$ of an inch, so that the length ratio of that needle is approximately one to eight.

The nylon connecting portion of each needle shown in the drawings is elongate; that is, its length is greater than either its average width or average thickness. However, where vertical compliance is primarily desired the width could equal or exceed the length, and where horizontal compliance is primarily desired, the thickness could equal or exceed the length. The exact proportions of length to thickness or of length to width, and the degree of taper, if any, may be varied according to the characteristics desired.

The nylon body members of the needles shown in the drawings may be formed from these types of nylon designated as "FM10001 nylon" and "FM3001 nylon" (formerly designated as "FM1 nylon" and "FM3 nylon," respectively). These types of nylon, as far as I know, are manufactured and sold only by the E. I. du Pont de Neumours and Company, of Arlington, New Jersey. I prefer to use FM10001 nylon, which in its natural unfilled and unpigmented state is a translucent white in color. However, the needle of Fig. 2, as pointed out above, preferably embodies an aluminum filler, and the needle of Fig. 10 is preferably formed from a black FM10001 nylon.

The metal shanks, where used, are preferably of aluminum alloy.

The word "nylon" as used herein, refers to a substance sold by E. I. du Pont De Nemours & Co. which is defined by them as "a generic term for any long-chain synthetic polymeric amide which has recurring amide groups as an integral part of the main polymer chain, and which is capable of being formed into a filament in which the structural elements are oriented in the direction of the axis." Nylon may otherwise be defined as a "fiber-forming polymer including synthetic linear condensation polyamides formed by reacting organic diamines with dibasic acids or with the amide-forming derivatives of dibasic acids, and polyamides formed from polymerizable amino acids."

The organic plastic material of which the body

members of the needles herein disclosed are formed may also be identified by certain physical characteristics set forth below. FM10001 nylon and FM3001 nylon have those physical characteristics. As used herein, the term "nylon having substantially the same physical characteristics as FM10001 nylon" designates nylon, including FM10001 nylon, having physical characteristics which fall within the ranges set forth in the following tabulation.

Characteristic	Test procedure A. S. T. M. Designation	Values
Specific gravity		1.09 to 1.16.
Flow temperature	D569-43	Not less than 400° F.
Deformation under load	D621-43	Not more than 5% at 122° F.
Stiffness in flexure	D747-43T	150,000 to 300,000 pounds per square inch at 77° F.
Flexural strength	D650-42T	8,000 to 15,000 pounds per square inch at 77° F.
Heat distortion temperature.	D648-44T	Not less than from 130° F. to 171° F. for 10 mils deflection at 264 pounds per square inch M50 to M100 Rockwell.
Hardness	D-229-43	1/4" ball; minor load 10 kilograms; major load 100 kilograms.

FM10001 and FM3001 are made in accordance with the disclosure of United States Patent No. 2,130,948, issued September 20, 1938, to Wallace Hume Carothers.

The use of the filler or pigments in combination with an organic plastic material having physical characteristics falling within the ranges set forth in the above tabulation shall be included in the term "having physical characteristics essentially the same as FM10001 nylon" even though the use of such fillers or pigments would increase the specific gravity beyond the range specified.

This application is a continuation in part of my copending application Serial No. 590,329, filed April 26, 1945, and the subject matter thereof, insofar as it is consistent with this application, is hereby incorporated by reference into this application.

I claim:

1. A phonograph needle comprising a stylus portion, a chuck engaging portion, and a portion connecting said stylus portion and said chuck engaging portion, said connecting portion being formed from nylon having substantially the same physical characteristics as FM10001 nylon and being of a length of at least one eighth of the total length of the needle.

2. A phonograph needle according to claim 1, in which said stylus portion comprises a separate stylus member inserted in said connecting portion at substantially an end thereof.

3. A phonograph needle according to claim 1, in which a part of said connecting portion is disposed at an angle with respect to said chuck engaging portion such that when said chuck engaging portion is gripped within the chuck of a pickup cartridge, the axis of said part will be disposed substantially parallel to the plane of a phonograph record when the needle is in cooperative relation thereto, and in which said stylus portion comprises a separate stylus member projecting from a face of said part.

4. A phonograph needle according to claim 1, in which said chuck engaging portion comprises a metallic member, a part of which is embedded in said connecting portion.

5. A phonograph needle comprising a stylus portion, a chuck engaging portion, and a portion

connecting said stylus portion and said chuck engaging portion, said connecting portion being formed from FM10001 nylon and being of a length of at least one eighth of the total length of the needle.

6. A phonograph needle comprising a stylus portion, a chuck engaging portion, and a portion connecting said stylus portion and said chuck engaging portion, said connecting portion being formed from FM3001 nylon and being of a length of at least one eighth of the total length of the needle.

7. A phonograph needle comprising a body portion formed from FM10001 nylon, a metallic chuck engaging portion having a portion embedded in said nylon body portion, and a stylus inserted in said nylon body portion at substantially the end thereof remote from said metallic chuck

engaging portion, said nylon body portion being of a length of at least one eighth of the total length of the needle and serving to connect said stylus and said chuck engaging portion.

8. A phonograph needle comprising a body portion formed from FM3001 nylon, a metallic chuck engaging portion having a portion embedded in said nylon body portion, and a stylus inserted in said nylon body portion at substantially the end thereof remote from said metallic chuck engaging portion, said nylon body portion being of a length of at least one eighth of the total length of the needle and serving to connect said stylus and said chuck engaging portion.

WILLIAM H. HUTTER.

No references cited.