E. F. LEEDS.

PHONAUTOGRAPHIC RECORD AND PROCESS OF DUPLICATING THE SAME.

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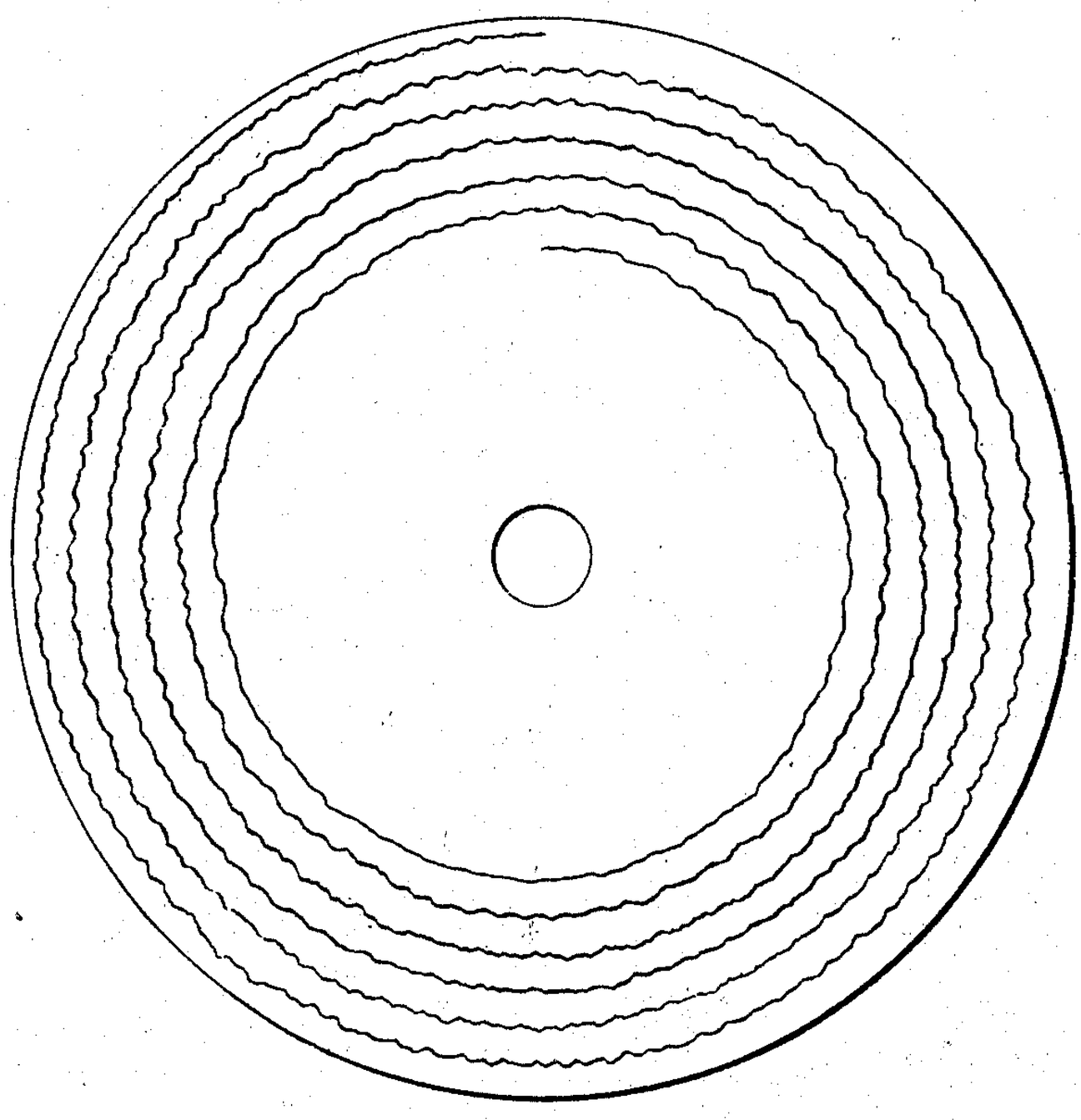
974,895. Patented Nov. 8, 1910.



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PHONAUTOGRAPHIC RECORD AND PROCESS OF DUPLICATING THE SAME.

974,895. Specification of Letters Patent. Patented Nov. 8, 1910.

Application filed March 5, 1906. Serial No. 304,418.

To all whom it may concern:

Be it known that I, EDWARD F. LEEDS, a citizen of the United States, residing in the borough of Brooklyn, city and State of New York, have invented certain new and useful Improvements in Phonautographic Records and Processes of Duplicating the Same, of which the following is a specification.

This invention relates to phonautographic records and to a new method of duplicating phonautographic records or copying the same in solid resisting material, and has for its object the treatment of phonautographic records as herein described and the production of duplicates or copies thereof superior to those heretofore produced.

In the accompanying drawing forming part of this specification is a plan view of a phonautographic record of lateral undulations and practically uniform depth made in accordance with this invention.

The characteristics of an original, phonautographic record and of a duplicate thereof are the same, except as to the material in which the record-groove is formed.

Phonautographic records have heretofore been produced by the lateral vibrations of a recording stylus in a layer or coating of a comparatively non-resisting material, that is a material offering but little resistance to the movements of the recording stylus and carried or spread upon a surface of a tablet or support. Through the removal of the material upon the surface of the tablet or support by the laterally vibrating end or point of the recording stylus, a phonautographic record is traced in the form of an undulatory line of even depth.

As used in the description and claims of this specification, the expression "phonautographic record" applies only to laterally undulating records of substantially even depth. Such phonautographic records have heretofore been traced or produced in a manner such as that above described in a layer or coating of lamp-black, or of beeswax, paraffin or other like substance dissolved in a suitable solvent, or of semi-fluid ink, or of other suitable non-resisting material, carried or spread upon the surface of the tablet or support.

As is well known, an original phonautographic record formed in non-resisting material is incapable of use for reproduction of sound directly therefrom, since the non-resisting material in which it is formed has not sufficient resistance to cause a reproducing stylus to be vibrated and thereby to cause the sounds originally recorded to be reproduced. For this reason such phonautographic records must be copied in solid resisting material in order to reproduce sound therefrom.

The expression "non-resisting material" has long been used in this art, and is used in the description and claims of this specification, to mean a recording material that offers a very small or minimum resistance to the recording stylus and not sufficient resistance to a reproducing stylus to cause it to be vibrated and the sounds originally recorded to be reproduced.

The tablet or support has been made in the form of a revoluble drum or cylinder but more often and preferably in the form of a flat rotary disk or tablet. The tablet or support has been made of paper, parchment, metal, glass or other suitable substance. Negatives, duplicates or copies of such phonautographic records, in solid resisting material, have heretofore been made by the purely mechanical process of engraving, or by chemical deposition, or by photo-engraving, or by the process of direct etching. In the making of negatives, duplicates or copies of such phonautographic records, by such processes, difficulties have been encountered and the results obtained have not been satisfactory. In the making of a negative of such phonautographic record by the process of chemical deposition, for example, the layer or coating of lamp-black or other material, which is spread upon a surface of the tablet or support and in which the undulatory line of even depth has been traced to form the phonautographic record, tends to separate, and at times does separate from the tablet or support when the same have been placed in the electrical bath. It will be understood by those skilled in the art that when a phonautographic record has been traced in a layer or coating of lamp-black, or other suitable material above described, spread or carried upon the surface of a tablet or support, the removal of the lamp-black or other material by the vibrating end or point of the recording stylus exposes, in some instances, the surface of the paper, parchment, metal, glass or other suitable material of which the tablet or support consists, so that the pho-

nautographic record thus traced in the form of an undulatory line of even depth has for the bottom of the groove or furrow the surface of the tablet or support, and for the sides or walls of the groove or furrow the material, such as lamp-black, beeswax, paraffin or other like substance dissolved in a suitable solvent, and the like, of which the layer or coating spread upon the surface of the tablet or support consists. In other instances, the surface of the support is not exposed and the phonautographic record has for the bottom, as well as for the sides, of the groove, the non-resisting material in which the record has been traced. Where the tablet or support has been made of material such as glass, difficulty has been experienced in depositing, by chemical deposition, upon such material, metal for the formation of a negative or copy—a difficulty not overcome by spreading upon the surface of such material any of the agents heretofore used to make the surface electrically conductive. By reason especially of the delicate nature of the material in which the phonautographic record is traced, because of the character of the material of which the tablet or support upon which it is spread consists, and because of the separation from the tablet or support of the material spread upon it, when placed in the electrical bath, and for other like reasons, in the circumstances of any particular case, great difficulty has been encountered in the making, by the process of chemical deposition, of a negative, for the duplication or copying of a phonautographic record in solid resisting material, or other copy of a phonautographic record, and the results obtained have been unsatisfactory.

I have discovered that if a film of metal, such as gold, silver or platinum, preferably gold, is deposited in the form of a vapor of the metal, in any well known manner, upon the surface of the phonautographic record, as by changing the condition of the metal to the form of a vapor by means of an electrical current in a vacuum in which the phonautographic record is present, a perfect negative matrix of the original phonautographic record can thus be made and backed up, so as to be self sustaining, by the process of chemical deposition, in the usual manner, and such perfect negative can then be used as a die or stamp with which to press duplicates or copies of the original phonautographic record into suitable material for the reproduction of the original sound waves, or as a matrix from which, by means of chemical deposition, to make duplicates or copies of the original phonautographic record, either for the reproduction of the original sound waves or for the making of other negatives by chemical deposition to be used as stamps or dies to impress duplicate copies of the original record into suitable material; or the said original and first negative matrix may be pressed into a tablet of wax or other suitable material and further negatives may be made by chemical deposition upon the impression in wax or in other suitable material; or any of the said negatives, or duplicates or copies may be used for analogous purposes either according to the method of this invention or according to other methods heretofore known according to the conditions or requirements of the case.

The negative matrix, formed of the vacuous deposit of a metal such as gold, is so delicate and soft that it is not adapted to be used as a stamp or die for the commercial production of duplicates of the original record by impressing it into hard, resisting material, such as compositions of shellac and earth ordinarily used for such purpose, and I, therefore, prefer to employ such negative matrix as a means of obtaining, by chemical deposition, as stated, a positive duplicate or copy of the original record from which a negative, stamping die may, by chemical deposition, be obtained in hard metal, as described.

Heretofore negatives, duplicates or copies of phonautographic records have not been successfully produced by the process of chemical deposition, principally because of the difficulties above mentioned and referred to. The process of chemical deposition has, heretofore, been used for the making of matrices, molds, duplicates or copies of records cut or engraved in wax or in a wax-like substance, of considerable resistance to the vibrations of the recording stylus. Such records are known as phonograph records or graphophone records and are to be distinguished from the phonautographic records traced, as above described, in nonresisting material.

Phonograph or graphophone records which are cut or engraved, as stated, in wax or a wax-like substance, of considerable resistance to the vibrations of the recording stylus, are capable of use for reproduction of sound directly therefrom, since the resisting material, in which they are cut or engraved by the vertical or lateral vibrations of the recording stylus, has sufficient resistance to cause a reproducing stylus to be vibrated and thereby to cause the sounds originally recorded to be reproduced. The resisting material, moreover, in which phonograph and graphophone records have been cut or engraved, is capable of withstanding the treatment necessary to make, by electrolysis, a chemical deposition of metal thereon, in order to obtain a matrix or a stamping die, without the danger of injury to or destruction of the original record, which exists in the case of the phonautographic record traced in a delicate, non-resisting material.

Experience has taught that in the making

of matrices, by chemical deposition, from records cut into wax or other like resisting material, it is advisable to coat the surface of the matrix, when it is to be used as a stamping die, with a comparatively slight deposit of nickel. The deposit of nickel has the advantage of hardening the surface of the matrix. In the making of duplicates or copies of phonautographic records, according to my invention, a deposit of nickel should, preferably, be made, by chemical deposition, when a stamping die is being formed; but the deposit of nickel should preferably be made before the deposit of copper or other suitable metal, so that the copper is deposited upon the nickel and not the nickel upon the copper as has been the practice heretofore. In depositing copper or other suitable metal upon nickel, the trouble and difficulty, experienced in depositing nickel upon copper, for instance, that of cleansing and preparing the surface of the copper, will not be encountered, as will be well understood by those skilled in the art of chemical deposition, and what is of more importance, by depositing nickel directly upon the surface to be duplicated, the nickel forms a more accurate negative thereof than it does when deposited as a coating upon a negative surface already obtained by deposit of metal upon the surface to be duplicated. In other words the surface of the deposited nickel, which is next to the surface upon which it was deposited, is a more exact negative thereof, when separated therefrom, than is the other surface a copy thereof.

From the foregoing description of my invention it will be understood that phonautographic records traced in a layer or coating of suitable non-resisting material carried upon the surface of a tablet or suitable support can, according to my invention, be duplicated and copied in solid resisting and other material.

It will, of course, be further understood that the vapor of suitable material deposited in a film upon the surface of the phonautographic record is electrically conductive; also that any hard metal, such as iron, may be used in place of nickel, to harden the surface of the matrix or negative of the phonautographic record and to make the surface more durable and resistant.

Having described my invention, which is the result of repeated trial and experiment, what I claim is;—

1. A phonautographic record, formed in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, provided upon its surface with a film of the vapor of an electrically conductive material, substantially as described.

2. A phonautographic record, formed in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, provided upon its surface with a film of the vapor of metal, substantially as described.

3. A phonautographic record, formed in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, provided upon its surface with a film of the vapor of gold, substantially as described.

4. A phonautographic record, formed in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, transferred to suitable resisting material and provided upon its surface with a film of the vapor of an electrically conductive material, substantially as described.

5. A phonautographic record, formed in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, transferred to suitable resisting material and provided upon its surface with a film of the vapor of metal, substantially as described.

6. A phonautographic record, formed in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, transferred to suitable resisting material and provided upon its surface with a film of the vapor of gold, substantially as described.

7. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of an electrically conductive material, then, by chemical deposition, depositing suitable material upon the film, then separating the negative so formed from the phonautographic record, and finally pressing the negative into a tablet of suitable material, substantially as described.

8. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of an electrically conductive material, then, by chemical deposition, depositing metal upon the film, then separating the negative so formed from the phonautographic record, and finally pressing the negative into a tablet of suitable material, substantially as described.

9. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonauto-

graphic record a film of the vapor of metal, then, by chemical deposition, depositing suitable material upon the film, then separating the negative so formed from the phonautographic record, and finally pressing the negative into a tablet of suitable material, substantially as described.

10. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of gold, then, by chemical deposition, depositing suitable material upon the film, then separating the negative so formed from the phonautographic record, and finally pressing the negative into a tablet of suitable material, substantially as described.

11. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of metal, then, by chemical deposition, depositing metal upon the film, then separating the negative so formed from the phonautographic record, and finally pressing the negative into a tablet of suitable material, substantially as described.

12. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of metal, then, by chemical deposition, depositing nickel upon the film, then, by chemical deposition, depositing metal upon the nickel, then separating the negative so formed from the phonautographic record, and finally pressing the negative into a tablet of suitable material, substantially as described.

13. The process of forming a negative for the duplicating of phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of an electrically conductive material, then, by chemical deposition, depositing suitable material upon the film, substantially as described.

14. The process of forming a negative for the duplicating of phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of metal, then, by chemical deposition, depositing metal upon the film, substantially as described.

15. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of an electrically conductive material to form a matrix, then, by chemical deposition, depositing suitable material upon the film, then separating the negative matrix so formed from the phonautographic record, then forming, by chemical deposition, from the matrix a positive, and from the positive a negative, copy of the original record, and finally pressing the second negative into a tablet of suitable, resisting material, substantially as described.

16. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of an electrically conductive material to form a matrix, then, by chemical deposition, depositing nickel upon the film, then separating the negative matrix so formed from the phonautographic record, then forming, by chemical deposition, from the matrix a positive, and from the positive a negative, copy of the original record, and finally pressing the second negative into a tablet of suitable resisting material, substantially as described.

17. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of an electrically conductive material to form a matrix, then, by chemical deposition, depositing metal upon the film, then separating the negative matrix so formed from the phonautographic record, then forming, by chemical deposition, from the matrix a positive, and from the positive a negative, copy of the original record, and finally pressing the second negative into a tablet of suitable resisting material, susbtantially as described.

18. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of metal to form a matrix, then, by chemical deposition, depositing metal upon the film, then separating the negative matrix so formed

from the phonautographic record, then forming, by chemical deposition, from the matrix a positive, and from the positive a negative, copy of the original record, and finally pressing the second negative into a tablet of suitable resisting material, substantially as described.

19. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of gold to form a matrix, then, by chemical deposition, depositing metal upon the film, then separating the negative matrix so formed from the phonautographic record, then forming, by chemical deposition, from the matrix a positive, and from the positive a negative, copy of the original record, and finally pressing the second negative into a tablet of suitable resisting material, substantially as described.

20. The process of forming a negative for the duplicating of phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of an electrically conductive material to form a matrix, then depositing metal upon the film, then separating the negative matrix so formed from the phonautographic record, and then forming, by chemical deposition, from the matrix a positive, and from the positive a negative, copy of the original record, substantially as described.

21. The process of forming a negative for the duplicating of phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of metal to form a matrix, then depositing, by chemical deposition, metal upon the film, then separating the negative matrix so formed from the phonautographic record, and then forming, by chemical deposition, from the matrix a positive, and from the positive a negative, copy of the original record, substantially as described.

22. The process of forming a negative for the duplicating of phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of gold to form a matrix, then, by chemical deposition, depositing metal upon the film, then separating the negative matrix so formed from the phonautographic record, and then forming, by chemical deposition, from the matrix a positive, and from the positive a negative, copy of the original record, substantially as described.

23. The process of forming a negative for the duplicating of phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of metal, then, by chemical deposition, depositing metal upon the film, then separating the negative so formed from the phonautographic record, and finally, by chemical deposition, depositing nickel upon the surface of the negative, substantially as described.

24. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of an electrically conductive material to form a matrix, then depositing suitable material upon the film, then separating the negative matrix so formed from the phonautographic record, then forming, by chemical deposition, from the matrix a positive, then, by chemical deposition, depositing hard metal upon the surface of the positive to form a negative, and finally pressing the second negative into a tablet of suitable resisting material, substantially as described.

25. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of an electrically conductive material to form a matrix, then, by chemical deposition, depositing metal upon the film, then separating the negative matrix so formed from the phonautographic record, then forming, by chemical deposition, from the matrix a positive, then, by chemical deposition, depositing nickel upon the surface of the positive to form a negative, and finally pressing the second negative into a tablet of suitable resisting material, substantially as described.

26. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of metal to form a matrix, then, by chemical deposition, depositing suitable material upon the

film, then, separating the negative matrix so formed from the phonautographic record, then forming, by chemical deposition, from the matrix a positive, then, by chemical deposition, depositing nickel upon the surface of the positive to form a negative, and finally pressing the second negative into a tablet of suitable resisting material, substantially as described.

27. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of gold to form a matrix, then, by chemical deposition, depositing metal upon the film, then separating the negative matrix so formed from the phonautographic record, then forming, by chemical deposition, from the matrix a positive, then, by chemical deposition, depositing hard metal upon the surface of the positive to form a negative, and finally pressing the second negative into a tablet of suitable resisting material, substantially as described.

28. The process of duplicating phonautographic records, which consists in forming a phonautographic record in comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the phonautographic record a film of the vapor of metal, then, by chemical deposition, depositing metal upon the film, then separating the negative so formed from the phonautographic record, then, by chemical deposition, depositing nickel upon the surface of the negative, and finally pressing the negative into a tablet of suitable material, substantially as described.

29. The process of duplicating phonautographic records traced in comparatively non-resisting material, incapable of vibrating a stylus and reproducing sound, spread upon a vitreous surface, which consists in depositing upon the surface of the phonautographic record a film of the vapor of an electrically conductive material, then, by chemical deposition, depositing suitable material upon the film, then separating the negative so formed from the phonautographic record, and finally pressing the negative into a tablet of suitable material, substantially as described.

30. The process of duplicating phonautographic records traced in comparatively non-resisting material, incapable of vibrating a stylus and reproducing sound, spread upon the surface of glass, which consists in depositing upon the surface of the phonautographic record a film of the vapor of an electrically conductive material, then, by chemical deposition, depositing metal upon the film, then separating the negative so formed from the phonautographic record, and finally pressing the negative into a tablet of suitable material, substantially as described.

31. The process of duplicating phonautographic records traced in comparatively non-resisting material, incapable of vibrating a stylus and reproducing sound, spread upon a vitreous surface, which consists in depositing upon the surface of the phonautographic record a film of the vapor of metal, then, by chemical deposition, depositing suitable material upon the film, then separating the negative so formed from the phonautographic record, and finally pressing the negative into a tablet of suitable material, substantially as described.

32. The process of duplicating phonautographic records traced in comparatively non-resisting material, incapable of vibrating a stylus and reproducing sound, spread upon the surface of glass, which consists in depositing upon the surface of the phonautographic record a film of the vapor of gold, then, by chemical deposition, depositing suitable material upon the film, then separating the negative so formed from the phonautographic record, and finally pressing the negative into a tablet of suitable material, substantially as described.

33. The process of duplicating phonautographic records traced in comparatively non-resisting material, incapable of vibrating a stylus and reproducing sound, spread upon the surface of glass, which consists in depositing upon the surface of the phonautographic record a film of the vapor of metal, then, by chemical deposition, depositing metal upon the film, then separating the negative so formed from the phonautographic record, and finally pressing the negative into a tablet of suitable material, substantially as described.

34. A negative of a phonautographic record formed in a comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, consisting of a layer of suitable material provided with a film of the vapor of suitable material, substantially as described.

35. A negative of a phonautographic record formed in a comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, consisting of a layer of suitable material, a layer of nickel and a film of the vapor of suitable material, substantially as described.

36. The process of making a negative matrix of a sound-record, which consists in forming the sound-record in a comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the record a film of the vapor of metal, then backing up the metal film, and then sep-

arating the negative matrix from the original record, substantially as described.

37. The process of making a negative matrix of a sound-record, which consists in forming the sound-record in a comparatively non-resisting material incapable of vibrating a stylus and reproducing sound, then depositing upon the surface of the record a film of the vapor of gold, then backing up the metal film, and then separating the negative matrix from the original record, substantially as described.

In witness whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

EDWARD F. LEEDS.

Witnesses:
GEORGE H. OLNEY,
CHAS. H. THURSBY.