Feb. 15, 1944. S. REY 2,341,652

PROCESS FOR RECORDING BY DIRECT LITHOGRAPHIC PRINTING, SOUNDS IMPINGING ON MICROPHONES OR THE LIKE

Filed May 13, 1941 2 Sheets-Sheet 1

Fig. 1.

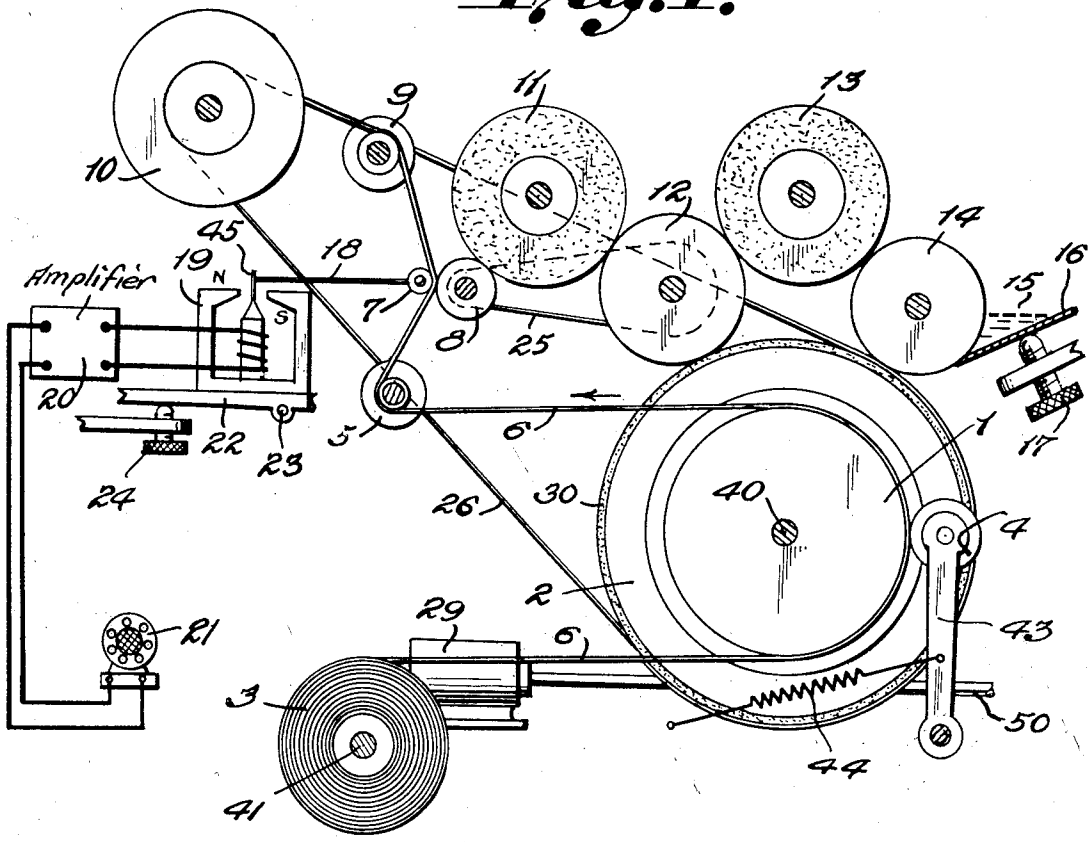
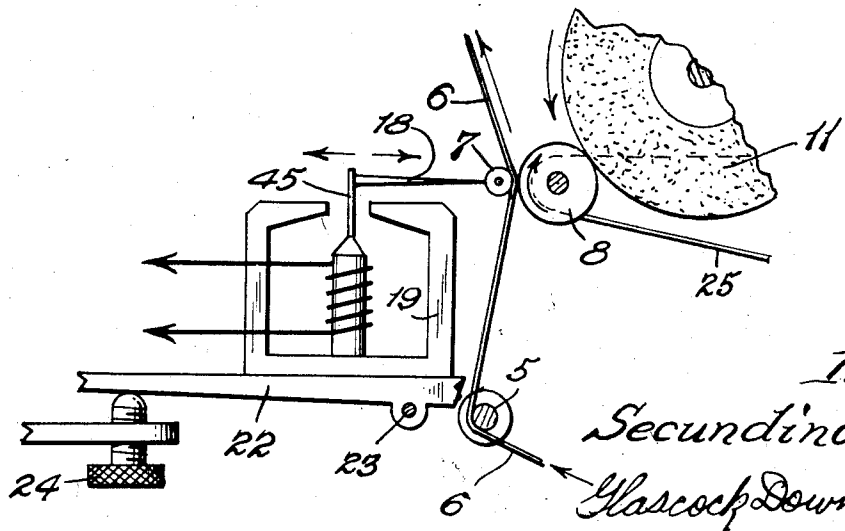


Fig. 3.



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Filed May 13, 1941 2 Sheets-Sheet 2

Fig. 2.

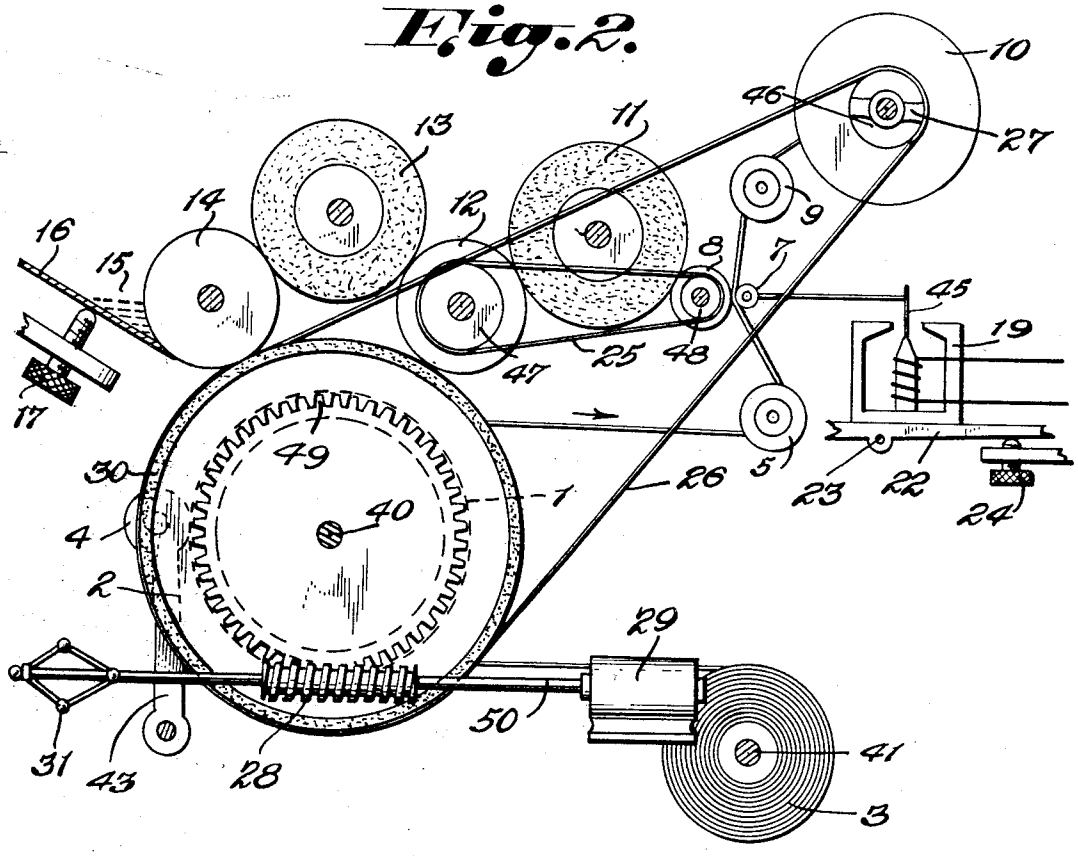


Fig. 4.

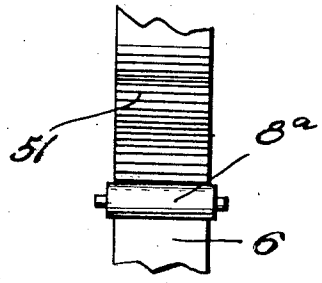
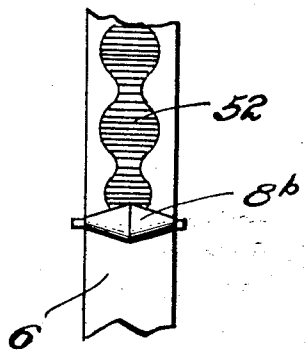


Fig. 5.



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UNITED STATES PATENT OFFICE

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PROCESS FOR RECORDING BY DIRECT LITHOGRAPHIC PRINTING, SOUNDS IMPINGING ON MICROPHONES OR THE LIKE

Secundino Rey, Buenos Aires, Argentina

Application May 13, 1941, Serial No. 393,300
In Argentina January 22, 1941

9 Claims. (Cl. 179—100.1)

The present invention relates to a new and hitherto unknown process for recording by direct lithographic printing, sounds impinging on a microphone or the like, and applied in the form of audio frequency potentials to a rotary press consisting of two small rollers urged towards each other in response to and under the control of said audio frequency currents, which are derived from an amplifier.

The direct lithographic printing is effected on strips or tapes of white, clear and glossy paper, or, alternatively, on any other flexible material, and reproductions can immediately be obtained without the necessity for subsequent processing.

By means of the controlled pressure, rotary phonoelectric printer of the present invention, the cost of the support for the sound record is reduced, since narrow tapes or strips of plain paper are used therefor, so that it now becomes possible to practice such sound recording widely in commerce, art and industry as well as in the home, where sound recording is not usually performed owing to the high cost of the supports. The novel printer of the present invention permits records to be made for unbroken periods of ten to fifteen minutes each, and consequently the printer is of high utility for congresses, speeches and the like, and, in general, wherever sounds are to be recorded in a highly economical manner. It is also especially adapted for the recording or printing of telegraphic signals at rates up to about 500 words per minute.

The recorder or printer of the present invention is likewise desirably provided with a source of light and a photoelectric cell, whereby the sounds recorded may be reproduced immediately after printing.

The apparatus which is the subject-matter of the present invention, is the first which permits a sound record to be made by a direct lithographic process (mechanical process), and opens up a wide field of applications, since it enables cheap sound record supports to be used which are readily obtainable in any part of this continent.

The fundamental novelty of the device, consists in a press composed of two rollers of very small size, the pressure between which is controlled by audio currents, one of said rollers being adapted to exert pressure on the paper strip, to which end it is rigidly attached to the moving tongue of a phonoelectric reproducer, the other of said rollers being adapted to print the traces on the paper by means of lithographic ink, which a series of inking rollers deposit on the periphery of said other roller.

In order to avoid the production of zones of varying thicknesses of ink, the inking roller is rotated with a peripheral velocity exactly equal to the velocity of displacement of the paper strip. This rotary movement ensures the replacement of that quantity of ink which was removed from the layer covering the roller, during the half cycles of pressure application, and said layer is rectified, even if there is an excess therein, as the result of half cycles of less than normal pressure.

The pressure is regulated by hand by means of an adjusting screw, while no audio currents are being produced by the amplifier connected to the phonoelectric reproducer, and the strip should then acquire a coating of ink giving a grey color, that is to say, a dark tone which is not black. If, in these circumstances, audio currents reach the amplifier from the microphone, the rollers of the controlled pressure rotary press will be subjected to variable oscillating pressures giving rise to blacker traces when the pressures are higher than normal, and to lighter traces when the pressures are lower than normal.

The sound waves are recorded by traces in which the tone (density of darkness) represents the amplitude of the sound, and the width or distance between the traces of darker and lighter tonality, represents the frequency.

If instead of two cylindrical metal rollers, a hard rubber roller is used in the controlled pressure rotary press, for inking, and a double cone roller is employed for the oscillating pressure roller, the record obtained will be of the variable amplitude and variable density, or mixed, type.

In order to obtain records by direct printing of more than 5,000 periods, the diameter of the rollers of the phonoelectric press must be less than 5 mms., and the length thereof must not exceed that of the strip of flexible material on which the sound record is printed. The strip of supporting material should run at a speed of more than half a meter per second.

During the experiments leading to the development of this invention, the paper strip was caused to unwrap itself from the spool at the rate of 50 cms. per second, and traces 0.1 mm. wide were obtained, corresponding to a frequency of 5,000 half periods. With the speed of translation of the support increased to 150 cms. per second, high fidelity sound records were obtained in which the frequencies of 7,000 and 8,000 cycles could be distinguished with the naked eye.

The speed of displacement of the support (paper strip) may be controlled manually, for which

purpose the motor is provided with a simple governor type regulator.

In addition to the phonoelectric press, the machine contains a rotary ink reservoir and the metal roller assembly adapted to feed the ink to the press and ensure that it is thoroughly mixed and forms a layer of small thickness.

For the purpose of filtering mechanically any vibration which might affect the tone of the record, the main roller or cylinder, hereinafter called the feeder, since it feeds the exact amount of paper required to the phonoelectric press, is connected to a fly-wheel which keeps the peripheral speed strictly constant and has a sufficiently high moment of inertia to prevent any irregularities in the rotation of the feeder, the phonoelectric press and the moving paper.

In order to prevent the formation of loops in the paper strip and to maintain the latter stretched at all times, the paper receiving drum or take-up roller should be continually taking up the strip, and this condition is achieved by means of a freely running, spring urged pulley so arranged that as the feeder roller withdraws strip from a fresh roll, the take-up drum takes up or winds on itself exactly the same amount of strip.

In the controlled pressure roller press, the oscillating roller is rigidly connected to the vibrating tongue or rod of a phonoelectric reproducing unit, such as a loud speaker, and said roller, in exerting pressure on the paper, replaces the diaphragm or cone and the ambient air. Instead of being transformed into sound waves, the audio frequency energy of the reproducer is converted into mechanical oscillations of the roller which prints said oscillations on the paper strip.

From the foregoing, and from the results obtained during the experimental trials, it will be seen that the novel apparatus of the present invention, in addition to being the first of its kind, leads to a considerable economy in the production of sound records in the home, in commerce, in art and in industry.

To facilitate the understanding of the present invention, an embodiment thereof will now be described with reference to the accompanying drawings, which illustrate by way of example and in diagrammatic form, a preferred manner of carrying the invention into practice.

In the drawings:

Fig. 1 is a diagram representing a complete sound record printing machine according to the present invention, comprising the controlled pressure roller press, the inking roll assembly, the feeder roller and the paper supply and receiving drums.

Fig. 2 is a diagrammatic detail view on a larger scale of the same machine seen from the rear, showing the couplings between the feeder roller and the fly-wheel and the printed strip receiving drum, as well as the connection between the press roller and a roller driven from the feeder. The same figure shows a motor with a worm drive for the machine.

Fig. 3 is a view showing diagrammatically in detail how the paper is displaced between the press rolls, and illustrating a detail of the phonoelectric controlled pressure roller press.

Figs. 4 and 5 are plan views of portions of paper strip illustrating the differences in traces obtained with different types of roller.

As seen in the drawings, the controlled pressure rotary printer of the present invention, illustrated in Fig. 1, consists of a main or paper feeder roller 1, the shaft 40 of which has fast on it a fly-wheel 2 adapted to act as a regulator for all the motions. Said feeder roller 1 draws paper from a supply drum 3 free to turn on a pin 41, and, to prevent slippage, is slightly braked by a roller 4 mounted for free rotation on an arm 43 urged by a spring 44 towards the feeder. The paper strip 6, on leaving the feeder 1, passes round guide roller 5 and thence between rollers 7 and 8 which form an integral part of the printer or press. Beyond said rollers 7 and 8, the strip 6 is guided by a second guide roller 9 onto a receiving drum 10.

The roller 8 is the inking roller and receives properly mixed or spread ink from the paste roller 11, which in turn, receives the ink from a metallic cylinder 12, which is inked by a composition or rubber roller 13, supplied with ink by an inking roll 14, to which a plate 16 is tangent, the ink being contained, as shown at 15, in the space between the inking roll 14 and said plate 16. The space 15 is adapted to be adjusted to control the supply of ink to the inking roll 14, as by means of an adjusting screw 17.

The roller 7 is the oscillating pressure roller and is connected by a rod 18 to the oscillating tongue 45 of an electromagnetic reproducer 19, whereby mechanical oscillations are communicated to said roller 7. The reproducer 19 is suitably connected to an amplifier 20, of the electronic type, which in turn, is connected to a microphone 21.

For manual regulation of the pressure between roller 7, strip 6 and roller 8, of the phonoelectric press, the latter is mounted on a platform 22 pivoted at 23 and provided with an adjusting screw 24.

Fig. 2, which, as already stated, is a rear view of the machine shown in Fig. 1, illustrates the drives for the various parts. Thus the fly-wheel 2 of the feeder 1 is in frictional driving engagement with roll 14 and cylinder 12, the friction being enhanced by a coating of rubber or the like 30 on the periphery of the fly-wheel 2. Alternatively, the driving engagement between said fly-wheel and the roll 14 and cylinder 12 may be of the gear variety. As shown, a belt 26 couples fly-wheel 2 operatively with a pulley 46 rigidly secured to the receiving drum 10, the free rotation of which is braked to a slight extent, to prevent irregularities in speed, by a spring brake indicated at 27. Cylinder 12 has fast on it a pulley 47 operatively coupled to a pulley 48, rigidly secured to the inking roller 8, by means of belting 25. Composition rollers 13 and 11 may be frictionally or positively driven from roll 14 and/or cylinder 12. A motor 29 is provided as a source of power and is operatively connected to the fly-wheel 2 by a worm 28 meshing with a worm-wheel 49 arranged in rigid relationship with the fly-wheel 2. The worm 28 may form part of or be mounted on an extension 50 of the motor shaft, the speed of which is kept adjustably constant by means of a centrifugal governor 31 or the like.

In Fig. 3 the controlled pressure phonoelectric press is shown on an enlarged scale in somewhat greater detail. As will readily be appreciated by those skilled in the art, the lateral oscillations of the tongue or reed 45 of the reproducer 19 are transmitted lengthwise of the coupling rod 18 to the roller 7 which presses the paper 6 against the inking roller 8, supplied with ink from the cylinder 11 and driven to rotate in the direction shown in Fig. 2 by the arrow, as previously described.

In operating the machine, the paper strip or tape 6 is withdrawn from the supply drum 3 and passed round the feeder 1 and thence, as already

described, round pulley 5 between rollers 7 and 8, to the receiving drum 10 by way of guide roller 9. If then motor 29 be started, the paper strip 6 will be fed from drum 3 to drum 10, its passage being accurately controlled by the feeder 1 and the fly-wheel 2. If a charge of lithographic ink is provided in space 15, and the screw 17 is suitably adjusted, a coating of ink will appear on the rollers and cylinders 14, 13, 12, 11 and 8, the coating on the last-named roller being very thin and even. Screw 24 is now adjusted to cause roller 7 to press the paper against roller 8 with just sufficient force to leave an even trace of a middle grey tone. When these adjustments have been completed, speaking into the microphone 21, by originating audio frequency variations in the current in the phonoelectric reproducer 19, which are converted into oscillations of the rod or reed 45 communicated through rod 18 to the roller 7, will cause variations in the pressure between the rollers 7 and 8, under direct control of the voice currents, and consequently produce controlled variations in the density of the trace left on the paper 6 by the inking roller 8. The paper, therefore, as it enters the receiving drum 10, will bear bands of lighter and darker tones than the uniform grey back-ground.

By suitably adjusting the governor 31, the paper strip can be made to run at speeds lying between 50 and 150 cms. per second, whereby the width of the lighter and darker bands printed on the strip may be varied. Such adjustment enables the machine to be used for amateur recording at 2,000 to 3,000 cycles or for professional recording and frequencies lying between 7,000 and 8,000 cycles, as the upper limit of high frequencies.

The type of record obtained with a cylindrical pressure roller and a cylindrical inking roller is shown at 51 in Fig. 4. The cylindrical inking roller 8a gives light and dark bands of substantially uniform width, and the record is therefore, a simple intensity record. In Fig. 5, the inking roller 8b is in the form of a double cone, which gives a trace 52 of varying width, the width variations corresponding to amplitude variations in the recorded sounds.

It is obvious that in carrying the invention into practice, many variations and modifications in construction and design may be made without departing from the spirit and scope thereof. For example, the sizes of the rollers of the phonoelectric press, the relative positions of the rollers, the number and shape of the inking rollers and rolls, the forms of drive and the like may be subject to variation, and it is not intended, therefore, that the present invention shall be limited to the specific examples hereinbefore described, except as defined in the appended claims.

I claim:

1. A controlled pressure phonoelectric roller type printer for recording audio currents comprising a supply of printable flexible strip material, a pair of parallel recording rollers, one of said rollers being a pressure roller exerting pressure on the other of said rollers, adjustable feeding means for feeding said strip material at adjustable uniform speeds between said recording rollers, ink applying means operatively associated with said recording rollers for applying a thin layer of ink against said strip material during its passage between said recording rollers, whereby a trace is printed on said strip material, an electro-acoustic reproducer including a sound receiver and electro-magnetic means for converting said sounds into audio frequency currents, said electro-magnetic means including an oscillating member adapted to oscillate in response to variations in said currents, said oscillating member being mechanically coupled to said pressure roller to vary the pressure between said recording rollers in response to said sounds and thereby cause variations in said trace to constitute a printed record of said sounds, said ink applying means including a band of ink supporting material passing between said pressure roller and said strip with the ink bearing surface in contact with said strip.

2. A controlled pressure phonoelectric roller type printer for recording audio currents, comprising a supply member, a take-up member, a charge of continuous printable flexible strip material in said supply member, a pair of recording rollers located between said supply member and said take-up member and comprising an inking roller and a pressure roller located adjacent and parallel to said inking roller and exerting pressure thereon, a rotary feeder member located between said supply member and said recording rollers and including a strip advancing member and a fly-wheel rigidly secured to said advancing member, guide means for said strip located between said advancing member and said recording rollers, and between said recording rollers and said take-up member, said strip being adapted to be threaded to partially embrace said advancing member and to pass over said guides between said recording rollers and thence into said take-up member, resilient braking means arranged to contact a part of the portion of the strip embracing said advancing member to prevent looping of the strip, inking means operatively associated with said inking roller to apply a thin uniform coat of ink thereto whereby a trace is printed on said strip during passage thereof between said recording rollers, an electro-acoustic reproducer including a sound receiver and means for converting received sounds into audio frequency currents, said converting means including an oscillating member adapted to oscillate in response to variations in said currents consequent on variations in the received sounds, said oscillating member being mechanically coupled to said pressure roller to vary the pressure between said recording rollers in response to variations in said audio currents and thereby cause variations in said trace to constitute a printed record of said sounds, driving means operatively connected to said feeder means, a driving connexion between said feeder means and said inking means, a second driving connexion between said feeder means and said take-up means, said second driving connexion including a resilient brake adapted to prevent over-running of said take-up means, and manually adjustable means operatively associated with said oscillating member and said pressure roller and adapted to vary the pressure between said pressure roller and said inking roller to adjust the intensity of the said trace.

3. A controlled pressure phonoelectric roller type printer for audio currents, comprising a supply of printable flexible strip material, a pressure roller, an inking roller located adjacent and parallel to said pressure roller, inking means operatively associated with said inking roller to apply ink thereon, feeding means adapted to feed said flexible strip between said pressure and said inking rollers, whereby a trace is printed on said strip during its passage between said rollers, an electro-acoustic reproducer including a sound re-

ceiver and an oscillating member adapted to oscillate in response to sounds impinging on said receiver, said member being mechanically coupled to said pressure roller to vary the pressure between said pressure and said inking rollers in response to said sounds and thereby cause variations in said trace to constitute a printed record of said sounds, said inking roller being formed of metal and said pressure roller being formed of relatively soft rubber-like material.

4. A controlled pressure phonoelectric roller type printer for audio currents, comprising a supply of printable flexible strip material, a pressure roller, an inking roller located adjacent and parallel to said pressure roller, inking means operatively associated with said inking roller to apply ink thereon, feeding means adapted to feed said flexible strip between said pressure and said inking rollers, whereby a trace is printed on said strip during its passage between said rollers, an electro-acoustic reproducer including a sound receiver and an oscillating member adapted to oscillate in response to sounds impinging on said receiver, said member being mechanically coupled to said pressure roller to vary the pressure between said pressure and said inking rollers in response to said sounds and thereby cause variations in said trace to constitute a printed record of said sounds, said inking roller being cylindrical whereby a trace is obtained consisting of bands substantially varying only in density.

5. A controlled pressure phonoelectric roller type printer for audio currents, comprising a supply of printable flexible strip material, a pressure roller, an inking roller located adjacent and parallel to said pressure roller, inking means operatively associated with said inking roller to apply ink thereon, feeding means adapted to feed said flexible strip between said pressure and said inking rollers, whereby a trace is printed on said strip during its passage between said rollers, an electro-acoustic reproducer including a sound receiver and an oscillating member adapted to oscillate in response to sounds impinging on said receiver, said member being mechanically coupled to said pressure roller to vary the pressure between said pressure and said inking rollers in response to said sounds and thereby cause variations in said trace to constitute a printed record of said sounds, said inking roller being in the shape of a double cone having its maximum diameter at the center whereby a trace is obtained varying simultaneously in width and intensity and constituting an amplitude-intensity sound record.

6. A controlled pressure phonoelectric roller type printer for audio currents, comprising a supply of printable, flexible strip material, a pressure roller, an inking roller located adjacent and parallel to said pressure roller, inking means operatively associated with said inking roller to apply ink thereon, feeding means adapted to feed said flexible strip between said pressure and said inking rollers in a direction substantially perpendicular to the axes of said rollers, said pressure roller being adjusted to press said strip into contact with the inking roller whereby normally a trace of uniform tone is printed on said strip during its passage between said rollers, an electro-acoustic reproducer including a sound receiver and an oscillating member adapted to oscillate in response to sounds impinging on said receiver, said member being mechanically coupled to said pressure roller to vary the pressure between said pressure and said inking rollers in response to said sounds and thereby cause variations in said trace to constitute a printed record of said sounds.

7. A controlled pressure phonoelectric roller type printer for recording audio currents, comprising a supply member, a charge of continuous printable flexible strip material in said supply member, a pair of recording rollers comprising a pressure roller and an inking roller located adjacent and parallel to said pressure roller, a rotary feeder member located between said supply member and said pair of recording rollers, and including a strip advancing member and a fly-wheel rigidly secured to said strip advancing member, guide means for guiding said strip between said pressure roller and said inking roller, and in simultaneous contact with both said rollers, the direction of advance of said strip being substantially perpendicular to the axes of said rollers, inking means operatively associated with said inking roller normally to apply a continuous unifrom thin coat of ink thereon, whereby a trace is printed on said strip during its passage between said pair of recording rollers, an electro-acoustic reproducer including a sound receiver and means for converting received sounds into audio frequency currents and an oscillating member adapted to oscillate in unison with said audio currents, said oscillating member being mechanically coupled to said pressure roller to vary the normal pressure between said recording rollers in response to variations in said audio frequency currents representative of said sounds and thereby cause variations in said trace to constitute a printed record of said sounds, and driving means operatively connected to said rotary feeder member.

8. A controlled pressure phonoelectric roller type printer for recording audio currents comprising a supply of printable flexible strip material, a pair of parallel recording rollers, one of said rollers being a pressure roller adjusted normally to exert pressure on the other of said rollers, adjustable feeding means for feeding said strip material at adjustable uniform speeds between said recording rollers, in a direction substantially perpendicular to the axes of the rollers and in simultaneous contact with both said rollers, ink applying means operatively associated with said recording rollers for applying a thin layer of ink against said strip material during its passage between said recording rollers, whereby normally a continuous uniform trace is printed on said strip material, an electro-acoustic reproducer including a sound receiver and electromagnetic means for converting said sounds into audio frequency currents, said electro-magnetic means including an oscillating member adapted to oscillate in response to variations in said currents, said oscillating member being mechanically coupled to said pressure roller to vary the pressure between said recording rollers in response to said sounds and thereby cause variations in said trace to constitute a printed record of said sounds.

9. In combination, a controlled pressure phono-electric roller type printer comprising a supply of printable flexible strip material, a pressure roller, an inking roller adjacent and parallel to said pressure roller, said pressure roller being adapted normally to exert pressure on said inking roller, inking means operatively associated with said inking roller to apply ink thereon, feeding means adapted to feed said flexible strip between said pressure roller and said inking roller,

in a direction substantially perpendicular to the axes of said rollers and in simultaneous contact with both said rollers, whereby normally a continuous uniform trace is printed on said strip during its passage between said rollers, a take-up device adapted to receive the strip after passing between said rollers, an electro-acoustic reproducer including a sound receiver and an oscillating member adapted to oscillate in response to sounds impinging on said receiver, said oscillating member being mechanically coupled to said pressure roller to vary the pressure between said pressure roller and said inking roller in response to said sounds and thereby cause variations in said trace to constitute a printed record of said sounds, and a photo-electric checking device for checking the record as made, located between said rollers and said take-up and including an amplifier, a source of light directed onto said strip, a photo-electric cell positioned on the side of the strip remote from said source and a slit interposed between said cell and said strip, said cell being connected to said amplifier.

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