Oct. 26, 1937. A. C. BLANEY 2,097,141

PHOTOPHONOGRAPHIC APPARATUS

Filed March 9, 1933

Fig. 1.

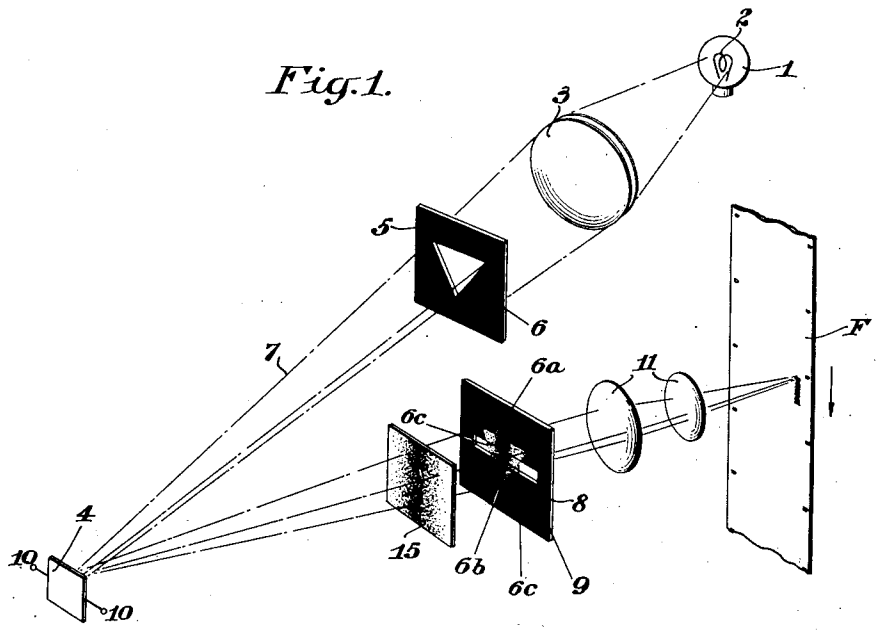


Fig. 2.

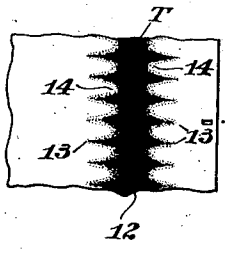
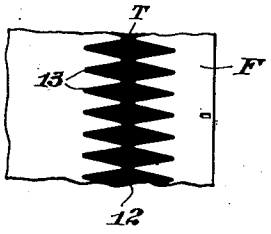


Fig. 3.



INVENTOR:
Arthur C. Blaney,
BY R. G. Goldsborough
HIS ATTORNEY.

Patented Oct. 26, 1937

2,097,141

UNITED STATES PATENT OFFICE

2,097,141

PHOTOPHONOGRAPHIC APPARATUS

Arthur C. Blaney, Erlton, N. J., assignor to Radio Corporation of America, New York, N. Y., a corporation of Delaware

Application March 9, 1933, Serial No. 660,106

2 Claims. (Cl. 179—100.3)

My invention relates to photophonographic apparatus, and more particularly to a method of and system for recording and/or reproducing sound photographically.

There are two well known types of photographic sound records which are in general use at present. In one type, the record is in the form of a long, narrow strip of uniform width having striations of varying density thereon extending transversely thereof along its length. A record of this type is known as the constant width, variable density record. In the other type, the record has the form of a long narrow strip of constant density, but its area varies along its length, the sound track being in the form of a series of continuous hills and valleys. A record of the latter type is known in the art as the constant density, variable area record, and it is to records of such type that my invention is particularly applicable.

Records of the latter type are formed, generally, by causing a very fine beam of light, modulated in accordance with the oscillations being recorded, to move across a photo-sensitive strip travelling uniformly in a direction at right angles to the direction of movement of the fine light beam. The variable movement of this beam across the strip or film is what produces the hills and valleys along the length thereof.

In records of this type, as produced by recording systems heretofore employed, there is a tendency, particularly at the higher frequencies, for the density of the record to be low in the peaks and high in the valleys. This, of course, results from the fact that the base portion of the wavy track receives a larger exposure than the peak portion. In order, therefore, to insure proper exposure at the peaks, it becomes necessary to expose the peaks to more intense light than would otherwise be necessary. By reason of the structure of the emulsion and the manner in which the light reaches it, there results, from this practice, a spreading of the light which causes a decrease in the density in a given unit area and an increase in adjoining areas. Since adjoining areas at the base of the waves are very close to each other, the stray light causes a density to be developed where theoretically there was no exposure. In other words, the voids or valleys at the base of the sound track become somewhat filled in and acquire a foggy appearance which gradually falls off in fogginess as the peaks are approached. This, obviously, cuts down the efficiency of the record greatly and results in noticeable distortion in the reproduced sound.

The primary object of my invention is to provide an improved system for recording sound which will produce a constant density, variable area record free from the defects present in records of this type as heretofore produced.

Another object of my invention is to provide an improved system for recording sound which will produce a record of the constant density, variable area type in which the intentionally exposed portion will be truly constant in density.

Still another object of my invention is to provide an improved sound recording system by means of which the exposure of the photo-sensitive film can be accurately controlled with a view particularly to avoid fogging of those parts of the film not intended to be exposed.

A further object of my invention is to provide a record of the type indicated which will be practically free from exposure except where exposure has been intentionally made.

Still a further object of my invention is to provide a sound record of the type indicated from which a more faithful output, particularly at the higher frequencies, can be obtained than was heretofore possible.

It is another object of my invention to provide an improved sound recording system which will be simple in construction and highly efficient in use.

According to my invention, I control the light intensity of the recording light beam in such a manner that the valleys of the sound track formed thereby are not filled in by exposure and so that the peaks of the track will have such a density that their light transmission, if any, will be negligible. This can be accomplished, for example, by inserting a suitable light filter, such as an optical wedge, in the path of the light beam either at the mask or at the slit, the filter being most transparent at that portion of the recording beam which forms the peaks of the track. Where a bi-lateral sound track is produced, as in the case of the system hereinafter described in detail, the filter has its highest density at its center and shades off equally in opposite directions. The density gradient of the filter may or may not be linear, being determined by the overall characteristic of the system which takes into account such factors as value of modulation, maximum frequency to be recorded, size of the optical slit, etc.

The novel features characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of op-

eration, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment, when read in connection with the accompanying drawing, wherein

Fig. 1 is a diagrammatic perspective view of a recording system in accordance with my invention, certain of the parts being separated for the sake of clearness,

Fig. 2 is a greatly enlarged fragmentary view of a film record as formed by recording systems heretofore known and showing the faded peaks and the filled in valleys formed thereby, and

Fig. 3 is a similar view, illustrating, by way of contrast, a high frequency record formed by my improved recording system, showing the clear, unexposed valleys and the black, undistorted peaks formed thereby.

Referring to Fig. 1 of the drawing, I have shown a light source 1 having a filament 2 an image of which is formed, by means of the condenser 3, upon a galvanometer mirror 4. A light limiting device or mask 5 having a triangular aperture 6 therein is placed in the path of the light passing from the source 1 to the mirror 4 and defines a triangular beam 7 which is reflected by the mirror 4 toward a second light limiting device 8 having a narrow slit 9 therein, a suitable lens (not shown) disposed adjacent the mirror 4 serving to form an image 6*a* of the aperture 6 on the device 8. As the mirror 4 is oscillated about the horizontal axis 10—10 in response to acoustical currents passing through the coil thereof (not shown), the image 6*a* is moved down or up, as the case may be, over the slit 9 to let more or less light through to the film F which is moved in the direction of the arrow at uniform speed by any suitable means. A pair of objectives 11 focus the light passed through the aperture 9 down onto the film F in the form of a fine line of light.

Normally, the system so far described produces a record as shown in Fig. 2. The positions of the mask 6 and the device 8 are originally so chosen that the lowermost vertex 6*b* of the image 6*a* is substantially centrally of the slit 9. Thus, the central or base portion 12 of the track T is always exposed so that the most dense portion of the track appears at the base. As the image 6*a* moves down, the sloping sides 6*c* of the image 6 extend over a greater length of the slit 9 than previously, causing the area of exposure of the track T to move away from the base 12 to the peaks 13. Due to stray light, the base portion 12 receives more light per unit area than the peak portions 13, and, with light of equal intensity, the base 12 receives greater exposure than the peaks 13. Also, some of the light is diffused, by reason of the structure of the emulsion, into the portions 14 between the slopes of the sinuous waves. All of this materially affects the output which can be obtained from the record to the detriment of greatest efficiency.

In order to eliminate the defects in the faded peaks 13 and the filled-in portions 14, I control the intensity of the recording light beam in a transverse direction in such a manner that the peak portions of the track T are exposed to the most intense portion of the recording light beam, while the base portion is exposed to the least intense portion thereof. As one way of accomplishing this, I have shown the filter 15 interposed in the path of the beam 7 near the device 8, slightly spaced therefrom for the sake of clearness. In actual practice, however, the filter 15 is placed immediately adjacent the device 8.

The filter 15 may be in the form of an optical wedge or a photographic film (as illustrated) having a variable density transversely thereof, the most dense portion being placed in alignment with that part of the beam 7 which forms the base portion 12 of the track T and the density gradually and continuously falling off toward the edges thereof, or those portions of the beam 7 which form the peaks 13. When such a filter is interposed in the path of the recording light beam, the image 6*a* is darkest at the center and becomes gradually lighter to either side thereof. The light forming the base 12, therefore, is less intense than that which forms the peaks 13, but, by reason of the diffusive quality of the emulsion, the base 12 receives substantially the same exposure as the peaks 13. By properly choosing the density gradient of the filter 15, the peaks 13 may be made precisely as dense as the base portion 12 and, in fact, the entire track T may be made of uniform density. At the same time, since relatively less intense light affects the base portion 12, there is little or no diffusion of the light into the portions 14, and these portions remain clear and distinct.

Although I have shown and described a certain specific embodiment of my invention, I am fully aware that many modifications thereof are possible. For example, instead of placing the light filter 15 adjacent the device 8, it may be placed immediately adjacent the mask 5, or the filter 15 may be entirely dispensed with and the filament 2 be so constructed that it will emit a beam of light varying in intensity in a transverse direction. Also, while I have shown and described my invention in connection with a sound recording system, it should be apparent that it is equally applicable to a system for printing sound records as well as to a system for reproducing sound from a record such as shown in Fig. 2. In fact, my invention is applicable to any photophonographic system, and therefore, wherever I have used the term "a system for photographically recording sound", I intend this to be used synonymously and interchangeably with the expression "a system for photographically recording sound" and/or "a system for photographically printing or otherwise reproducing sound records". Moreover, while my improved recording system has been described with reference to sound, it is clear that the system may be employed equally well for recording any other sort of impulses, whether within the audible, the super-audible, or the sub-audible range. I desire, therefore, that only such limitations shall be imposed on my invention as are necessitated by the prior art and as are indicated in the appended claims.

I claim as my invention:

1. A sound recording system including a light source, a mask defining a beam of light from said source, slit means for selecting a narrow line of light from said beam, means for focusing an image of said narrow line of light on a photographically sensitive film, means for vibrating said beam along said slit in accordance with the impulses to be recorded, and a light filter of varying density interposed in the path of the beam, said filter decreasing in density lengthwise of said slit from the base line of the impulses to be recorded to the peaks thereof for producing a uniform exposure of all portions of the film subjected to said beam.

2. A sound recording system including a light

source, a mask defining a triangular beam of light from said source, slit means for selecting a narrow line of light from said beam, means for focusing an image of said narrow line of light on a photographically sensitive film, means for vibrating said beam along said slit in accordance with the impulses to be recorded, and a light filter of varying density interposed in the path of the beam, said filter decreasing in density lengthwise of said slit from the base line of the impulses to be recorded to the peaks thereof for producing a uniform exposure of all portions of the film subjected to said beam.

ARTHUR C. BLANEY.