

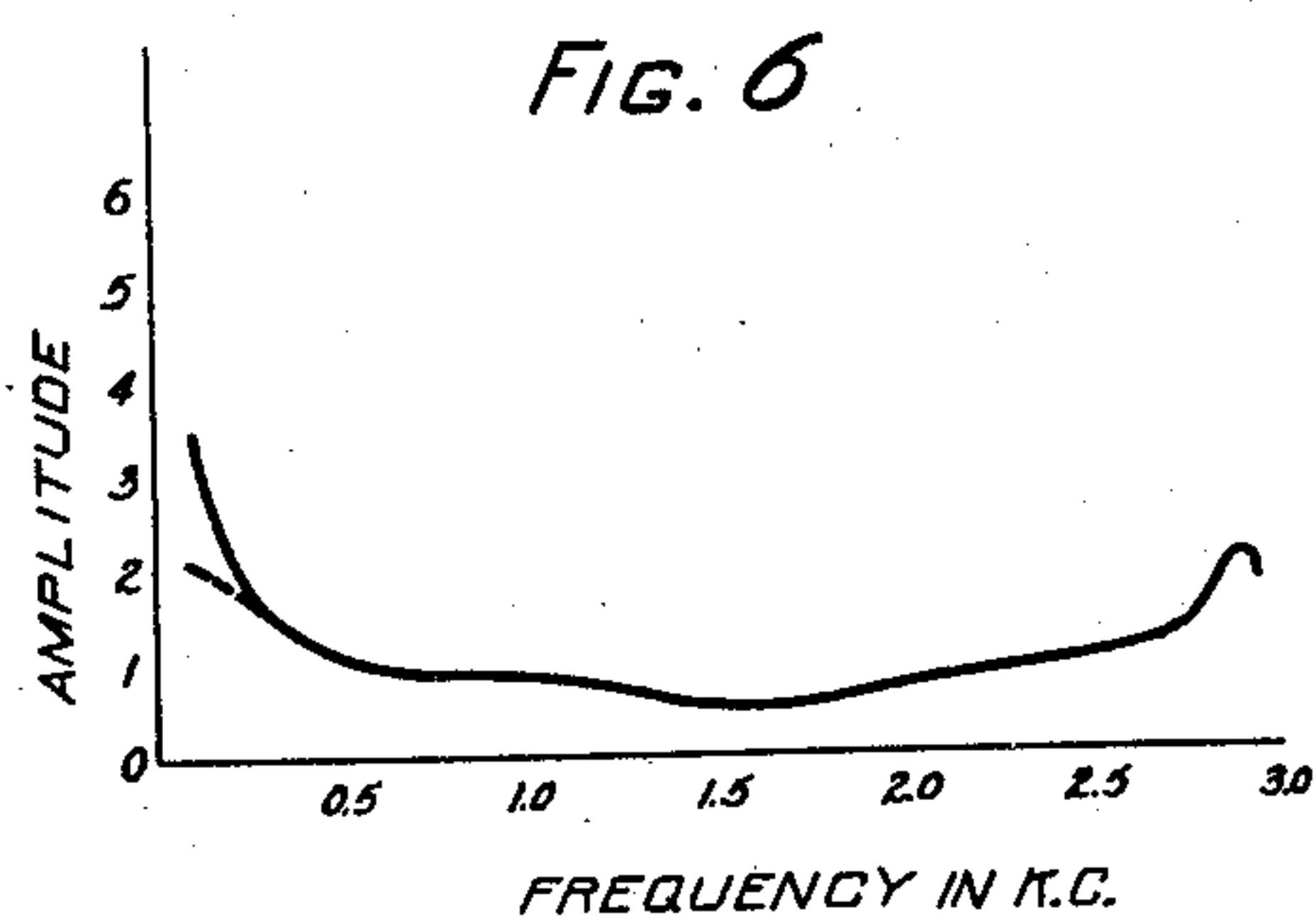
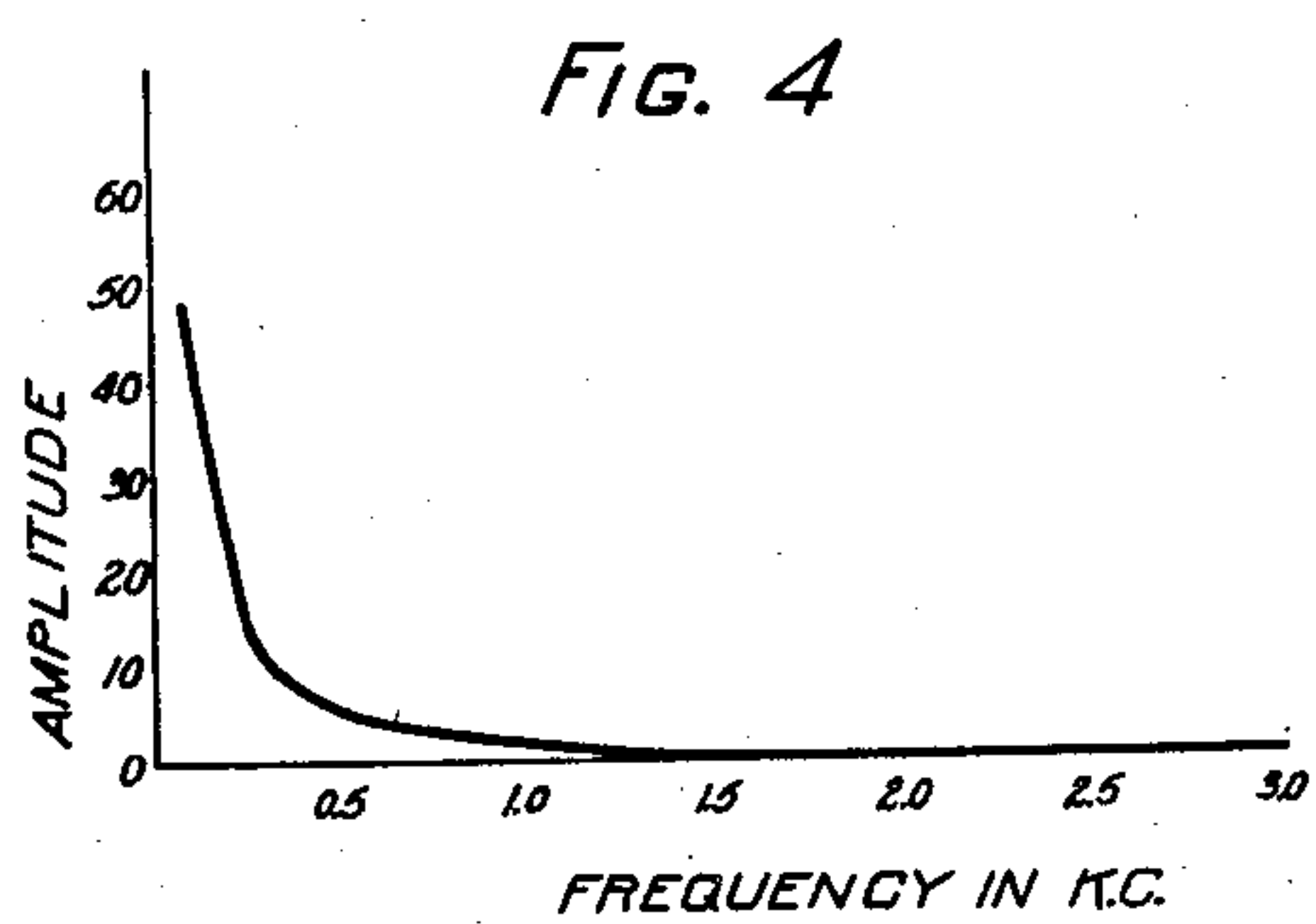
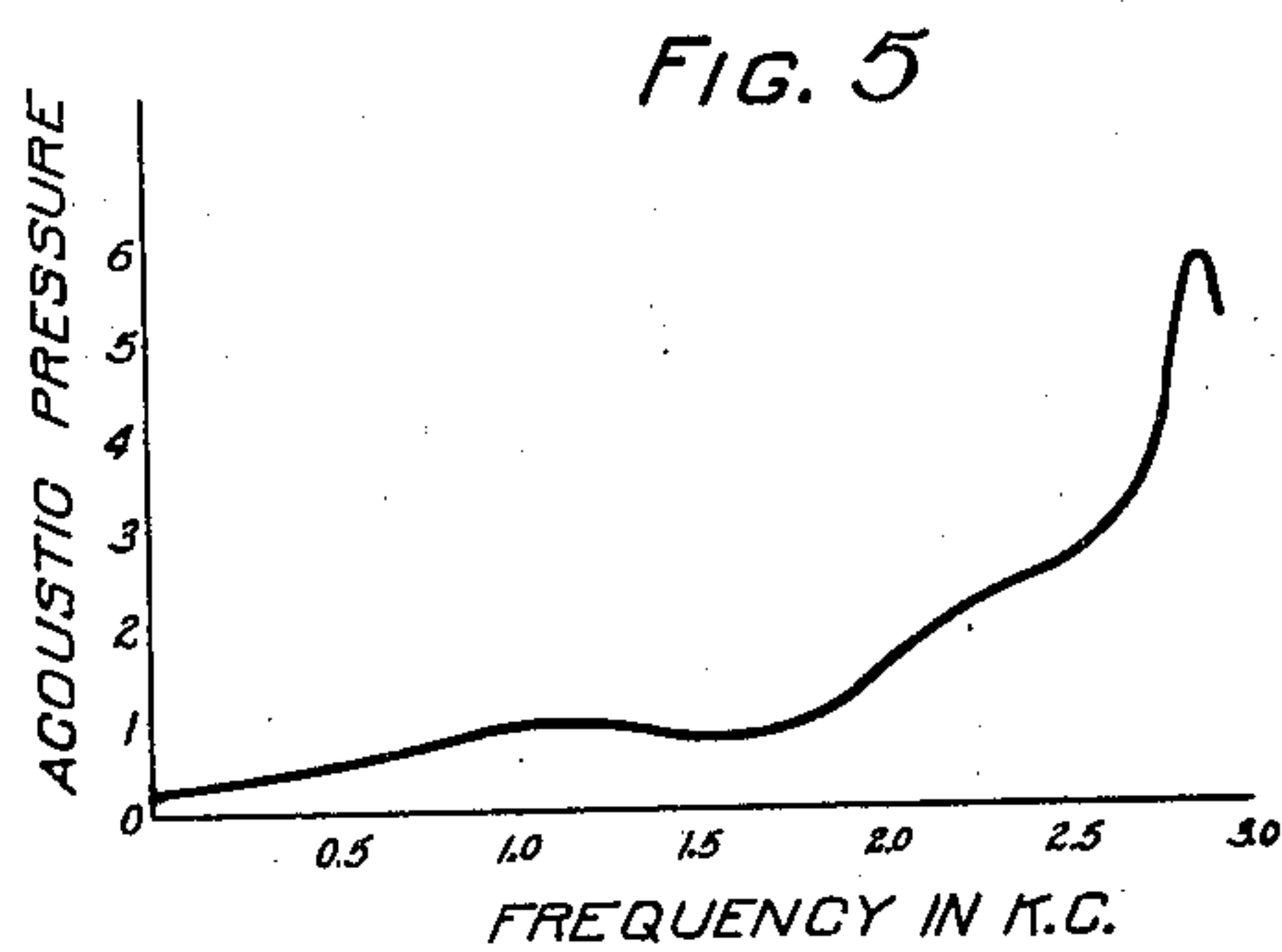
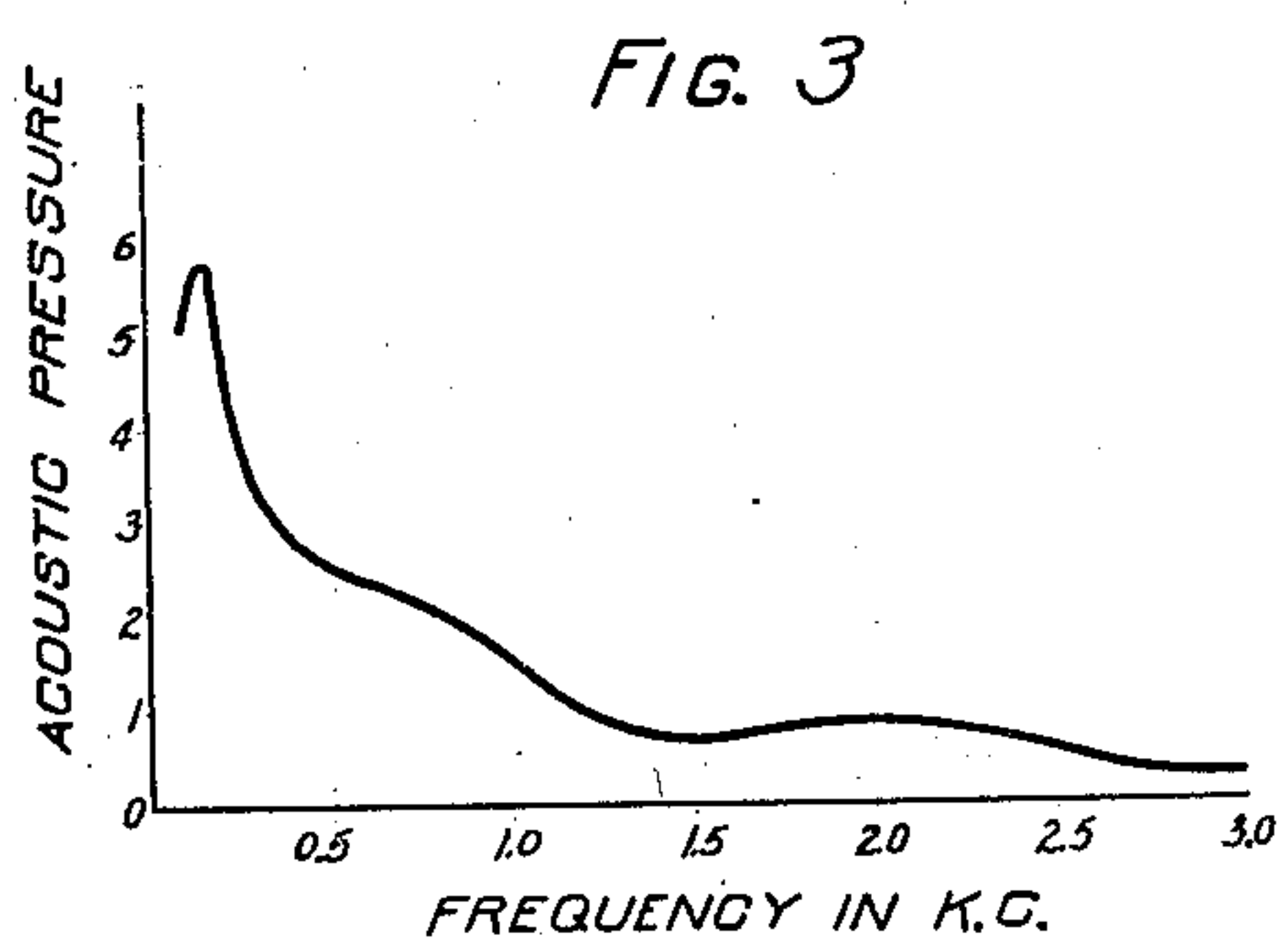
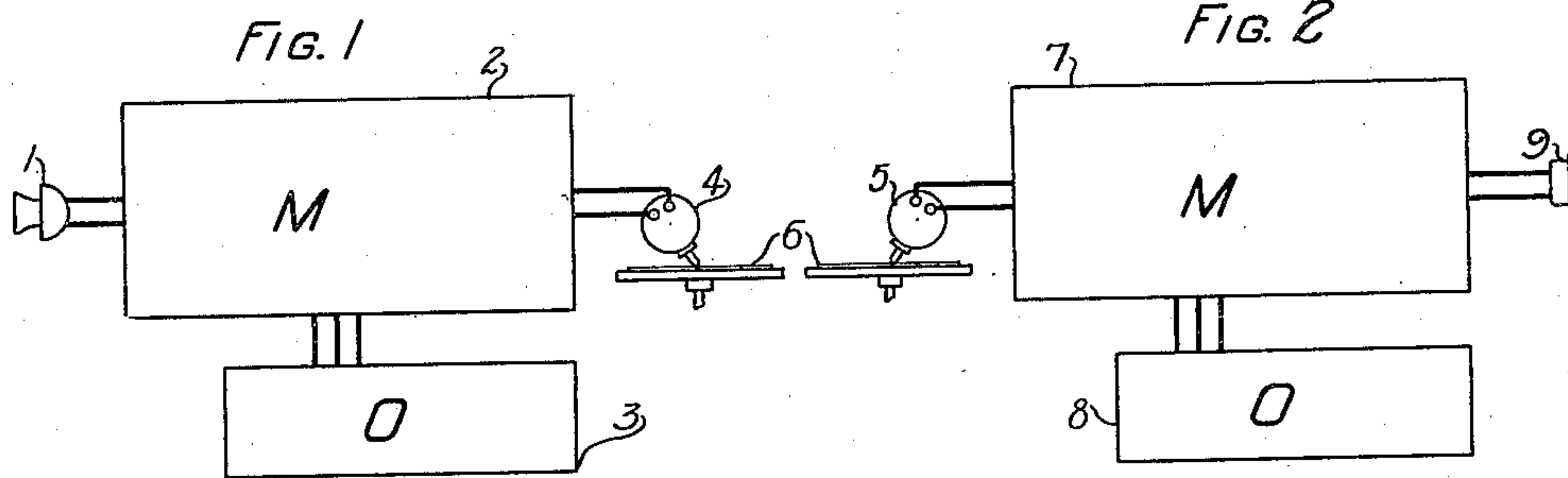
Jan. 14, 1930.

C. R. KEITH

1,743,456

SOUND RECORDING

Filed May 4, 1928



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SOUND RECORDING

Application filed May 4, 1928. Serial No. 275,083.

This invention relates to sound recording and reproducing systems and more particularly to such systems wherein sound currents are modulated before recording.

5 It is well known in the art of sound reproduction that for constant sound intensity over the range of speech and music the air pressure at the diaphragm, and hence the energy level, must be increased very rapidly as the
10 frequency falls below 1000 cycles. From this it follows that the record groove for low frequencies must be many times the amplitude required for high frequencies. This high
15 amplitude ratio introduces a serious limitation in recording for when a wide band of frequencies is to be covered the energy level is limited by the tendency of the stylus at low frequencies to cut over into an adjacent groove.

20 It is the object of this invention to overcome this objection and provide a method of recording a wide range of frequencies at a high energy level with only a moderate variation in the record trace amplitude.

25 In accordance with the general features of the invention the currents representing the sounds to be recorded are inverted on the frequency scale so that the components of high energy are given a high frequency and the
30 normally low energy components are transposed to the low frequency band. As a result of this inversion the high stylus velocity required at low frequencies is obtained with much lower displacement and the variation
35 between maximum and minimum displacement is much reduced.

This invention may be more readily understood from the accompanying drawing and the following description of one manner in
40 which it may be carried out. Fig. 1 of the drawing shows diagrammatically a system for recording a sideband of a carrier modulated by currents corresponding to sound waves and Fig. 2 indicates a system for reproducing records made by the system of
45 Fig. 1. Figs. 3 and 4 show the relation between acoustic pressure and frequency and the necessary record trace amplitude and frequency for recording the various fre-
50 quencies of speech and music by ordinary

recording methods. Figs. 5 and 6 apply to the corresponding sideband of frequencies recorded in the present invention and show the large reduction in record trace amplitude when the frequency order is inverted.

55 The recording and reproducing systems used for illustrating this invention are well known to those skilled in the art and a detailed description of them may be found in Mills Patent 1,603,287, granted October 19, 60 1926. In the present case therefore only a diagrammatic showing of these systems is made. In Fig. 1, 1, is a sound pick-up device; 2, represents the modulating system including all necessary filters, transformers, 65 etc.; 3, the source of carrier frequency; and 4, the electrical recorder. Likewise in the reproducing system of Fig. 2, 5, is the reproducer for retranslating into electrical currents the wave form recorded on record 6; 7, 70 the amplifying and modulating systems; 8, the source of carrier frequency; and 9, a suitable receiver for reproducing the original sounds.

The operation of these systems is identical 75 with the description given in the Mills patent previously mentioned and since the particular modulating and demodulating systems employed form no part of the present invention, no detailed description of their operation is 80 given. If the carrier frequency is made equal to the highest frequency in the wave form to be recorded the lower sideband delivered to the recorder will be composed of the same frequency as the original band but the order 85 of the frequencies will be reversed or inverted.

Since it is proposed according to this invention to record a wide range of frequencies, it would be an advantage to employ a carrier of somewhat higher frequency than the upper 90 limit of the band to be recorded. As stated in the application of J. W. Horton, Serial No. 275,409, filed May 5, 1928, this results in displacing as well as inverting the band on the frequency scale in such a way that the ratio 95 between the upper and lower limits is reduced so that the recording and reproducing mechanisms are more uniformly responsive to the frequencies involved.

If in the present case, for instance, fre- 100

quencies from 100 to 3000 cycles are to be recorded, this ratio is 30 when the wave form is merely inverted; but when a 3500 cycle carrier is used the lower side band will range from 3400 to 500 cycles which means that the ratio is reduced to approximately 7.

For the purposes of illustrating the present invention, however, the curves of Figs. 3 to 6 in the drawings have been shown for inversion only in order that direct comparison between the inverted and uninverted wave forms may be made.

From a comparison of the curves in Figs. 3 and 5 it is readily seen that as a result of this inversion the major part of the energy in the wave form is transposed to the high frequency range. It is well known in the art that the stylus velocity, and hence the amplitude of the record trace, varies directly with the acoustic pressure, or square root of the energy level, and inversely with the frequency to be recorded. From this it follows that the velocity required to represent the high energy components may be obtained at lower trace amplitude if the components are transposed in the manner described.

The very marked reduction in maximum amplitude and the more nearly constant average value obtained are shown by the curves of Figs. 4 and 6 which are plotted in the same units. A further gain in this respect may be obtained by slightly attenuating the currents representing the sounds of highest frequency such as between 2800 and 3000 cycles in the present instance, so that the amplitude of the record trace at the lowest frequency recorded does not exceed that required for the highest frequency. This result is indicated by the dotted portion of the curve in Fig. 6.

This arbitrary loss in the recording circuit is by no means as objectionable as a similar loss would be in normal recording for it should be observed that due to the frequency inversion the sound frequencies affected are those between 2800 and 3000 rather than those at the lower end of the scale. Accordingly, the low frequencies, which are entirely lost or greatly attenuated with ordinary recording methods, are reproduced at natural intensity and the loss in quality due to the attenuation is negligible.

As a result therefore of the inversion and reinversion of the frequencies in the speech or music, it is possible to use a great deal more energy in recording on standard records or to increase the playing time without sacrificing quality by reducing the spacing of the record grooves.

What is claimed is:

1. A method of recording wave forms embracing a wide range of frequencies at substantially constant amplitude of the record trace which consists in shifting the wave form upward on the frequency scale and recording them in inverted frequency order.

2. A method of increasing the effective ca-

capacity of recording media which consists in shifting upward on the frequency scale and inverting the frequency order of the wave forms to be recorded whereby the low frequency components of said forms may be represented by a record trace substantially equal in amplitude to that required for the high frequency components.

3. A method whereby wave forms may be recorded at substantially the maximum capacity of the recording medium for all frequencies in said forms which consists in displacing the frequencies and inverting the frequency order of said forms before recording and adjusting the energy level in the recording circuit in accordance with the maximum capacity of said medium.

In witness whereof, I hereunto subscribe my name this 2 day of May, 1928.

CLYDE R. KEITH.