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STEREOPHON SOUND RECORDING SYSTEM

DEVELOPED BY DR. CARLHEINZ BECKER

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COMBINED INTELLIGENCE OBJECTIVES

SUB-COMMITTEE

LONDON—H.M. STATIONERY OFFICE

Stereophon Sound Recording System
Developed by Dr. CARLHEINZ BECKER

Reported by

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SUMMARY

This report describes a system intended primarily for high quality sound recording on film. It was privately developed by a German physicist, Dr. Carlheing Becker, of Thansau uber Rosenheim. The system employs well-known means in some respects, but has the important advantage of giving excellent 3-channel reproduction of great dynamic range and low noise level using a sound track of total width of only 2.65 millimeters.

STEREOPHON SOUND RECORDING SYSTEM

1. Introduction.

(a) The system described here was developed by Dr. Carlheinz Becker of Thansau uber Rosenheim, Germany. Dr. Becker is a capable German physicist who started development of the system in 1938. He worked without government interference until 1942 when he was ordered to convert it to an explosion power recorder for which it is well suited in many respects. In 1944, work on the recorder was stopped and Dr. Becker was put to making high voltage regulated power supplies for laboratory use. Several of these were delivered. These are of excellent quality but represent no advance over our own designs.

(b) Dr. Becker, as do most Germans now, professes to be willing to undertake development work for the Allies. It should be said that he and his staff (about 10 or 12 men) are thoroughly competent. They have a small but very well equipped laboratory and machine shop. Both are undamaged, have power available, and could start work at once.

2. Description.

(a) The system is termed the "STEREOPHON" system and has for its purpose very high fidelity reproduction of sound utilizing a film sound track 2.65 millimeters in width. Truly faithful sound reproduction requires not only distortionless rendition of frequency and amplitude, but also a means for creating a lifelike illusion of auditory depth. This latter can be achieved by employing several microphones during the recording and a like number of properly placed loudspeakers for reproduction. The result is to give to the ears a stereophonic impression. The improvement in this respect, of two microphones and speakers over one is very great. The additional improvement of three (3) over two (2) is not as great and the improvement of four (4) over three (3) is still less. For this reason, and an additional one, the system employs three (3) independent channels. The additional reason is that a simple channel requires a film sound track of .7 millimeters and three (3) channels require a track 2.65 millimeters

wide. Four (4) channels would require a track of approximately 3.43 millimeters which cannot be accomodated on standard film. The gain of a fourth channel does not justify the additional equipment needed.

(b) A schematic diagram of the electrical portion of the system is shown in Figure 1. The output of each microphone is fed to a low frequency amplifier capable of accurately passing frequencies from 23 to 10,000 cycles. From each such amplifier, the signal passes to a pair of oppositely connected diodes which split the signal into plus and minus components. This system of half wave recording is used because it offers a very great advantage in noise reduction. Half wave recording dates back to 1881. When it is employed, the non-modulated positive sound track is completely dark without resort to "noiseless" equipment and the amplitude of film noise is almost zero. Each half wave signal is then amplified in conventional manner by stages having a band-width of 20 kilocycles because of the harmonics introduced by the phase split.

(c) Actual modulation of the light beam that is impressed on the film takes place in a Kerr Cell. The characteristics of the solution used in this cell (nitro benzene) are such that excessive electrolysis would occur if it were operated by the half wave intelligence frequencies. To avoid this, it is necessary to operate the cell by a higher frequency signal modulated by the half wave intelligence frequencies. Accordingly, a single oscillator stage provides a 170 kilocycle signal to each of six (6) mixer or modulator stages where the 170 kilocycle signal and modulated by the six (6) half wave intelligence bands. Adjustable gain 170 kilocycle amplifiers are provided so that the modulation can be properly controlled. The output of each mixer stage is passed through a band pass filter to eliminate undesired modulation products, and is fed to one (1) plate of the Kerr Cell, which cell serves to wed the electrical and optical systems.

(d) A schematic diagram of the optical system is given in Figure 2. The light source is a high pressure mercury lamp giving monochromatic light which is passed through a convex lens to the first of a pair of Nicol prisms. Between the Nicol prisms is the Kerr Cell. In traversing the first Nicol prism, the light

2. Description (d) (Cont'd)

is plane polarized and, if no signal were applied to the Kerr Cell, would be completely cut off by the polarizing effect of the second prism. The Kerr Cell, however, has the property of altering the polarization of light traversing it in accordance with an applied signal. Due to this property, light is passed by the second Nicol prism in an amount that varies with the impressed signal. After leaving the second Nicol prism, the modulated light is focused on the moving negative film by a pair of lenses and the signal is thus recorded.

(e) The film drive system is worthy of mention because the possibility of uneven motion, due to film sprockets, is eliminated. Two (2) separate synchroneous motor drives are used. One drives the film wind and unwind sprockets and the other drives a transparent wheel over which the film passes to receive the modulated light. Two (2) rubber idlers keep the film up against this latter wheel and insure that there is no sprocket effect at this point. The effect of the wind and unwind sprockets is insulated by loops of film between these sprockets and the transparent wheel. The speed of the transparent wheel can be varied mechanically using a variable ratio drive so that the proper amount of looping can be obtained.

(f) Essential data on the recorder are:

Signal Frequency Rage - 23 to 10,000 cycles.

Dynamic Range - 60db without resort to expansion and compression.

Distortion - Less than 3% over the whole dynamic range.

Film Noise - 70 db below greatest amplitude.

Film Velocity - 45 cm/sec.

Sound Track Width - 2.65 mm.

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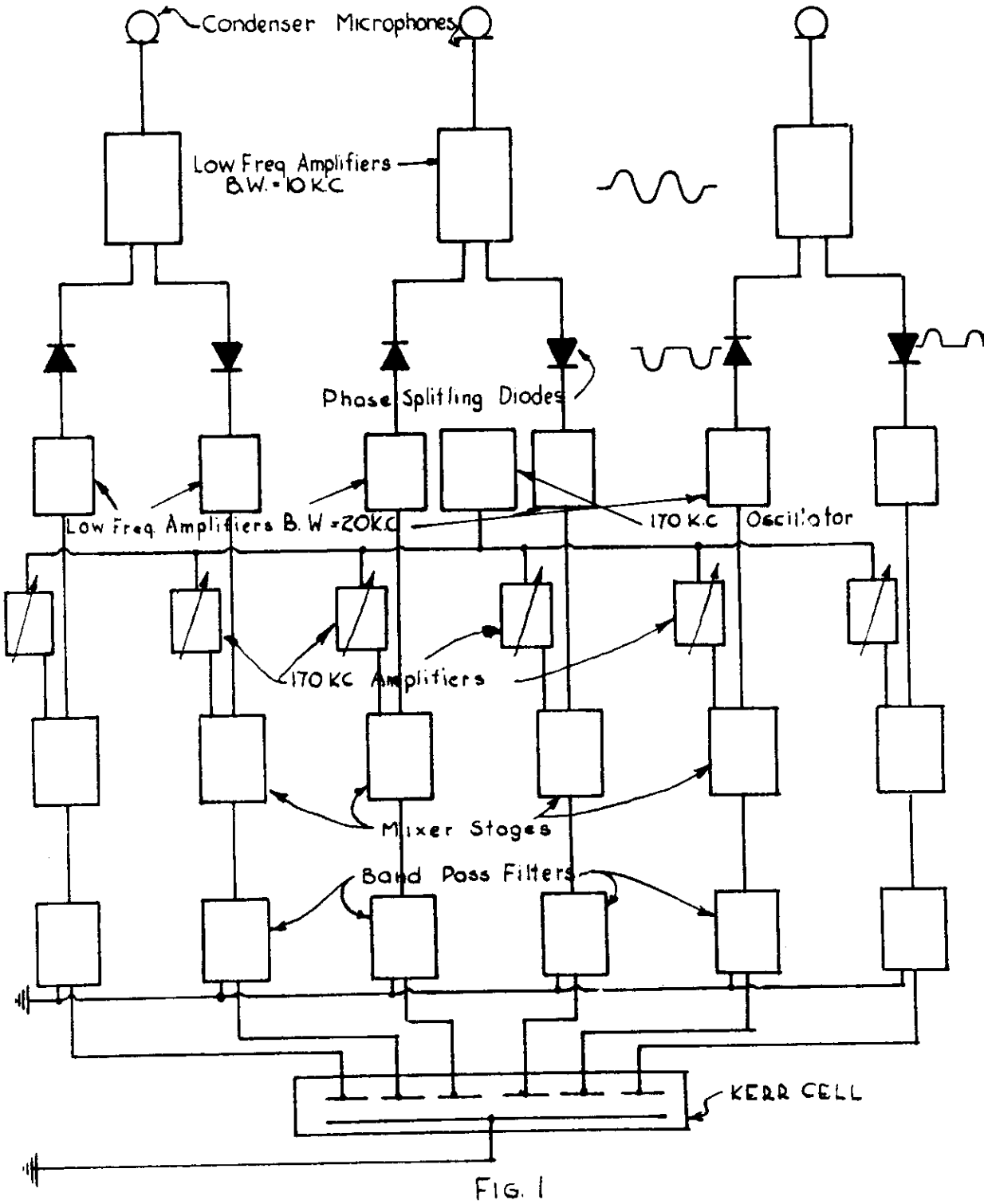

FIG. 1

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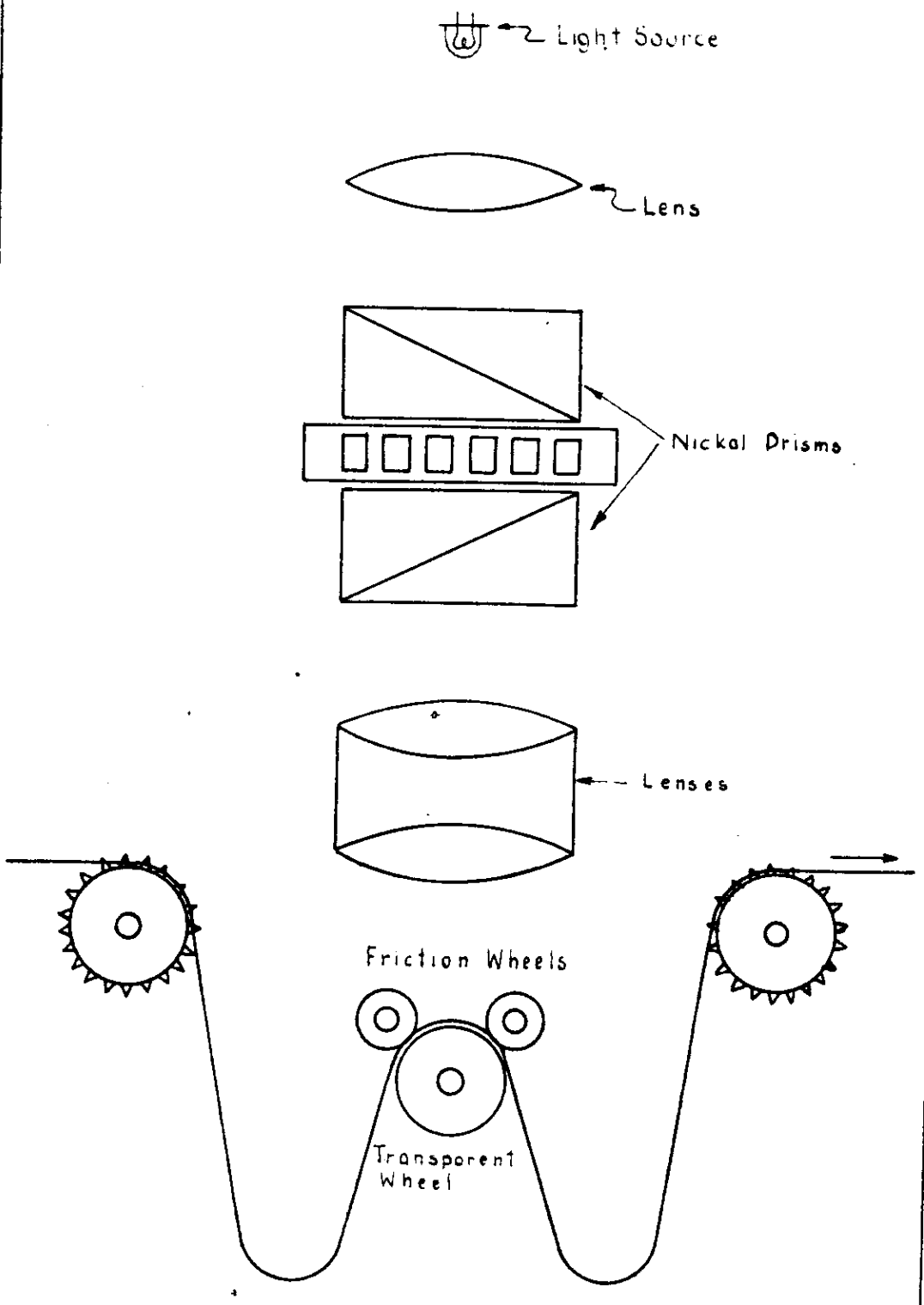

FIG 2.

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transparent wheel?