Sept. 25, 1934. J. WEINBERGER ET AL 1,975,055

TELEVISION SYSTEM

Filed March 25, 1929 2 Sheets-Sheet 1

Fig. 1

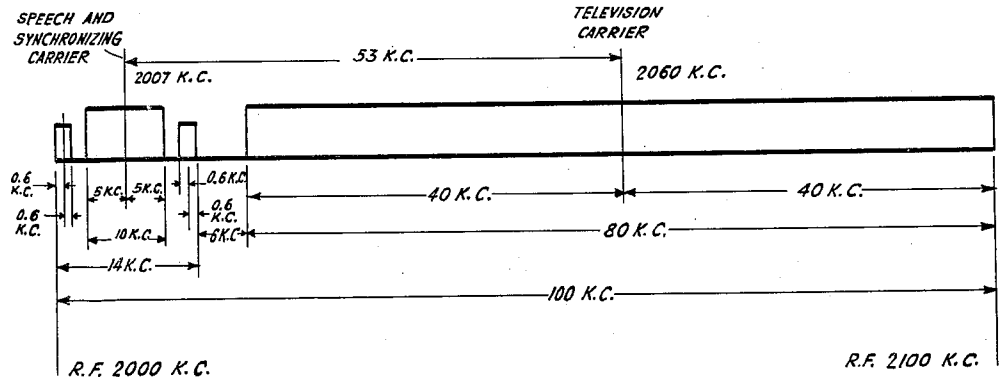
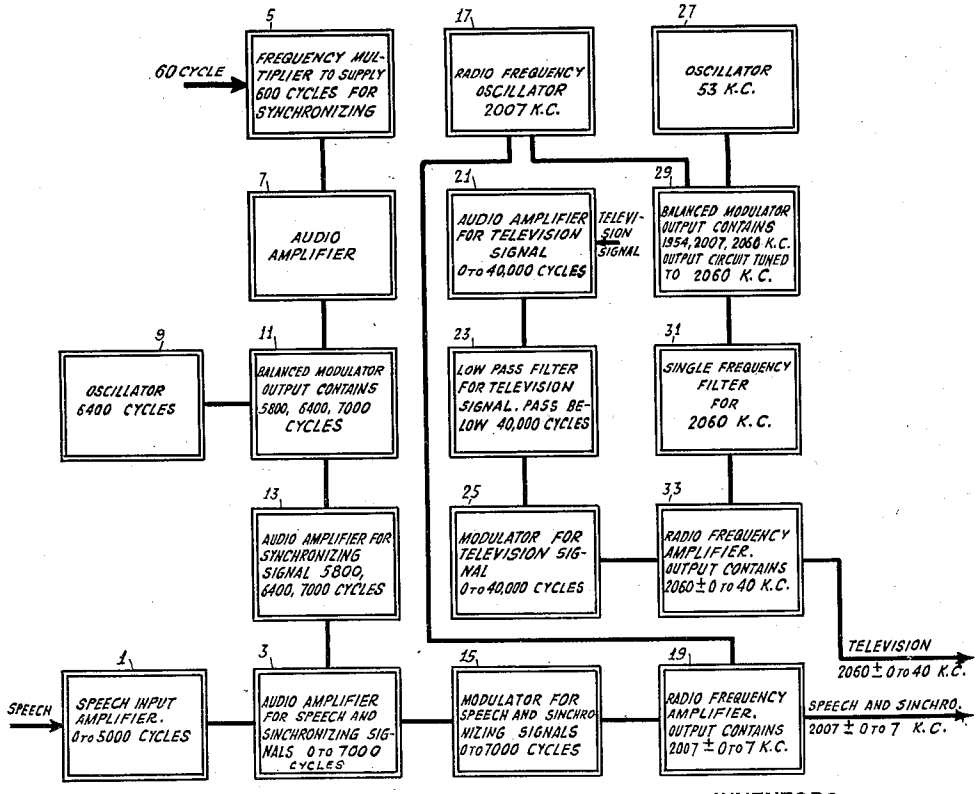


Fig. 2



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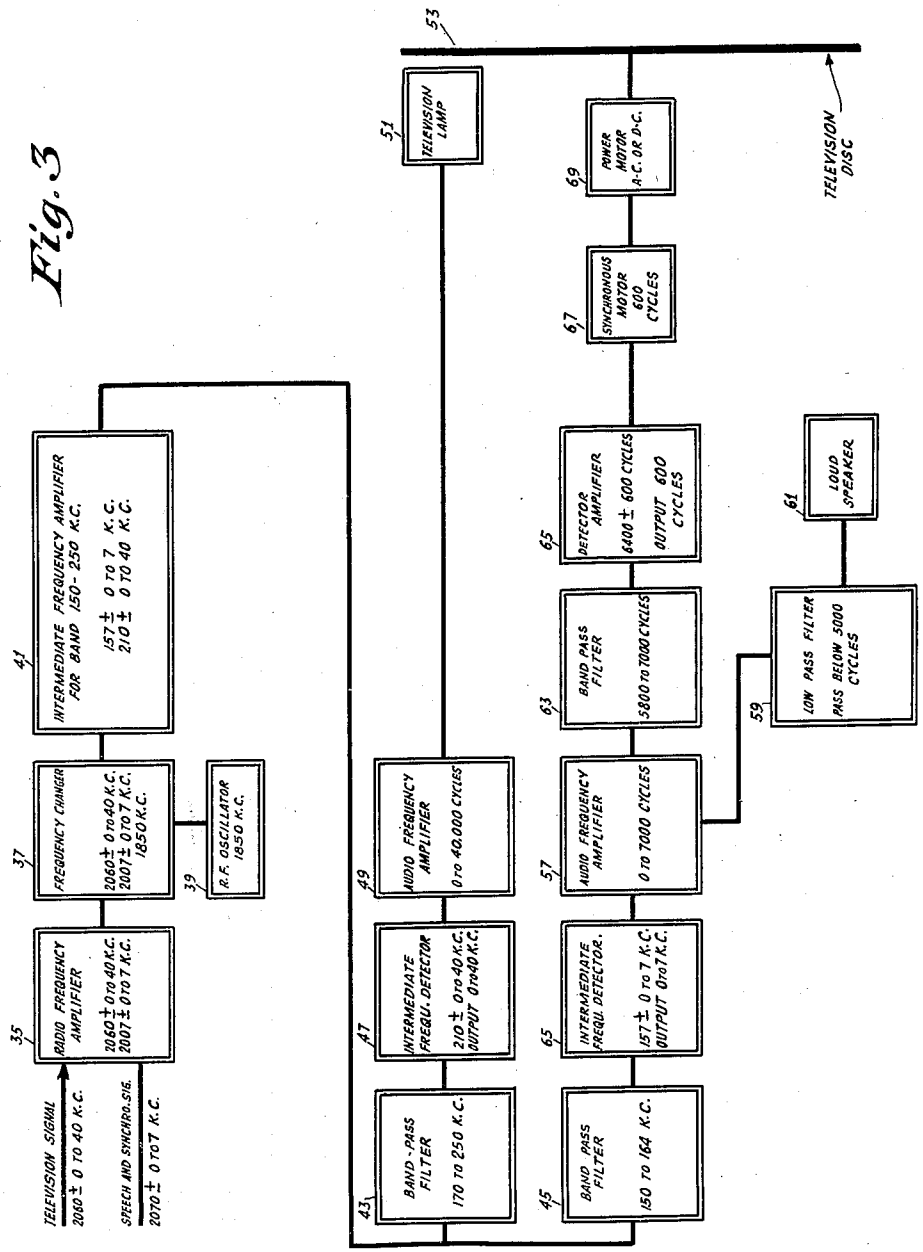
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Fig. 3



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TELEVISION SYSTEM

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Application March 25, 1929, Serial No. 349,834

2 Claims. (Cl. 178—6)

The present invention relates to television systems and more particularly to television systems in which the picture signal, speech signal, and a synchronizing signal are all simultaneously transmitted within a frequency band of a predetermined width.

As was disclosed by copending application of Alfred N. Goldsmith and Julius Weinberger, in application Serial No. 349,652, filed March 25, 1929, now Patent No. 1,770,205, of July 8, 1930, it has been found most practical with the present commercial developments of various types of television apparatus to transmit a synchronizing frequency simultaneously with the television picture signal so that proper synchronization between the transmitter and receiver may be continually maintained, and the need for constantly framing the received picture by manual means avoided.

Also, in connection with television transmission, it is particularly desirable in many cases to transmit speech or music accompanying the action simultaneously with the picture. Particular application of the simultaneous transmission of speech and picture signals is found in the transmission of moving picture films where it is customary in the present developments of the moving picture art to produce a sound record accompanying the film.

Therefore, one of the objects of the present invention is to provide a method and arrangement by which the transmission of the television picture impulses, the speech signals, and the synchronizing frequency is accomplished simultaneously.

Still a further object of our invention is to provide a system wherein the picture signals, the speech signals, and the synchronizing frequency may be transmitted simultaneously within a predetermined frequency band of minimum width for commercial application, which, for example, has been illustrated as being of a width of 100 kilocycles.

Still another object of our invention is to provide a system wherein the synchronizing frequency is produced as a beat note in contrast to generating a higher frequency suitable for synchronizing.

Still another object of our invention is to provide a method and arrangement whereby the incoming signals are amplified to a large extent, while they are still of superaudible character so that little, if any, amplification may be necessary after these signals have been properly filtered for discriminating between each of the three above named types of signals.

Other and ancillary objects of our invention will at once suggest themselves to those skilled in the art to which the invention relates by reading the following specification in connection with the accompanying drawings, wherein:

Fig. 1 shows diagrammatically an arrangement of the location of the particular frequencies chosen by way of example so that the television picture signals, the speech signals, and the synchronizing signals may all be confined within a frequency band of a predetermined width; and,

Fig. 2 conventionally illustrates in a diagrammatic manner one form of transmitter arrangement for accomplishing the above named results; and,

Fig. 3 diagrammatically and conventionally illustrates a form of receiving apparatus which may be used in conjunction with the transmitter arrangement of Fig. 2.

Now making reference to the accompanying drawings, and, in particular, Fig. 1 thereof, it will be noted that an arrangement has been disclosed wherein the television signals are spaced over 80 kilocycles of the 100 kilocycle band, and the speech signals are clustered about a carrier frequency removed by 53 kilocycles from the television carrier, and extend over a 10 kilocycle band in the usual manner for broadcast work. The synchronizing frequencies have been chosen as being of 1.2 kilocycles wide, and arranged so as to appear as side-bands located 6.4 kilocycles on either side of the speech and synchronizing carrier frequency, and, as shown, are 1.2 kilocycles wide.

For the purpose of giving concrete examples of the particular chosen carrier frequencies, we have herein illustrated the same by specific examples, and by applying suitable values to each carrier and to each frequency band, although it is to be recognized that many changes may herein be made without departing from the spirit and scope of the invention, and that all values of frequencies illustrated herein are to be regarded as merely illustrative and not limiting.

Now referring more particularly to Fig. 2 of the drawings, further explanation of the diagrammatic arrangement of the various carriers shown in Fig. 1 will be apparent. In Fig. 2, we have arranged a speech input amplifier 1, for example of the type disclosed by Arnold Patent No. 1,329,283, dated January 27, 1920, as capable of carrying speech frequencies varying between zero and 5000 cycles, and the output of this amplifier is directed to an audio amplifier 3, which may be of the same type as the above named

Arnold patent, as will hereinafter be described, is for amplifying both the speech and the synchronizing frequencies.

It has been found suitable in some commercial work in connection with television apparatus to synchronize from the 60 cycle A. C. mains, but in cases where the receiver is located in a different city from the transmitter, the power line frequency is apt to vary and unsatisfactory results, so far as the synchronizing of television apparatus is concerned, are produced. Therefore, we have provided an arrangement wherein the 60 cycle frequency supplied in the city where the transmitter is located may be used for synchronizing apparatus, and by the aid of a frequency multiplier 5, such as has been disclosed by Kendall Patent No. 1,446,752, dated February 27, 1923, we have raised this frequency to one of the harmonics of 60 cycles, and, as illustrated, have chosen to supply 600 cycles as a synchronizing frequency. While not shown on the illustration, this may readily be produced by biasing a vacuum tube fed with 60 cycle A. C. energy and tuning the plate circuit to 600 cycles, or, in other words, by a distorted amplifier in which the output thereof is tuned to one of the harmonics of the impressed frequency.

The 600 cycle energy used for synchronizing may then be directed through an audio amplifier 7 of the type disclosed for the amplifier 3 for example, preferably of a highly regenerative type, which may be provided to act as an additional filter for the purpose of selecting the 600 cycle note, and also function as a high gain amplifier. Also located at the transmitter, we have provided an oscillator 9 generating a frequency of 6400 cycles, for example, which has been shown as a suitable frequency for producing the 600 cycle synchronizing tone as a beat note in the receiver, and this 6400 cycle generated tone is then modulated in the balanced modulator 11, such as is disclosed by Hartley Patent No. 1,571,006 of January 26, 1926, by means of the 600 cycle tone produced as a harmonic of the 60 cycles, so that the output of the balanced modulator 11 contains frequencies of 5800, 6400 and 7000 cycles, which may then be amplified through an audio amplifier 13 of any well known type such as is disclosed by Arnold Patent No. 1,329,283 above named. The output from the audio amplifier 13 is then directed to the audio amplifier 3 already containing the speech input frequencies varying between zero and 5000 cycles so that the combined audio output from the amplifier 3 contains both speech and synchronizing signals which vary in frequency between zero and 7000 cycles. The output from this amplifier is then directed through a modulator 15 of any well known type disclosed by Heising Patent No. 1,442,146 of January 16, 1923 arranged for modulating both the speech and synchronizing signals varying between zero and 7000 cycles.

A radio frequency oscillator 17 of the well known Hartley type, for example, such as is disclosed by Hartley Patent No. 1,356,763, dated October 26, 1920, has been provided for the purpose of generating a carrier frequency suitable for the speech and synchronizing signals, and a portion of the output of this oscillator, which, as herein shown, has been chosen as a 2007 kilocycle oscillator, is directed through a radio frequency amplifier 19, such as that disclosed by Alexanderson Patent No. 1,173,079, dated February 22, 1916, where it is modulated by means of the speech and synchronizing signals varying between zero and 7000 kilocycles so that the output of the radio frequency amplifier 19 contains the 2007 kilocycle frequency plus or minus frequencies varying between zero and 7 kilocycles, which will be transmitted as the speech and synchronizing signals.

Television signals produced by means of scanning the subject which is to be transmitted, such as, for example, a person seated in front of the televisor, moving picture film, or even an outdoor scene, have been chosen as varying between zero and 40,000 cycles, and these signals are then amplified through an amplifier 21 of well known type such as is shown for example by Arnold Patent No. 1,129,942 of March 2, 1915 in connection with television apparatus, and the output thereof is arranged to pass through a low pass filter 23 of well known type such, for example, as that disclosed by Campbell Patent No. 1,227,113, dated May 22, 1917, arranged to pass all signals of frequencies between zero and 40,000 cycles with a cut-off point at 40,000 cycles. These signals are then directed through a modulator 25 as shown for example by Nelson Patent No. 1,349,729, dated August 17, 1920, which also passes signals varying between zero and 40,000 cycles.

As a generator of the carrier frequency for the television signal, we have provided an oscillator 27 of the type disclosed by Nelson Patent No. 1,349,729, dated August 17, 1920, whose frequency has been chosen as 53 kilocycles, for example, and this frequency is arranged to modulate the 2007 kilocycle frequency of the radio frequency oscillator 17 so as to produce in the balanced modulator 29, of the same general type as that disclosed by Hartley Patent No. 1,571,006, above named, output frequencies of 1954, 2007 and 2060 kilocycles. The output of the balanced modulator 29 is preferably tuned so as to pass the carrier frequency of 2060 kilocycles. This energy is then directed through a single frequency filter 31, for example such as that disclosed by Alexanderson Patent No. 1,173,079, above named, tuned to the 2060 kilocycle carrier which is then passed to the radio frequency amplifier 33 which is preferably of the type disclosed in the last named Alexanderson patent, where it is modulated by the television signals varying between zero and 40,000 cycles, so that the output of amplifier 33 contains the frequency 2060 kilocycles, plus or minus frequencies varying between zero and 40 kilocycles, which may then be transmitted as a television signal.

Now referring to Fig. 3 showing a receiver system suitable for use in connection with the transmitter of Fig. 2, we have shown a radio frequency amplifier 35 such as that disclosed by Alexanderson Patent No. 1,173,079, which receives the television signal varying from zero to 40 kilocycles on either side of the 2060 kilocycle carrier frequency, and speech and synchronizing signals, varying between zero and 7 kilocycles on either side of the speech and synchronizing signal, carrier frequency of 2007 kilocycles, as illustrated by way of example. The output of this amplifier is then passed through a frequency changer 37 preferably of the general type disclosed by Armstrong Patent No. 1,342,885 of June 8, 1920, to which is supplied a locally generated frequency of 1850 kilocycles generated in the local oscillator 39 which is preferably of the same type of oscillator as the oscillator 17 of the transmitter, so that the output from the frequency changer 37 appearing in the intermediate frequency amplifier 41 ap-

pears as frequencies of 210 kilocycles, plus or minus frequencies varying between zero and 40 kilocycles, and 157 kilocycles, plus or minus zero to 7 kilocycles. The intermediate frequency amplifier 41, preferably of the type disclosed by above named Armstrong Patent No. 1,342,885, is tuned to pass a frequency band lying between 150 and 250 kilocycles. It is important to herein note that the television signals, as well as the speech and synchronizing signals, are amplified to a large extent in this intermediate frequency amplifier 41 so that the need of amplification to any high degree after the separate signals have been separated one from the other is unnecessary. By the term "intermediate frequency" we mean a frequency which lies intermediate a radio frequency and a second generated frequency which is used to modulate the radio frequency. It is known that in every radio frequency transmitter there is generated a radio frequency carrier and one or more modulation frequencies, such as voice signals, picture or television signals, or the like, to modulate this radio frequency carrier, and an intermediate frequency is any frequency which lies between these two and which appears at the receiver but does not exist at the transmitter. In other words, an intermediate frequency receiver is one which is characterized by the fact that there is developed locally in the receiver apparatus a frequency lying in the range between the received radio frequency and the range of the frequency finally detected and serving to actuate an electro-optical or electro-acoustic device.

After amplification to the desired extent in the intermediate frequency amplifier 41, it is necessary to select the individual signals, such as the television signal, the speed signal and the synchronizing signal, and these various signals may be selected by means of band pass filters 43 and 45, each preferably of the type disclosed by Whittle et al. Patent No. 1,714,149, dated May 21, 1929, in which the band pass filter 43, for example, is tuned to frequencies varying between 170 and 250 kilocycles for the purpose of determining the television signal. The output from the band pass filter 43 is then detected in the intermediate frequency detector 47 as disclosed by Armstrong Patent No. 1,342,885, so that the output thereof appears as frequencies varying between zero and 40 kilocycles, which were the original television signals appearing in the audio amplifier 21. These frequencies varying between zero and 40 kilocycles are then amplified to whatever extent is found necessary by means of the amplifier 49, of the type disclosed by Arnold Patent No. 1,129,742, above named, and used for the purpose of producing a glow in the television lamp 51 which may be of the usual neon, helium or argon type, well known in the art to which this invention relates.

The television lamp 51 is then arranged behind the disk 53, assuming that a disk is used for the purpose of rebuilding the television image, so that a person looking at the disk from the right of the showing of Fig. 3 will see the lamp behind the various holes in the disk, and the position of the holes with respect to the lamp will determine the image reproduced from the transmitter.

Now referring to the speech and synchronizing signals passed through the band pass filter 45, we have arranged this filter so as to pass frequencies varrying between 150 and 164 kilocycles, which provides a 6 kilocycle separation from the television signals so that the danger of overlapping signals is avoided to a material extent. Output energy from the band pass filter 45 is then directed through an intermediate frequency detector 55, similar to the intermediate frequency detector 47, so that the output thereof appears as signals of frequency varying between zero and 7 kilocycles, and then by passing these signals through the audio frequency amplifier 57 of the type disclosed by Arnold Patent No. 1,329,283 of January 27, 1920, for the purpose of further amplifying the same, signals of a strength sufficient to produce a good indication in the loud speaker or a large synchronizing torque on the synchronizing device are obtained.

For the purpose of reproducing the speed signals, we have provided a now pass filter 59 of the Campbell type, such as has been disclosed by Campbell Patent No. 1,227,113, dated May 22, 1917, tuned to pass signals of a frequency below 5000 cycles, and connected the same to the output of the audio frequency amplifier 57, and connected a loud speaker 61 or other similar device to the output of the filter 59 so as to produce an audible indication at the receiver of the sound impulses produced at the transmitter.

Also connected to the output of the audio frequency amplifier 57, we have arranged a second band pass filter 63 which is preferably constructed in accordance with the teachings of Whittle et al. Patent No. 1,714,149, dated May 21, 1929 tuned to pass signals of frequencies varying between 5300 and 7000 cycles which will be used as the synchronizing signal, and, by means of a detector amplifier 65, preferably constructed in accordance with the combined teachings of Alexanderson and Arnold as disclosed in their respective Patents Nos. 1,173,079 and 1,129,942 are able to produce as an output thereof, signals of a frequency of 600 cycles which may then be applied to drive a synchronous motor or other appropriate synchronous mechanism 67 located at the receiver. The synchronous motor 67, as shown, is connected with the main shaft of a power motor 69, which may be either of the A. C. or D. C. type for driving the disk 53, and by means of the synchronous motor 67, the torque exerted on the power motor 69 either serves to retard or advance the motor speed, and thus keep the disk in synchronism with a similar element at the transmitting station.

As a modification of the above described arrangement, we may, where desired, utilize only a single side band for the television signal and a slight variation in the arrangement of all frequencies in the transmitted band. For example, the speech and synchronizing frequencies may be as shown by Fig. 1 and the television carrier may be moved to 2020 kilocycles. In this manner television frequencies from zero to 80 kilocycles can be employed and thus give better picture detail. One side band of the modulated television carrier may then be filtered out by suitable means. In the case illustrated, the lower side band will be filtered out and thus leave the television carrier of 2020 kilocycles with a single side band extending from 2020 kilocycles to 2100. kilocycles.

In the last mentioned illustration, the receiver arrangement may remain unchanged from the form illustrated, with the exception that the amplifier following the television intermediate frequency detector should be arranged to pass zero to 80,000 cycles.

While we have herein illustrated concrete examples of the various frequencies chosen for the

purpose of illustration, it is to be noted that these are merely suggested so as to give a clearer idea of the arrangement, and we believe ourselves entitled to make all modifications and changes in the present system such as would readily suggest themselves to one skilled in the art to which the invention relates, provided, of course, all such modifications and changes fall fairly within the spirit and scope of the present invention as defined by the hereinafter appended claims.

Having now described our invention, what we claim and desire to secure by Letters Patent is the following:

1. The method of receiving television signals wherein the signals include a wide band of frequencies and are composed of image, speech and synchronizing signals wherein a relatively large portion of the entire frequency band is occupied by image signals, a small portion is occupied by speech signals, and a minute portion is occupied by synchronizing signals, which comprises picking up at the receiving point the combined image, speech and synchronizing signals, amplifying all the signals, generating at the point of reception a local frequency, beating all incoming signals with the locally produced frequency to produce an intermediate beat frequency representative of all signals received, amplifying the produced intermediate beat frequencies to substantially the fullest extent desired as intermediate frequencies, filtering the intermediate frequencies to select in one group image signals and in a second group speech and synchronizing signals, detecting each of the filtered band of frequencies, producing from the detected image signals the visible indications, filtering from the detected synchronizing and speech signals two independent signals, and producing from the filtered and separated speech and synchronizing signals sound effects and framing effects of the produced visible signals.

2. A television receiving method for receiving jointly transmitted image and synchronizing signals to coordinate the image signals to proper locations when the image signals are reproduced as electro-optical image representations which comprises the steps of receiving the image and synchronizing signals, amplifying both signals in a common amplifier, locally generating signals, beating the locally generated with the received signals to produce intermediate frequency signals therefrom, amplifying the resulting beat frequency signals of intermediate frequency value to substantially the full extent while the signals are in the frequency range of the produced intermediate frequency, separating the amplified intermediate frequency image signals from the synchronizing signals, detecting each of the separated frequencies producing electro-optical detected image representations from the image signals, and locating the points at which the produced image representations are observable by the detected synchronizing signals.

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