

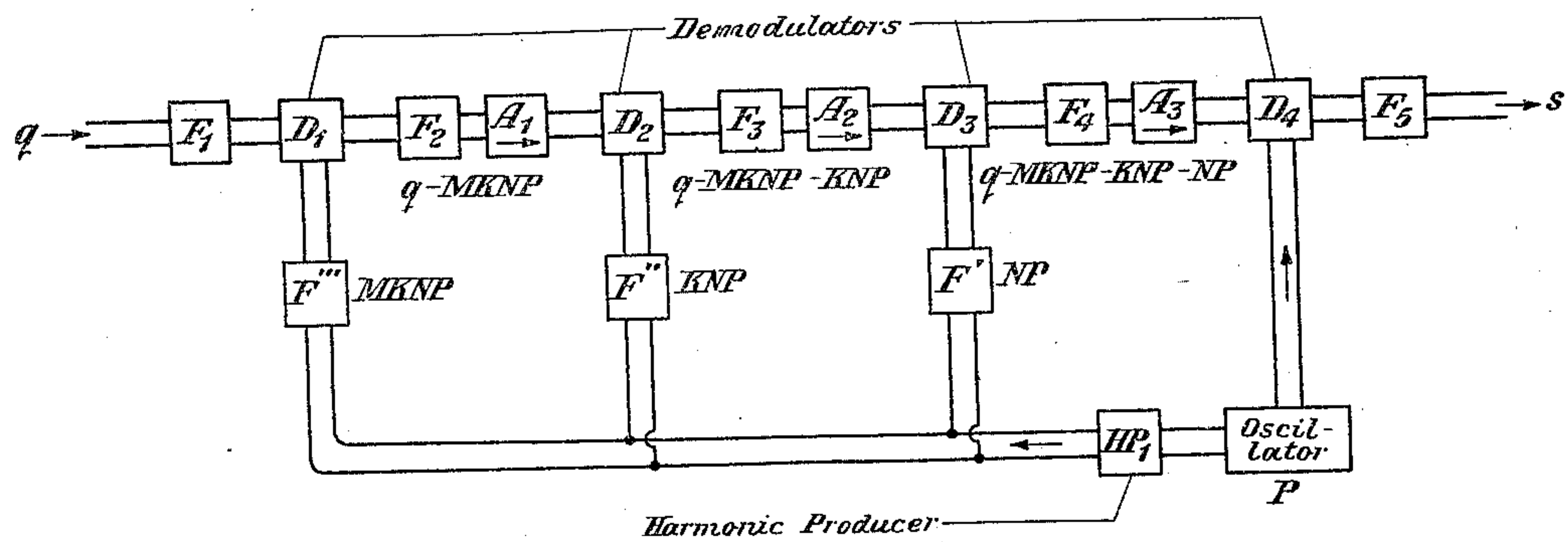
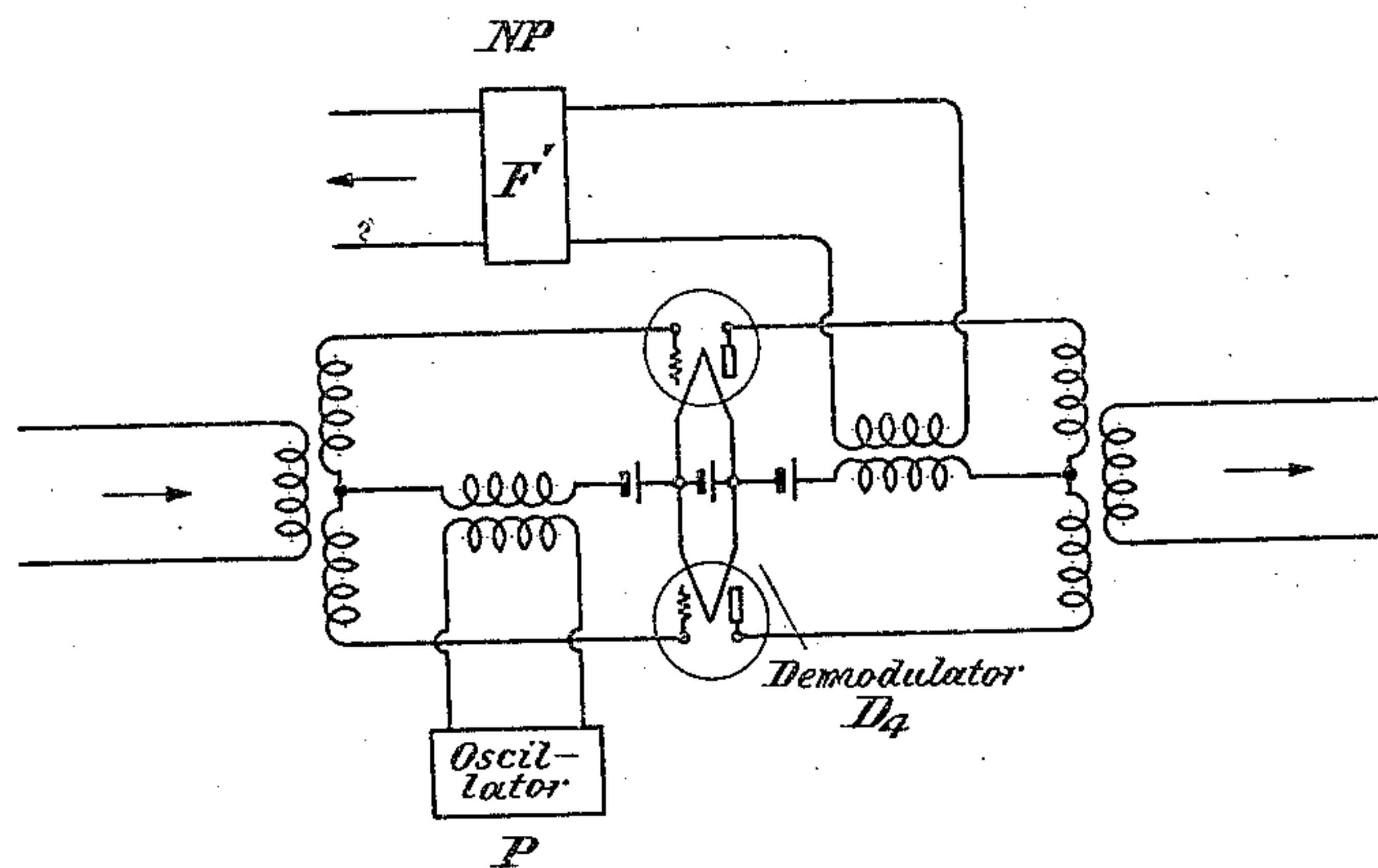
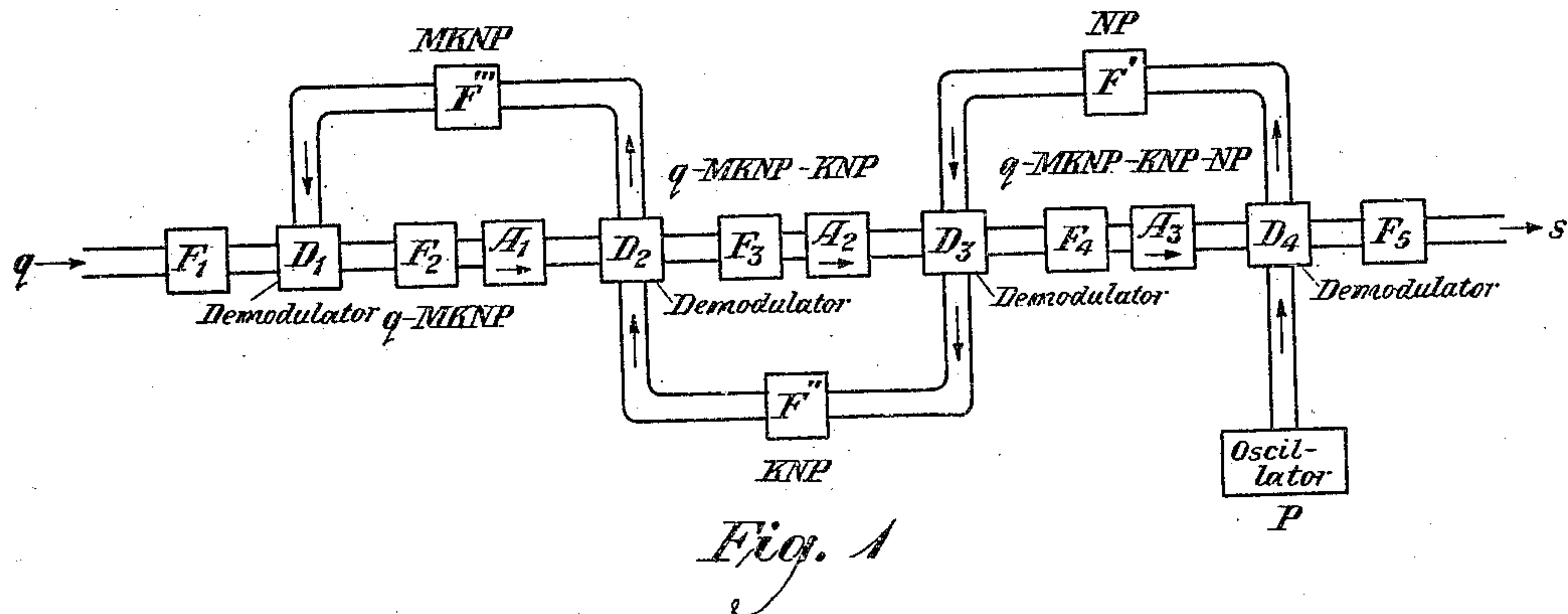
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MULTIPLE MODULATION SYSTEM

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MULTIPLE-MODULATION SYSTEM

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This invention relates to high frequency transmission systems and more particularly to systems of the type utilizing a plurality of stages of modulation to effect a translation
5 between the high frequency signal and the signal of low frequency. The principles of the invention are applicable to both the transmitting and the receiving portions of such systems.

10 The arrangements of the invention have the advantage in multiple demodulation receivers of making it necessary to adjust the frequency of only one oscillator in tuning the receiving set. The carrier supplies for the
15 various demodulation stages are automatically kept in proper frequency alignment by selecting harmonics of the single oscillator, which appear in the outputs of the various demodulators and feeding them into preced-
20 ing demodulator stages as the beating frequency.

Multiple detection systems in the past, have consisted of a number of detectors or demodulators with their associated oscilla-
25 tors, separated by amplifiers and filters. The object of such a system has been to change the frequency of the input potential from high values, down to a range where it may be satisfactorily amplified. The fact that a
30 multiplicity of oscillators must be used in such a system has added considerably to its complexity of design and adjustment because the frequencies of the demodulator oscilla-
35 tors must be so chosen that unwanted frequencies, due to their combinations or combinations of their harmonics, do not appear in the audio-frequency output. On the as-
40 sumption that a suitable combination of frequencies has been found, it is necessary to continually adjust a number of oscillators to compensate for any frequency instability.

With the arrangements of the invention, if the radio signals to be received are, for example, of very high frequency and of the
45 type known as suppressed carrier, apparatus comprising a plurality of stages of demodulation such, for example, as four might be utilized. A single oscillator would be pro-
50 vided. This would be used to supply the pseudo-carrier frequency corresponding to

the carrier which was suppressed at the distant transmitter. By the use of suitable branches in a balanced demodulator or other-
wise, there would be obtained the output side-
band, such as S, and a series of harmonics 55 of the supplied carrier frequency P. A suitable band filter is used to select the Nth harmonic of this series, which is applied as a carrier for the preceding demodulator. In this third demodulator, there is obtained a
60 side-band output and, as above, there is selected the Kth harmonic of the carrier supplied to this stage. The above process may be continued as far as design considerations require.

65 The advantages of the method and arrangements of the invention as outlined above, are as follows: Since only one oscillator is used, economy is attained through the elimination of a multiplicity of oscillators. 70 Simplicity of adjustment follows from the fact that there is only one oscillator to be corrected in the maintenance of constant frequency. Since all the supplied carriers are harmonics of a single frequency, they can
75 not vary in respect to each other and hence, constancy of frequency alignment is obtained. Since all the supplied carriers are harmonics of a single frequency, they can
80 not beat together at audible frequency. By elimination or addition of demodulation stages, the same receiver may be used for reception over a very wide band of frequencies. Other features and advantages of the in-
85 vention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in the Figures 1, 2 and 3 of which the invention
90 is illustrated. Fig. 1 shows a schematic arrangement of the invention, as applied to a receiving set. Fig. 2 shows in detail a portion of the arrangements of Fig. 1. Fig. 3 is a modification of the arrangements of Fig. 1. Similar reference characters have been
95 used to denote like parts in all of the figures.

In Fig. 1 there is shown schematically, a portion of a receiving station utilizing the principles of the invention. In this arrange- 100

ment, four stages of demodulation are used to translate the incoming high frequency signal q down to a lower frequency S . Accordingly, the demodulators D_1 , D_2 , D_3 and D_4 are illustrated. These demodulators might be of the well known balanced duplex type. The demodulator D_4 is shown in more detail in Fig. 2. Interconnecting these demodulators, are the filters F_1 , F_2 , F_3 and F_4 and the amplifiers A_1 , A_2 and A_3 . A single oscillator is used to supply current of a frequency P to the demodulator D_4 . This will be of a frequency corresponding to the carrier utilized at the transmitting station. In a carrier suppression type system, this carrier would have been suppressed at the sending station. By use of suitable branches in the balanced demodulator D_4 , as shown more fully in Fig. 2, there is obtained the output side-band S and a series of harmonics of the supplied carrier frequency P . A suitable band filter F' is utilized to select the N th harmonic of the carrier P . This frequency NP is then applied as a beating frequency to the preceding demodulator which is D_3 . By use of a suitable branch circuit and the filter F'' , there is obtained from demodulator D_3 the K th harmonic of the series from frequency P . This is then applied as a beating frequency to the next preceding demodulator D_2 . By use of a suitable branch circuit and the filter F''' , there is obtained from demodulator D_2 the M th harmonic of the series from frequency P . This is applied to the demodulator D_1 as a carrier for modulation with the incoming high frequency q .

To more completely illustrate the operation of the arrangements of the invention as shown in the receiving set of Fig. 1, let it be assumed that the incoming frequency q is of the order of 50,000 KC, or 6 meters. Let it be assumed that the amplifiers A_1 , A_2 and A_3 and the filters F_2 , F_3 and F_4 are designed to pass frequencies of 5,000 KC, 500 KC and 50 KC, respectively. The frequencies in the various portions of the circuit will then be as follows:

$$\begin{array}{lll}
 q = 50,000 \text{ KC} & & \\
 q - MKNP = 5,000 \text{ KC} & \therefore & MKNP = 45,000 \text{ KC} \\
 q - MKNP - KNP = 500 \text{ KC} & \therefore & KNP = 4,500 \text{ KC} \\
 q - MKNP - KNP - NP = 50 \text{ KC} & \therefore & NP = 450 \text{ KC} \\
 q - MKNP - KNP - NP - P = 0 & \therefore & P = 50 \text{ KC}
 \end{array}$$

Therefore, M , K and N , which are integral multiples of P , will have the following values:

$$\begin{array}{l}
 M = 10 \\
 K = 10 \\
 N = 9
 \end{array}$$

In other words, it is assumed that we are receiving single side-band transmission and are supplying from the local oscillator a carrier frequency P of 50 KC in obtaining voice frequencies S from demodulator D_4 . Demodulator D_4 , accordingly, is supplied with a "carrier" of 50 KC and in turn, supplies to

demodulator D_3 , a "carrier" of 450 KC which is the ninth harmonic of its oscillator of frequency P . The demodulator D_3 , being supplied with its incoming signal frequency of 500 KC and with the 450 KC "carrier", feeds to demodulator D_2 the tenth harmonic of 450 KC, or a "carrier" of 4,500 KC. The demodulator D_2 , being supplied with its incoming signal frequency of 5,000 KC, and with the carrier of 4,500 KC, feeds to demodulator D_1 the tenth harmonic of 4,500 KC, or a "carrier" of 45,000 KC. In other words, the "carrier" supplied to demodulator D_1 , will be 900 times the oscillator frequency P . As a result of these stages of frequency transformation, there is obtained a zero frequency output at S when a frequency equal to the untransmitted carrier, or 50,000 KC, is applied at the input of the set. A frequency of 50,000,045 cycles at the input would give 45 cycles at the output. Although the above specific illustration has been chosen as applied to single side-band reception, it is pointed out that the method and arrangements of the invention may equally well be applied to other types of systems, such as those in which the carrier is transmitted, by utilizing receiving apparatus suitable for type of system employed.

The method and arrangements of the invention are applicable to a transmitting station as well as to a receiving station. When the arrangements of the invention are utilized for transmitting, arrangement similar to those of Fig. 1 may be utilized to step up the frequency from the voice range to the frequency to be radiated at the antenna by a suitable reversal of the path of the applied signal through the apparatus and by making the demodulators act as modulators.

In Fig. 3 there is shown a modification of the arrangements of the invention as applied to a radio receiving system. Similar reference characters have been utilized for parts identical with those of the arrangements of Fig. 1. The transmission line will include the demodulators D_1 , D_2 , D_3 and D_4 . As before, these demodulators will be interlinked by the filters F_1 , F_2 , F_3 , F_4 and F_5 , and the amplifiers A_1 , A_2 and A_3 . The demodulator D_4 will be supplied with a "carrier" frequency P from the single oscillator shown. The oscillator output will also be connected to a harmonic producer HP_1 . Connected to the output of harmonic producer HP_1 will be a branch circuit including the filter F' which will select the N th harmonic of the carrier frequency P and apply it as a "carrier" to the demodulator D_3 . Connected to the output of harmonic producer HP_1 will be a branch circuit including the filter F'' which will select the K th harmonic of the series from P and will apply it as a "carrier" to the demodulator D_2 . Included in the output circuit of harmonic producers HP_1 is a filter

F''' which will select the Mth harmonic of the series from P and apply it as a "carrier" to demodulator D₁. As further operation of the arrangements is substantially similar to that of Fig. 1, no further description thereof will be given.

While the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many other and widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. The method of effecting a translation of signals from a certain position in the frequency spectrum to certain other positions in the frequency spectrum which comprises subjecting said signals to a plurality of stages of modulation, supplying a fundamental frequency as a carrier for one of said stages of modulation, selecting a harmonic of said fundamental frequency from the output of said stage as the carrier for an adjacent stage of modulation, and successively selecting from the output of such adjacent stage of modulation the carrier frequency for the next adjacent stage of modulation.

2. The method of effecting a translation of signals from a certain position in the frequency spectrum to certain other positions in the frequency spectrum which comprises subjecting said signals to successive stages of modulation and utilizing a product of each stage of modulation as the carrier frequency for the next adjacent stage of modulation.

3. The method of receiving high frequency signals which comprises subjecting said signals to successive stages of demodulation and utilizing a product of each demodulation stage to control the preceding stage of demodulation.

4. The method of receiving high frequency signals which comprises subjecting said signals to successive stages of demodulation and utilizing a product of the demodulation in the last successive stage to control the preceding stages of demodulation.

5. The method of receiving high frequency signals which comprises subjecting said signals to successive stages of demodulation, providing a fundamental carrier frequency for the last successive stage of demodulation, selecting from the product of said last stage of demodulation a harmonic of said fundamental carrier frequency and utilizing said selected harmonic frequency to control the next preceding stage of demodulation.

6. A high frequency translating device comprising a circuit interconnecting a plurality of demodulators, an oscillator for supplying a carrier frequency for one of said demodulators, a branch circuit connected to the output of said demodulator, means in

said branch circuit for selecting a harmonic of said carrier frequency, and means for connecting said branch circuit to a preceding one of said demodulators whereby said selected harmonic frequency may operate as a carrier frequency therefore.

7. A high frequency translating device comprising a circuit interconnecting a plurality of demodulators, an oscillator for supplying a carrier frequency for one of said demodulators, means for selecting from the output of said demodulator different harmonics of said carrier frequency, and means for supplying said selected harmonic frequencies as carriers for preceding ones of said demodulators.

8. A high frequency translating device comprising a plurality of successive demodulators working one into the other for translating high frequency signals into audio frequency signals by a plurality of steps, an oscillator for supplying a carrier frequency for one of said demodulators, means for selecting from the output of said demodulator a harmonic of said carrier frequency, means to supply said harmonic as the carrier frequency for the next preceding demodulator, means to derive from the output of the next preceding demodulator a harmonic of the carrier frequency thereof, and means to supply said harmonic as the carrier frequency for still another preceding demodulator.

In testimony whereof, I have signed my name to this specification this 27th day of March, 1929.

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