

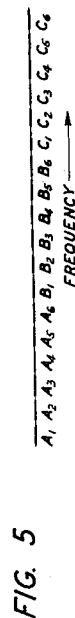
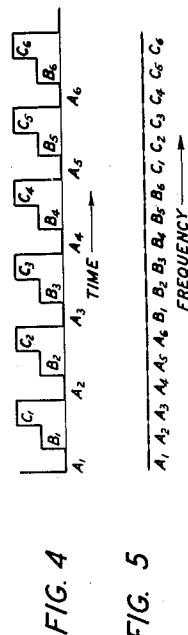
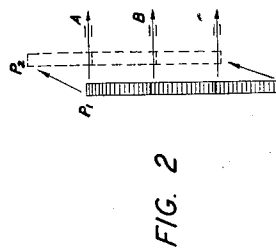
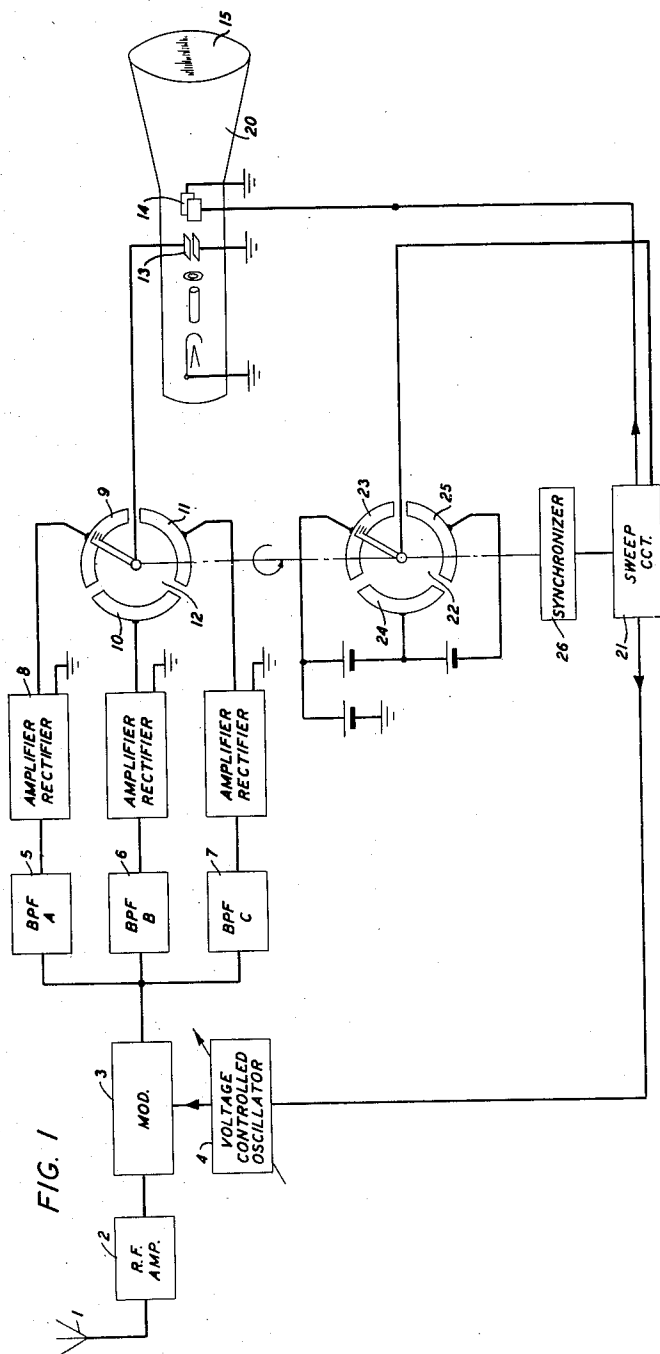
Nov. 21, 1950

E. I. GREEN

2,530,693

PANORAMIC SIGNAL RECEIVING SYSTEM

Filed June 17, 1944



INVENTOR
E.I. GREEN
BY *N. D. Ewing*
ATTORNEY

UNITED STATES PATENT OFFICE

2,530,693

PANORAMIC SIGNAL RECEIVING SYSTEM

Estill I. Green, Millburn, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application June 17, 1944, Serial No. 540,763

7 Claims. (Cl. 250—20)

1

This invention relates to scanning systems and more particularly to systems in which a wave frequency range or other subject is repeatedly scanned by selective means and in which wave effects of different frequencies encountered by the selective means, or other effects according to the nature of the subject, are individually displayed by an oscilloscope or otherwise utilized.

Among the objects of the invention are to simplify the construction and improve the performance of systems of the type to which the invention relates; to increase the frequency range that can be accommodated by a wave frequency range scanner without sacrifice of frequency resolution, or to improve the resolution, or both; and to reduce the range of variation required of the scanning control means.

In accordance with an embodiment of the invention a multiplicity of selective means are employed for simultaneously scanning respectively individual parts of the frequency range of interest, and the effects encountered by the several selective means are commutatively applied to an oscilloscopic system wherein they are displayed at various points individual to their respective positions in the frequency range of interest. In accordance with a feature of the invention the several selective means are associated with a common scanning control element.

The nature of the present invention and its various objects, features and advantages will appear more fully from a consideration of the following description of the embodiment illustrated in the accompanying drawings. In the drawings,

Fig. 1 illustrates schematically a panoramic radio receiver in accordance with the invention; and

Figs. 2 to 5 are diagrams illustrating certain features of the construction and operation of the Fig. 1 system.

Referring more particularly now to Fig. 1 the system therein illustrated is adapted to receive simultaneously all radio signals lying within a predetermined frequency range, and to produce on the luminescent screen of a cathode ray oscilloscope distinct luminous marks representative of the several radio signals of different frequencies that are being received at any time. Sweep circuit means associated with the oscilloscope establish a timing or reference axis that may be calibrated in terms of frequency, and each received signal produces its luminous mark at a point along the axis corresponding to its wave frequency.

The system thus enables one to maintain all of the radio channels within a predetermined fre-

2

quency range under continuous, simultaneous observation, and to detect at least the presence if not the character of the wave activity at any frequency within the monitored range.

Radio waves within the frequency range of interest are intercepted by antenna 1 and applied through radio frequency amplifier 2 to a frequency translator comprising modulator 3. Beating oscillations are concurrently supplied to modulator 3 from beating oscillator 4 which is of a well-known type such that its operating frequency can be varied periodically between predetermined limits under the control of a sawtoothed voltage wave. The latter is illustrated in Fig. 3 and it may be derived from a sweep circuit 21 as indicated in Fig. 1.

One of the sidebands appearing in the output circuit of modulator 3, an upper sideband, is represented diagrammatically in Fig. 2. It is coextensive with the frequency range to be monitored and all of the received radio signals appear within it unaltered in relative position. During each cycle of the sweep circuit 21 the sideband moves relatively gradually from a lower frequency position P1 to an upper frequency position P2 and then abruptly drops back to its initial position P1. This operation is repeated cyclically in synchronism with the varying voltage produced by sweep circuit 21, which may have an operating frequency of fifteen cycles per second for specific example.

The sideband output of modulator 3 is applied concurrently to a multiplicity of frequency selective means here shown as three band-pass filters 5, 6 and 7. The pass bands of the several filters are narrow and they are uniformly spaced apart across the sideband frequency range as illustrated in Fig. 2. More particularly the pass frequency of filter 5 coincides with the top frequency of the sideband when the latter is in its lowermost position P1 and the pass frequencies of filters 6 and 7 are lower by one-third and two-thirds respectively of the frequency width of the sideband. Hence as the sideband cyclically shifts between its extreme frequency positions the three filters scan respective thirds of the sideband frequency range and each transmits in succession, although only momentarily, the waves it encounters in its traverse across its respective part of the sideband.

Each of the filters 5, 6 and 7 is connected to an individual device 8 in which wave effects received from the filter are amplified and rectified. The devices 8 are connected in turn to respective segments 9, 10 and 11 of a commutator 12. The latter may be of mechanical or electronic type as

desired and in either case the rotary contacting means delivers in succession the unidirectional voltages picked up from the several commutator segments to the cathode ray deflecting plates 13 of the cathode ray tube 20. Deflecting plates 13 control the position of the cathode ray in a vertical plane. Whenever signal effects are received from the connected commutator segment the cathode ray is deflected from the horizontal plane thereby producing on the screen 15 a luminous vertical line the length of which is more or less proportional to the intensity of the received signal causing the deflection.

The position of the cathode ray in the horizontal plane, and therefore also the position of the luminous spot along the horizontal reference axis or frequency scale, is controlled by voltages applied to deflecting plates 14. The control voltages are derived in part from sweep circuit 21 and in part from voltage biasing sources that are connected through a commutator 22 to the plates 14. Commutator 22, which is driven in synchronism with commutator 12, comprises three conducting segments 23, 24 and 25. The biasing sources connected with the several segments are such that when segment 23 is connected through the rotating contactor of the commutator to the cathode ray tube, the luminous spot is positioned at the left-hand extremity of the frequency scale. While the contactor passes across segment 24 the applied biasing voltage is such as to deflect the spot to a point that is one-third the length of the frequency scale from the left-hand extremity; and while contact is made with segment 25 the spot is advanced by another third along the frequency scale. Superposed on the applied biasing voltages is the saw-toothed voltage wave produced by sweep circuit 21, and its intensity is so adjusted that if applied alone it would cause the spot to traverse one-third of the frequency scale.

The period of commutators 12 and 22, i. e., the time required to complete one rotation, is made a small submultiple of the period of sweep circuit 21, and any suitable synchronizing means 26 may be employed to maintain this harmonic relation. For simplicity of illustration it will be assumed that the one is six times the other. Fig. 4 illustrates the time variation in the applied biasing voltage under the conditions assumed. Because of the superposed saw-toothed wave the total deflecting voltage would be represented by a summation of the applied saw-toothed wave and the wave represented in Fig. 4.

Considering now the operation of the Fig. 1 system one may take as a starting point the instant of time represented at the left-hand extremity of Fig. 4. At this instant the sideband is in the position represented at P1 in Fig. 2, contact has just been made with commutator segments 9 and 23, and the luminous spot is at the left-hand or low frequency end of the frequency scale. In the ensuing period A1 during which contact is maintained with the specified segments, the luminous spot advances a short distance to the right across the frequency scale, as indicated at A1 in Fig. 5, while the scanner comprising the "A" filter 5 which is then connected to the oscilloscope scans a corresponding small portion of its third of the frequency range. Any wave effects encountered by the filter during this period are translated into momentary vertical excursions of the spot. At the beginning of the next time interval B1, during which contact is made with segments 10 and 24, the spot is instantly deflected to a point about a third from the

low frequency end of the frequency scale, and it is then gradually advanced during the remainder of the period, as indicated at B1 in Fig. 5. Meanwhile the connected "B" filter 6 explores a small portion of the middle third of the frequency range, and any effects encountered are registered in the proper section B1 of the frequency scale. During the third period C1 the "C" filter 7 is connected to the oscilloscope through commutator 12 while the spot traverses the corresponding C1 portion of the frequency scale as indicated in Fig. 5. The "A" scanning filter 5, which has continued to advance across the frequency range during the second and third periods, is reconnected to the oscilloscope at the beginning of the fourth interval A2, and during this period the deflection-controlling sweep voltage causes the spot to traverse the scale portion A2. The further sequence of operation will be evident from a consideration of the foregoing and of Figs. 3 to 5.

During each cycle of the saw-toothed wave, therefore, the luminous spot traverses all portions of the frequency scale and the entire signal frequency range is traversed by the scanning means. Inasmuch as this operation is repeated at an assumed rate of fifteen times per second, the several vertical lines produced on the oscilloscope appear to remain there continuously without sign of flicker. It may be added that although each of the scanners continues to progress across the frequency range while disconnected from the oscilloscope, the pass band of the filter may be made wide enough in relation to the rate of scanning to insure that each received signal is registered on the oscilloscope during every scanning cycle.

To simplify the foregoing exposition it has been assumed that the number of scanning filters is three, these being band-pass filters 5, 6 and 7. It will be appreciated, however, that a much larger number may be employed in other embodiments of the invention. For specific example, there may be a total of ten filters, each having a band width of 200 cycles, spaced 10 kilocycles apart to cover a total frequency range of 100 kilocycles. In this example, the change in frequency required of the scanning control oscillator 4 would be only one-tenth the width of the monitored frequency range or 10 kilocycles. This substantial reduction in the frequency swing required of the beating oscillator is an important feature of the present invention, for large percentage variations in the frequency of the beating oscillator are undesirable and often difficult to achieve in practice.

With elements now available the resolution of a frequency scanning system, that is, the ability to discriminate between waves of closely adjacent frequencies, is limited by transient effects arising within the frequency selective element, the scanning filter. These effects appear if the rate of scanning, measured in cycles per second per second, is made too high or if the pass band of the filter is made too narrow in an effort to obtain greater discrimination. Assuming any given repetitive rate m of scanning, such as fifteen times a second for specific example, the present invention permits a substantial decrease in the width of filter band and a corresponding increase in the frequency resolution. For if n filters are employed to scan a total frequency range F , the scanning rate for each filter is only Fm/n cycles per second per second. Alternatively, the inherent advantage may be utilized to secure an n -fold increase in the frequency range that is scanned or an n -fold increase in the repetitive

rate of scanning, without sacrifice of frequency resolution.

Although the present invention has been described largely with reference to a specific embodiment thereof, it will be understood that the invention is susceptible of embodiment in various other forms within the spirit and scope of the appended claims.

What is claimed is:

1. In combination, means for receiving simultaneously waves of different frequencies lying within a predetermined frequency range, frequency translating means comprising a modulator to which the said received waves are applied and a source of beating oscillations connected to said modulator, the frequency of said oscillations varying cyclically between predetermined frequency limits, whereby the several received waves give rise to respectively corresponding modulator output waves having cyclically varying frequencies lying within a predetermined frequency band, a multiplicity of frequency selective wave translating means the pass frequencies of which are systematically spaced apart across the said frequency band, means for applying the several said output waves concurrently to said multiplicity of frequency selective translating means, utilization means and means for delivering electrical effects derived from the received waves to said utilization means, said last-mentioned means including means connecting the several said selective means in cyclically repeated succession to said utilization means.

2. A combination in accordance with claim 1 in which said utilization means comprises an oscilloscope.

3. A combination in accordance with claim 1 comprising a cathode ray oscilloscope, sweep circuit means for systematically varying the position of the cathode ray, and cathode ray controlling means responsive to electrical effects derived from said successively connected selective means.

4. In combination with wave receiving means and an oscilloscope, a modulator having wave input means connected to said receiving means, means for supplying said modulator with beating oscillations of cyclically varying frequency, a multiplicity of electric transmission paths connected at one end to receive the wave output of said modulator, said paths including respective band-pass filter means having mutually different transmission frequencies, a commutator for connecting said paths at their other ends in succession to said oscilloscope to register thereon any wave-derived effects appearing in said paths, said oscilloscope including ray deflecting means synchronized with the variations in frequency of said oscillations for establishing a reference axis having the sense of a frequency scale.

5. A combination in accordance with claim 4 in which more particularly the frequency inter-

vals between successive pairs of said transmission frequencies are all substantially alike, and in which the frequency of said beating oscillations is cyclically variable over the same said frequency interval.

6. A combination in accordance with claim 4 in which said ray deflecting means includes means for dividing said reference axis into a multiplicity of adjacent segments, each of which corresponds to one of said electric transmission paths, and means for causing the ray to sweep fractional portions of each of said segments successively and cyclically as each respective corresponding said electric transmission path is connected by said commutator to said oscilloscope.

7. A system for scanning a predetermined wave frequency range comprising a multiplicity of frequency selective means for simultaneously cyclically scanning respective different portions of said frequency range whereby each of said selective means selects in cyclically repeated succession such wave effects of different frequencies as may appear within the said portion of the frequency range respective thereto, and means for visually indicating along a single reference axis the relative frequencies of the said wave effects, said last-mentioned means comprising an oscilloscope, a sweep circuit for said oscilloscope synchronized with the cyclical operation of said scanning means, and means connecting the several said scanning means to said oscilloscope in continually repeated succession.

ESTILL I. GREEN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,994,232	Shuck, Jr.	Mar. 12, 1935
2,084,760	Beverage	June 22, 1937
2,098,695	Southwick	Nov. 9, 1937
2,121,359	Luck et al.	June 21, 1938
2,159,790	Freystedt et al.	May 23, 1939
2,178,074	Jakel et al.	Oct. 31, 1939
2,237,440	Jones	Apr. 8, 1941
2,273,914	Wallace	Feb. 24, 1942
2,275,460	Page	Mar. 10, 1942
2,279,246	Podliasky et al.	Apr. 7, 1942
2,312,203	Wallace	Feb. 23, 1943

FOREIGN PATENTS

Number	Country	Date
834,082	France	Aug. 1, 1938

OTHER REFERENCES

"Panoramic Radio Spectroscopes," Panoramic Radio Corp. of 242-250 West 55th Street, New York City, 1942.