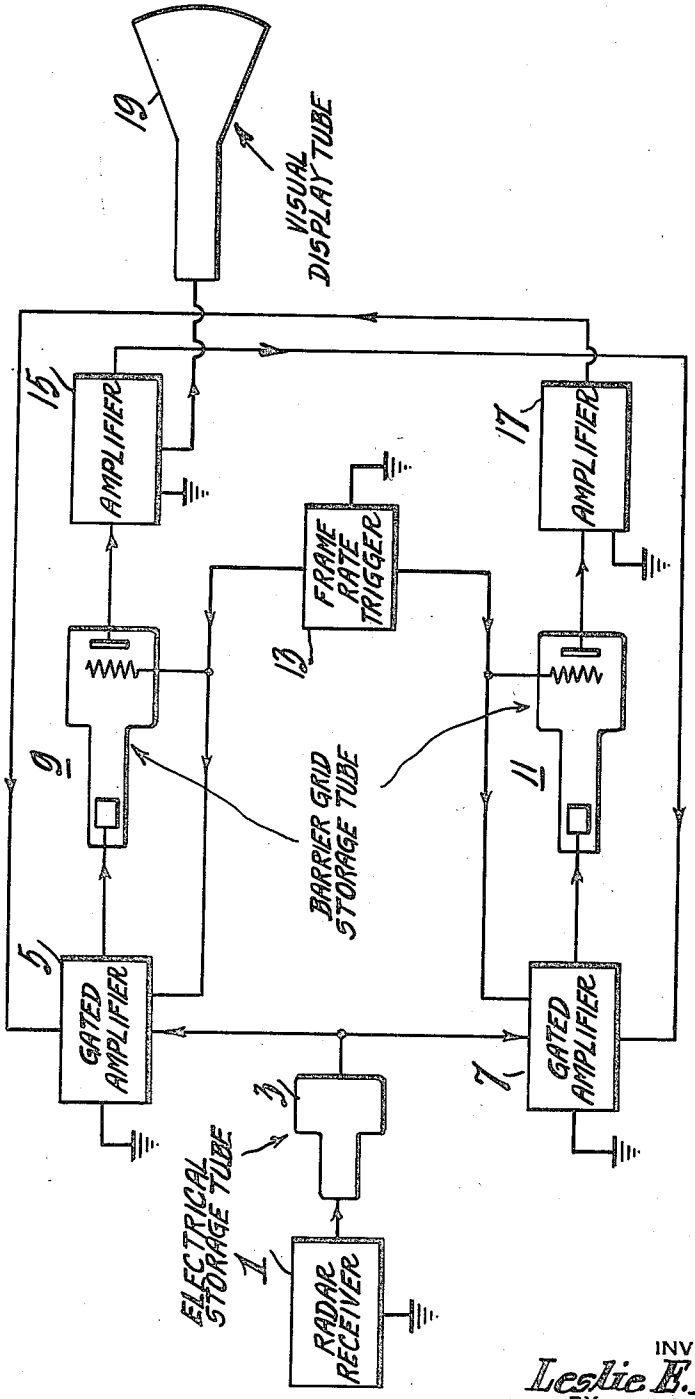
Feb. 15, 1955

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2,702,356

SIGNAL STORAGE SYSTEM

Filed May 8, 1951



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United States Patent Office 2,702,356
Patented Feb. 15, 1955

2,702,356

SIGNAL STORAGE SYSTEM

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Application May 8, 1951, Serial No. 225,197

7 Claims. (Cl. 315—9)

This invention relates to an electrical energy storage system in which there is continuous storage of desired electrical wave signal energy and is an improvement upon a copending application filed concurrently herewith, Serial No. 225,230 by Richard E. Baker and Frank D. Covely 3rd and entitled Signal Display System.

A system for continuously storing electrical energy is of particular utility as a navigational aid for viewing and interpreting visual display indications attributable to either moving or stationary radar targets.

One mode of operation for the herein disclosed system provides for continuous storage of repetitive radar signals reflected by stationary wave reflecting objects, while effectively rejecting random signals or signals reflected by moving targets. A second mode of operation affords, for example, continuous storage of a large number of P. P. I. radar displays and conversion thereof into a composite television picture which provides an automatic television plot of all radar targets, both stationary and moving, within the service area of the P. P. I. radar system. Observation of the television plot, derived in accordance with this second and preferred operational mode, by a trained observer (possibly a ship's navigator, airport traffic personnel, or the like) enables the observer to obtain therefrom information relating to the ranges, bearings, and courses being pursued by various remote wave reflecting objects thus displayed.

It is the principle object of the present invention to provide an improved electric energy storage system in which there is continuous storage of electrical energy.

Another object of the invention is to provide a system for use with a radar moving target indicating system providing continuous storage of electrical wave signals attributable to moving radar targets.

Another object of the invention is to provide a system for continuous storage of electrical energy which system is substantially free from the effects of random signals such as "noise."

A further object of the invention is to provide an electrical energy storage system utilizing a plurality of barrier grid electrical storage tubes.

The operation of the system, according to a typical embodiment of the invention, is substantially as follows: P. P. I. radar video signals containing target information in polar coordinates are converted into television video signals representing this information in rectangular coordinates by means of a suitable signal converter storage tube. The first frame of television video information is written on the first of two barrier grid storage tubes, substantially as shown and described in U. S. Patent No. 2,503,949 granted to A. S. Jensen and Leslie E. Flory on April 11, 1950 and entitled Storage Tube. During the second frame time the information written on the first storage tube is read therefrom, new video signals are added to the signals read, and the composite video information is written upon the second storage tube. During the third frame time the composite information stored on the second storage tube is read, added to more new video, and the new composite information is written back upon the first storage tube.

The system thus operates cyclically and provides for an indefinite storage of certain video signals. The two storage tubes in alternately reading and writing this information set up a loop circuit through which the video target signals circulate. By suitably adjusting the gain of this loop circuit the system may operate in either of

two ways. First, it may effectively operate as an integrator system responsive only to stationary target signals which system is substantially unaffected by random or moving target signals. Secondly, it may operate in conjunction with a moving target radar system and provide a television plot of the targets detected thereby.

The invention will be described in greater detail with reference to the accompanying drawing of which the single figure is a schematic block diagram of a system utilizing a pair of barrier grid electrical storage tubes, according to the invention, for continuously storing electrical energy.

Referring to the drawing, P. P. I. radar video signals are obtained from a radar receiver 1 and are applied to and stored within a scan converter type electrical storage tube 3. Such a storage tube is shown and described in an article entitled "The Graphecon—a picture storage tube" by Louis Pensak, the article appearing in the RCA Review, vol. X, No. 1, pp. 59–73 (March 1949). In the storage tube 3 the P. P. I. radar video signals are converted into appropriate television video signals which, on alternate television frames, are successively coupled through differently gated amplifiers 5 and 7 and stored in respectively associated barrier grid storage tubes 9 and 11.

A frame rate trigger circuit 13 is provided which, during alternate frame times, gates one of the gated amplifiers, say 5, and at the same time makes positive the barrier grid screen electrode of the associated storage tube 9. While one of the barrier grid tubes 9 is enabled in the manner described above, the trigger circuit 13 simultaneously disables the second storage tube 11, and its gating amplifier 7, by the application thereto of trigger signals opposite in polarity to those applied to the enabled circuitry. The television video signals are then amplified in the first gated amplifier 5 and stored in the first barrier grid tube 9.

When the first frame of television video information has been stored, the frame rate trigger circuit operates disabling the first gated amplifier 5 and also reduces the potential of the first barrier grid screen electrode to substantially zero volts. Simultaneously, the second gated amplifier 7 is gated and the screen electrode of its associated barrier grid storage tube 11 is raised to a positive value, thus enabling the tube. The information stored on the first storage tube 9 is read therefrom, amplified in an amplifier 15, and applied to the second gated amplifier 7 wherein the information thus read is mixed with a new frame of television video information (derived from the signal converter storage tube 3). The "composite" video signals are then amplified and stored in the second barrier grid tube 11. When the second frame time has elapsed the trigger circuit 13 again operates and reverses the polarity of the trigger signals restoring the conditions prevailing during the first frame period thus again enabling the first storage tube 9. The composite video data stored on the second barrier tube 11 is read, amplified in amplifier 17 and coupled back to the first gated amplifier 5 (now conductive). It is therein mixed with another new frame of video information and the "new composite" for the first, second, and third frames stored in the first barrier grid tube 9.

It may be seen then that the system herein disclosed provides a loop circuit in which the video signals are circulatory. A large number of successive P. P. I. sweep signals may be converted to television signals and stored indefinitely. A visual display device 19 (such as a television kinescope) is coupled to the output circuit of one of the barrier grid tubes 9 or 11 and provides a display of the charge pattern stored.

Two convenient modes of operation are afforded in the instant invention. In the event that it is desirable to retain only target indications derived from stationary targets, the gain of the circulatory loop may be adjusted to be less than unity. With the loop gain less than unity, the effective dynamic negative resistance of the loop is less than the positive loop resistance and there is a certain amount of attenuation. With this condition the stored signals decay at a rate depending upon the loop gain, hence repetitive signals add while random signals decay.

When the loop gain is adjusted to be equal to or greater than unity the effective dynamic negative resistance of the circulatory loop is equal to or greater than the positive loop resistance and the signals circulated therein are regenerative. The system then provides for continuous storage of signals derived from both repetitive fixed and moving targets. The display device, by providing a continuous plot of these targets, provides an extremely useful tool for navigation and the like.

While the invention has been described with reference to storage of radar signals converted into television signals, the invention is not so limited. It may be desirable in certain applications thereof to continuously store radar "A-scope" or other wave signals in the manner previously described for integrating repetitive signals and hence improve the signal-to-noise ratio of a particular system.

What is claimed is:

1. A signal display system for continuously storing electrical wave signals, said system comprising a source of electrical signal intelligence, a first electrical storage tube means for converting signal intelligence derived from said source into appropriate television wave signals, a second electrical storage tube means for storing said television wave signals during alternate television frames, said second storage tube means operating cyclically with a third electrical storage tube means for compositely storing conjugate alternate television frames of newly obtained video information derived from said storage tube converting means and said stored information, and visual display means for viewing said stored signals.

2. A system as claimed in claim 1 wherein a gated amplifier is connected to each of said second and third storage tube means, said system including trigger circuit means for alternately gating said amplifiers at the television system frame repetition rate.

3. A system as claimed in claim 2 wherein trigger circuit means are coupled to and alternately enable said second and third electrical storage tube means.

4. A system as claimed in claim 1 including a plurality of amplifier means loop connected with said second and third electrical storage tube means for regeneratively circulated electrical signals conveyed therein.

5. A signal storage system comprising, a first electrical storage tube, input and output circuits for said first storage tube, a second electrical storage tube, input and output circuits for said second storage tube, means for connecting the output circuit of said first storage tube to the input circuit of said second storage tube and for connecting the output circuit of said second storage tube to the input circuit of said first storage tube whereby said first and second storage tubes are connected in a loop circuit, means for introducing signal intelligence to be stored into said loop, and means connected to said first and second storage tubes for operating said tubes so that said first and second storage tubes circulate and alternately store said introduced signal intelligence.

6. A system as claimed in claim 5 including amplifier means connected in said loop circuit for controlling the gain of signal intelligence circulated therein.

7. A system as claimed in claim 5 including a display device coupled to said loop circuit for visually displaying the signal intelligence circulated therein.

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