

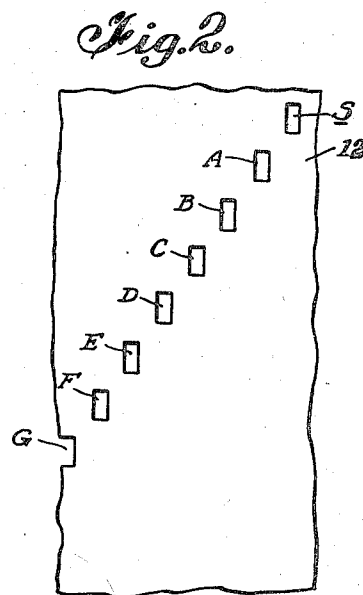
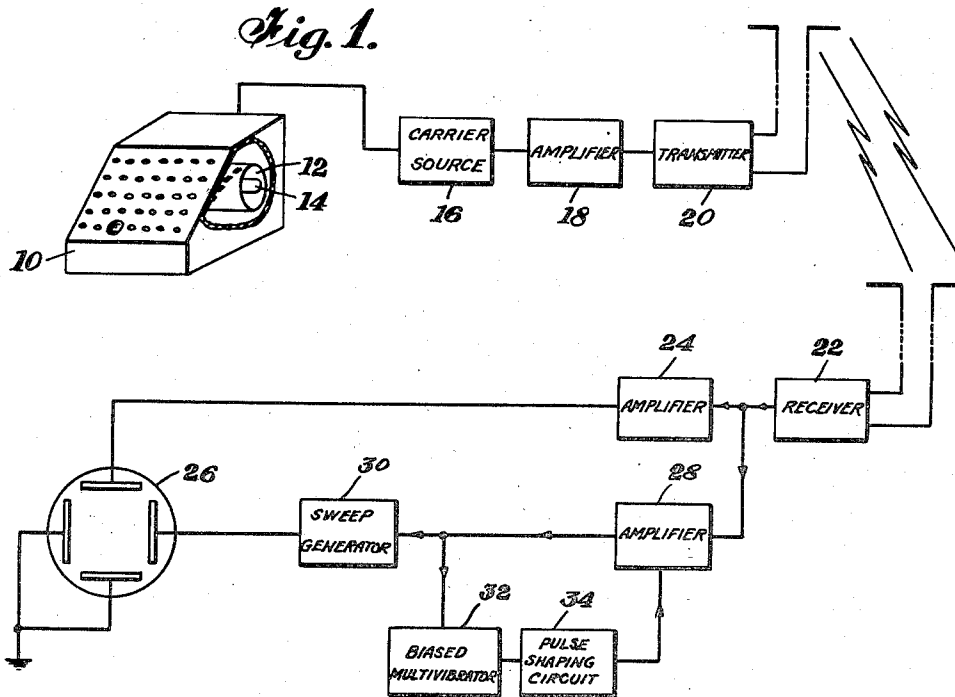
May 31, 1949.

N. H. YOUNG, JR
TRANSMISSION SYSTEM

2,471,473

Original Filed Nov. 1, 1943

4 Sheets-Sheet 1



INVENTOR.
NORMAN H. YOUNG, JR.

BY *Percy P. Lantry*
ATTORNEY

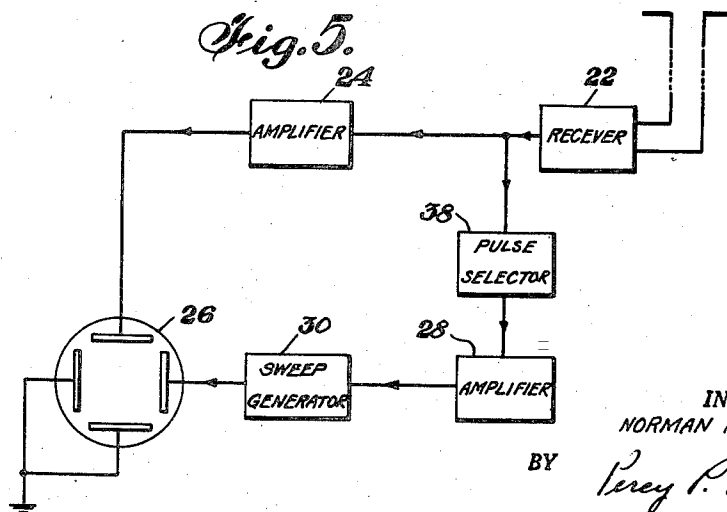
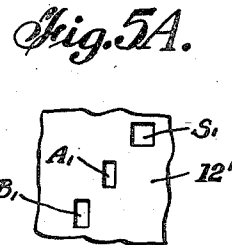
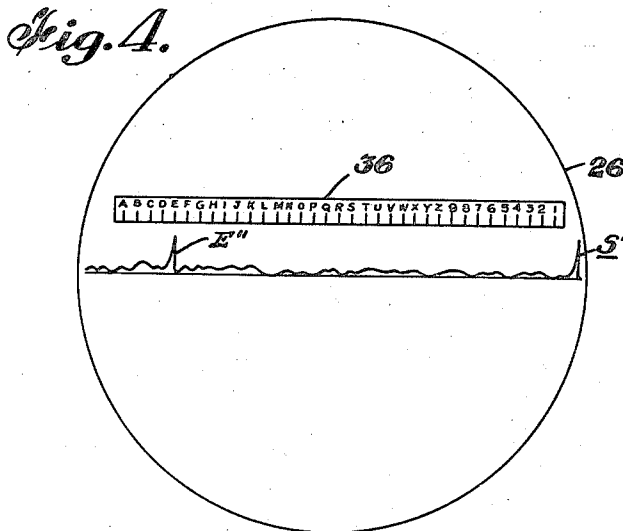
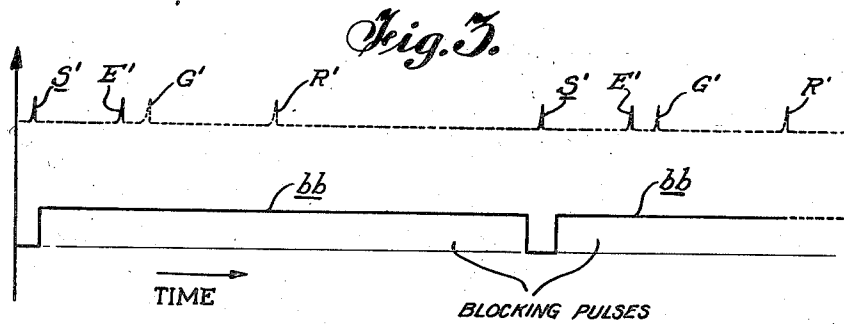
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N. H. YOUNG, JR
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2,471,473

Original Filed Nov. 1, 1943

4 Sheets-Sheet 2



INVENTOR.
NORMAN H. YOUNG, JR.

BY

Percey P. Lantier

ATTORNEY

May 31, 1949.

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Original Filed Nov. 1, 1943

4 Sheets-Sheet 3

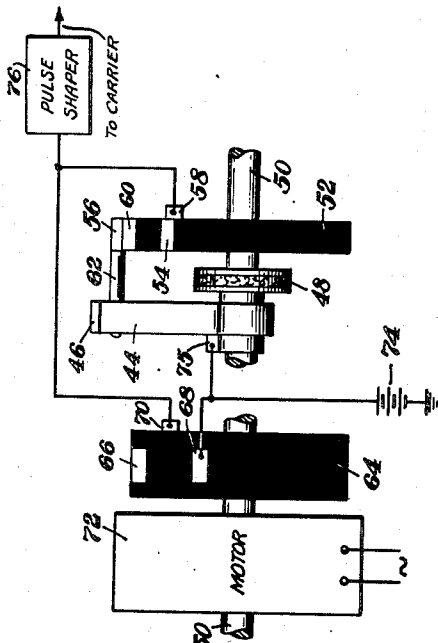


Fig. 7.

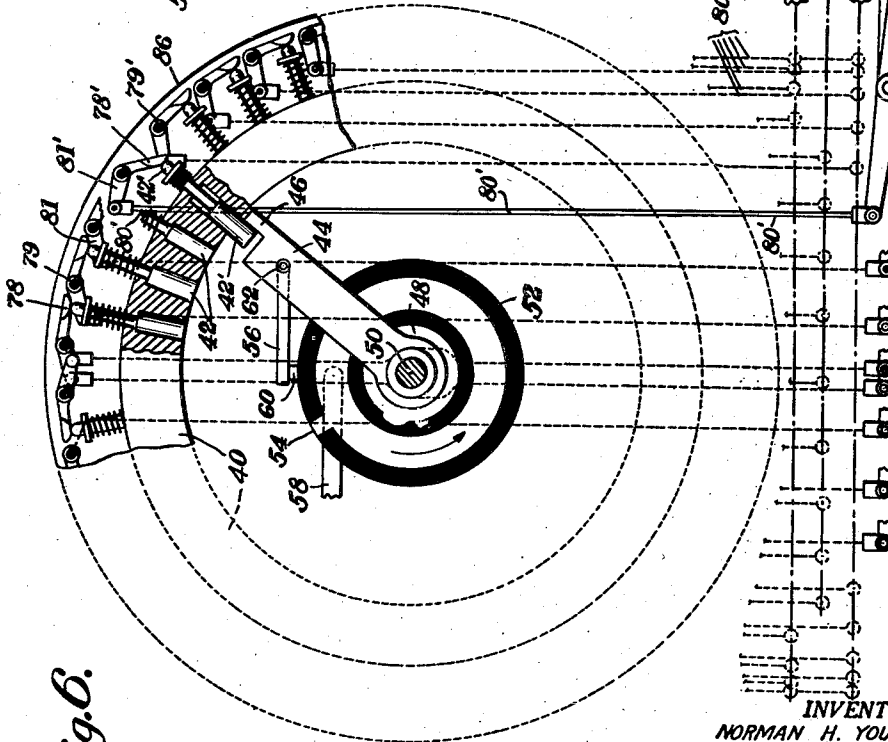


Fig. 6.

INVENTOR.
NORMAN H. YOUNG, JR.

BY

Percy P. Lantry

ATTORNEY

May 31, 1949.

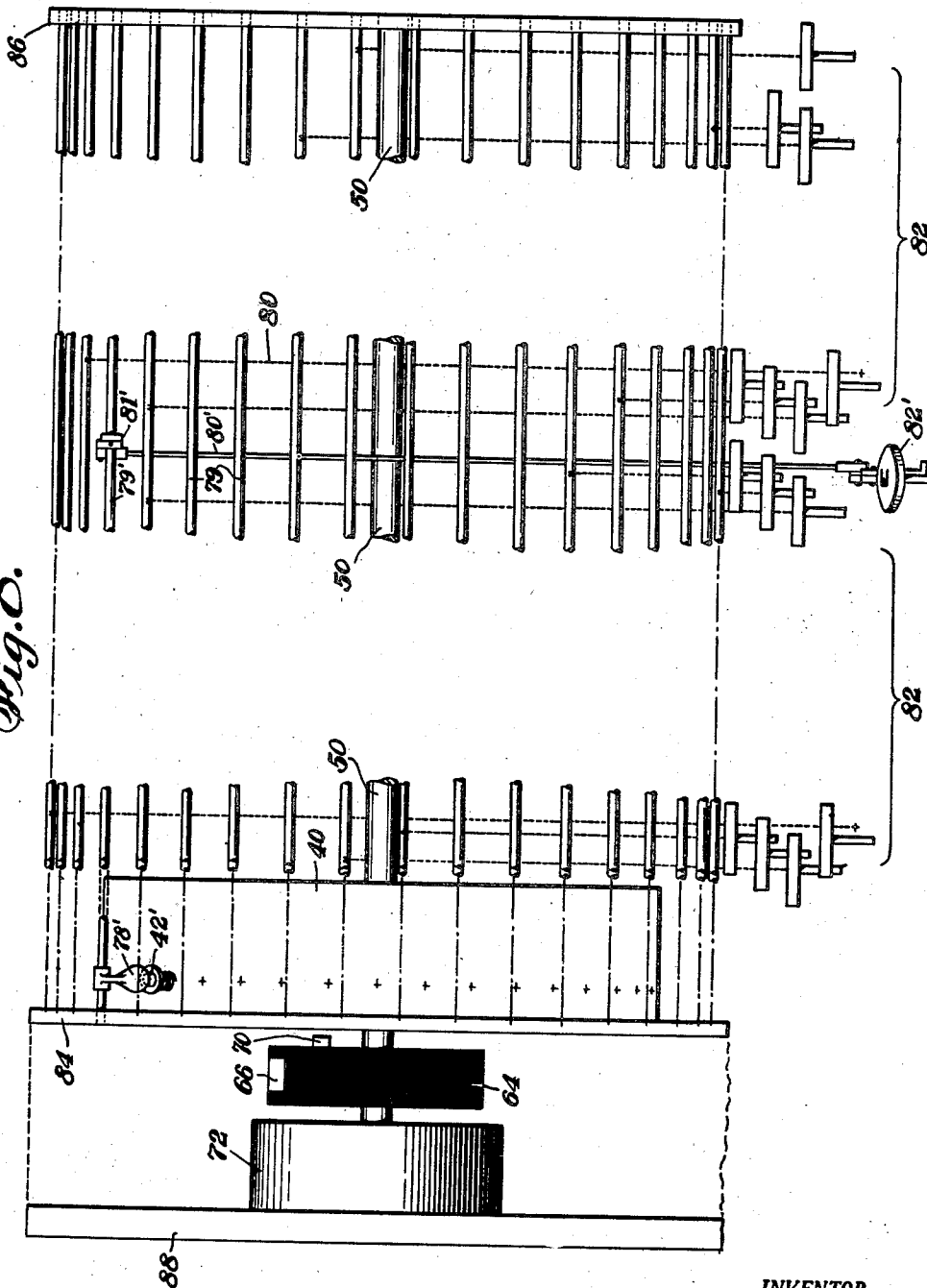
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Original Filed Nov. 1, 1943

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Fig. 8.



INVENTOR.
NORMAN H. YOUNG, JR.

BY

Lucy P. Lantry
ATTORNEY

UNITED STATES PATENT OFFICE

2,471,473

TRANSMISSION SYSTEM

Norman H. Young, Jr., Jackson Heights, N. Y.,
 assignor to Federal Telephone and Radio Cor-
 poration, New York, N. Y., a corporation of
 Delaware

Original application November 1, 1943, Serial No.
 508,617, now Patent No. 2,407,336, dated Sep-
 tember 10, 1946. Divided and this application
 March 19, 1945, Serial No. 583,538

8 Claims. (Cl. 177-380)

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This invention relates to methods and means for transmitting intelligence, and more particularly to a secret radio transmission system of the type in which pulse signals are converted into intelligence signifying indications.

This is a division of my copending application for "Methods and means for transmitting intelligence," Serial No. 508,617, filed November 1, 1943; now U. S. Patent Number 2,407,336, dated September 10, 1946.

An object of this invention is to provide a novel method and means for secret radio or other transmission of signal pulses, which provide a favorable signal-to-noise ratio and good resistance to interference, such as jamming.

A further object of this invention is to provide means for transmitting predeterminedly timed synchronizing pulses and variably timed intelligence-signifying pulses.

An additional object of this invention is the provision of an improved pulse-generating device for providing one set of continuously spaced synchronizing pulses and another selective set of intelligence signifying pulses variable in spacing from said synchronizing pulses.

Generally speaking, this invention may be defined as comprising the construction and combinations recited in the annexed claims and illustrated in certain embodiments in the drawings accompanying and forming a part of this application wherein:

Fig. 1 is a block circuit diagram of a preferred form of communication system in accordance with the present invention;

Fig. 2 is an enlarged plan view of a detail of one of the elements of the communication system illustrated in Fig. 1;

Fig. 3 is a chart illustrating the time spacing between certain intelligence-signifying pulses and the synchronizing pulses in accordance with the present invention, together with their relationship to an amplifier blocking pulse;

Fig. 4 is a front plan view of a cathode ray screen illustrating the manner in which signals are reproduced according to a preferred form of this invention;

Fig. 5 is a block circuit diagram of a modified form of a receiving system;

Fig. 5A is a partial enlarged plan view of a modified form of pulse-generating apparatus to be used in connection with the receiving system illustrated in Fig. 5;

Fig. 6 is a transverse view partially in section, of

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a partial circuit diagram of a part of the pulse generating apparatus illustrated in Fig. 6;

Fig. 8 is a partial front elevation of the pulse-generating apparatus illustrated in Fig. 6.

In the preferred and simplest form of the invention illustrated in Fig. 1, I propose to use pulse-generating apparatus of generally known form, consisting of a keyboard 10 provided with suitable indicia designating various characters to be selectively produced, which controls the passage of light through a rotatable drum 12 to a light-responsive cell or cells 14. Similar apparatus is already known in the art, for example, in the British patent to Creed and Company, 469,809, and also disclosed in the copending application of Edmond M. Deloraine, S. N. 415,554, filed October 18, 1941; now U. S. Patent Number 2,365,458, dated December 19, 1944. As is more fully explained in the aforesaid patent and copending application, the different keys of the keyboard 10 control the passage of light through various openings on the rotatable drum 12 to initiate action of the light-sensitive device which, in turn, through suitable apparatus is converted into usable pulses. In accordance with the present invention the drum 12, shown in more detail in Fig. 2, may be provided with one or more openings *s* used to generate a series of regularly timed pulses used for synchronizing purposes. Each opening *s* is followed by laterally displaced additional openings indicated at A, B, C, D, E, F, G, by way of example, each one of these openings being spaced about the drum 12 a different distance from the synchronizing opening *s*. In accordance with the present invention no control of light through the opening *s* is necessary since this will produce synchronizing pulses which are desired at all times that the apparatus is operated. However, suitable means are provided, such as key-controlled shutters, for controlling the passage of light through the remaining openings, at will. It will be seen that if light is permitted to pass through opening A, a pulse will be generated, and timed after the synchronizing pulse formed by the opening *s* with a predetermined spacing. If the opening B is exposed, another pulse at a different time from the synchronizing pulse will be generated, etc. It will therefore be apparent that according to the present invention various characters are designated by individual pulses which differ in timed relationship with the synchronizing pulse.

The synchronizing pulse and the character

amplified as by amplifier 18 and transmitted by transmitter 20.

The receiver 22 will demodulate the signals and at its output will produce both the synchronizing pulses and the timed intelligence-signifying pulses. The receiver output may be amplified as through amplifier 24 and thence connected across the vertical plates of a cathode ray tube 26. The receiver output is passed through another amplifier 28 controlling a sweep generator 30 connected across the horizontal plates of the cathode ray tube. However, in order to properly reproduce a signal or a character in accordance with that transmitted, the sweep generator 30 should be keyed by the synchronizing pulses only. For this purpose the output of the amplifier 28 is also directed to a suitable apparatus such as a biased multivibrator 32 whose output may then be passed through a pulse shaping circuit 34 to block the amplifier 28. The timing of the biased multivibrator 32 is so arranged as to block the amplifier 28 upon the reception of a synchronizing pulse, and for a period substantially equal to the period between successive synchronizing pulses such intelligence-signifying pulses as may be impressed upon the amplifier 28 will not be effective to key the sweep generator, since the latter pulses all occur during this blocking period.

This operation may be more clearly understood from the diagram shown in Fig. 3. In the first place, the synchronizing pulses caused by the opening *s* in the pulse-generating device are shown at *s'* while, if it is assumed that the letter "E" is being transmitted, pulses properly spaced from the synchronizing pulses may appear at *E'*. Other pulses shown merely by way of example in order to indicate the general difference in timed relationship, are shown at *G'* and *R'*. All intelligence signifying pulses will occur between successive synchronizing pulses *s'*. When a received synchronizing pulse *s'* passes through the amplifier 28, it not only initiates the action of the sweep generator 30 but also that of the biased multivibrator 32. The latter can be so designed as to produce a single pulse *bb* of predetermined length indicated at Fig. 3. As shown in Fig. 3 this pulse can be made to extend from the first of the synchronizing pulses *s'* substantially up to the next synchronizing pulse, blocking the amplifier 28 for that entire period, and as a result none of the intelligence-signifying pulses will falsely key the sweep generator.

As shown in Fig. 4, the cathode ray tube 26 may be provided on its screen with a suitable scale 36 bearing in spaced relation the characters corresponding to the characters transmitted. When the sweep generator, as initiated by the synchronizing pulse, begins its action to move the cathode ray beam across the screen at a predetermined time, the vertical plates of the cathode ray tube will be energized by an intelligence signifying pulse whose position is so calibrated with the scale 36 as to point to the character originally transmitted and corresponding to this time spacing. In Fig. 4, by way of example, I have shown the pulse signal *E''* appearing under the letter "E" on the scale 36, and thus the operator can pick out this letter and similar letters so indicated in accordance with the spacing and timing of the intelligence-signifying pulses. The synchronizing pulse is also applied to the vertical deflecting plates of the cathode ray tube but its position will be removed from the scale 36, being shown for example, at *s''* in Fig. 4.

In the form of invention described above, it has been assumed that the individual synchronizing pulses have the same parameters as the various intelligence-signifying pulses. It is known, however, that pulses may be distinguished by their parameters and if, for example, the synchronizing pulses are given a different parameter from the intelligence-signifying pulses, separation of such synchronizing pulses at the receiver may be more simply effected than in the system just described. In this case, the receiving system, shown by way of example in Fig. 5, would consist of the receiver 22, amplifier 24 and cathode ray tube 26 in the manner described above, but the output from the receiver 22 would also be passed through a pulse selector 38 prior to the amplifier 28 controlling the sweep generator 30. If, for example, the synchronizing pulses were of greater amplitude than the intelligence-signifying pulses, as might be effected as seen in Fig. 5A, by a drum 12' having a synchronizing opening *s₁* of greater amplitude than openings *A₁* and *B₁*, the resulting synchronizing pulses, as will be clear to those skilled in this art, would be of greater amplitude and could be clipped for the purposes of pulse selection. Of course, distinction could be made by reason of pulse width or shape, selecting circuits for which are known to the art. The modification of my system just described may provide simpler receiving apparatus but, on the other hand, slightly complicates the transmitting system.

In Figs. 6, 7 and 8, I have illustrated a novel type of device for the purpose of generating both synchronizing and intelligence-signifying pulses, and which may take the place of the light-sensitive type of pulse-generating device known to the art and used by way of example in the systems shown in Figs. 1 and 5. This device may consist of a small drum or cylinder 40 provided with a plurality of peripherally spaced radial openings in which are slidably mounted stop arms 42 which, therefore, will be angularly displaced about this drum. An arm 44 having an extension 46 is connected through a friction drive 48 to a rotating shaft 50 and will be normally free to rotate within the drum unless one of the various stop arms 42 is depressed, in which case the arm 44 will be held in fixed angular position, as shown in Fig. 6. On the shaft 50 there also appears a rotating switch 52 having a conductive portion 54. An arm 56 holds a brush 60 in contact with the surface of the rotating device 52, and will therefore intermittently contact the conductive portion 54 thereof. A second brush 58 may be in continuous contact with the conductive portion 54. The brush 60 and arm 56 are pivotally mounted as by shaft 62 on the arm 44. It will thus be seen that when none of the stops 42 are depressed, the arm 44 rotates with the rotating switch 52 and there will be no relative movement between the brush 60 and conductive portion 54. However, when the arm 44 is held stationary in various angular positions, the clutch 48 permits relative movement between the arm and the rotating switch 52 and intermittent contact between the brush 60 and the conductive portion 54. Rotating on the shaft 50 is a second rotary switch 64 having a conductive portion 66 making intermittent contact with a fixed brush 68. A second brush 70 is in contact with conductive portion 66. A motor 72 may be used to drive the shaft 50. If a source of power such as a battery 74 is connected to the brush 68 it will be seen that from the brush 70 will appear, at a frequency de-

terminated by the speed of the motor 72, a series of positive pulses have a predetermined time spacing. If the source of power 74 is also connected through a brush 75 to the rotating contact arm 44, no pulses will appear at the brush 58 when the contact arm is free to rotate with the rotary switch 52, but when the contact arm 44 is held in a fixed angular position upon the depression of one of the stops 42, the contacting of the brush 60 with the conductive portion 54 due to the relative rotation at this time will produce a series of pulses bearing a definite time relation to the pulses produced by the device 64, such time relation depending upon the angular position at which the contact arm 44 is stopped. In accordance with the present invention and as previously described, the different intelligence-signifying pulses are characterized by different spacing from these synchronizing pulses and accordingly, if the stops 42 are selectively depressed in accordance with the signal or character desired, the aforescribed device will produce this selected time variation in the manner desired. Since the pulses produced by this device will be of a relatively long duration and will be relatively coarse, the output therefrom may be shaped through a suitable pulse-shaping device 76 before used to modulate the carrier for transmitting purposes.

In Figs. 6 and 8, I have shown, by way of example, means by which the various stops 42 may be selectively controlled, as by a keyboard. The stop arms 42 are preferably biased to an outward position by any suitable means such as springs, while cam members 78 are utilized to press the various stops inwardly against the action of such retracting springs. The cams 76 are mounted on individual rocker shafts 79 which, in turn, may be rotated by longitudinally extending rods 80, acting through individual rocker arms 81. The longitudinally extending rods 80 are moved upwardly upon a depression of keys 82 of the keyboard which, as is common in the art, will bear suitable identifying indicia. Upward movement of the rods 80 rotates the individual shafts 79 in a direction to press the selected cams 78 against the individual stop members 42. The assembly may be mounted in a suitable frame, the rocker shafts 79 being pivotally supported at either end by rings 84 and 86 supported within a suitable mounting frame 88. As will be seen in Fig. 8, in which some of the connections between keys and rocker shafts have been illustrated by way of illustration, while others have been omitted to prevent complicating and confusing the drawing, the vertical rods 80 with the individual rocker arms will be longitudinally spaced from one another comparatively to the positions on the controlling keys of the keyboard. In these figures I have indicated further, by way of example, the depression of the key 82' corresponding to the letter "E," resulting in an upward movement of the rod 80' and a clock-wise rotation of the rocker arm 81' and shaft 79', with a resulting downward movement of the cam 78' against the now depressed stop member 42'.

While in Figs. 7 and 8 I have illustrated for the purpose of showing an operable example, various links, cams, rods and levers for suitably operating the stop arms 42 from a keyboard, it is contemplated that other equivalent means for this purpose may be used.

fulfill the objects primarily stated. While the timing of the synchronizing pulses and the following intelligence signifying pulses can be varied in accordance with the desired apparatus and within limits which will be clear to those skilled in this art. For example, in order to more clearly distinguish at the receiver between synchronizing and intelligence-signifying pulses, the two sets of pulses could be transmitted at different frequencies as disclosed, for example in my copending application S. N. 457,407, filed September 5, 1942, or the two may be distinguished by utilizing one as an amplitude modulator and another as a frequency modulator, with comparable discriminating apparatus at the receiver. Both of these methods would avoid all possibility of error due to keying of the synchronizing apparatus by the intelligence-signifying pulses, which might occur for a brief period, although this condition would soon automatically correct itself due to the regularity of the synchronizing pulses and the irregularity between different sets of intelligence signifying pulses. Obviously the system is applicable to direct or carrier wire transmission as well as radio transmission. Accordingly, while I have described above the principles of my invention in connection with certain specific apparatus and particular modifications thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of my invention as set forth in the objects and the accompanying claims.

I claim:

1. An intelligence transmission system comprising means generating a series of synchronizing pulses of a predetermined frequency, means generating a series of sets of intelligence-signifying pulses of the same frequency as said synchronizing pulses, the pulses for each intelligence-signifying character occurring between successive synchronizing pulses, and the pulses of each set being distinguished from the pulses of another set by a different time spacing from the synchronizing pulses, and controllable means for varying said time spacing at will.
2. A transmission system according to claim 1, in which both pulse-generating means are arranged to produce individual pulses having substantially identical parameters.
3. A transmission system according to claim 1, in which the second-named pulse-generating means includes a rotary switch device having a rotating contacting surface provided with a predetermined conductive portion, a contactor urged against said surface, frictional means normally rotating said contactor with said rotary switch device, and controllable means holding said contactor in various fixed angular positions depending on the intelligence to be transmitted, whereby the time relationship between said contactor and said rotary switch device may be varied according to the intelligence character to be transmitted.
4. A transmission system according to claim 1, in which the second-named pulse-generating means includes a rotary switch device having a rotating conductive portion, a contactor biased to a position in contact relationship with said conductive portion during rotation thereof, frictional means normally rotating said contactor with said rotary switch device, a plurality of

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and selective means for moving said stop arms inwardly in the path of said contactor to hold it in selective angular positions, whereby the time relationship between said contactor and said rotary switch device may be varied according to the intelligence character to be transmitted.

5. A transmission system according to claim 1, in which the first-named pulse-generating means includes a rotary switch device having a rotating contacting surface provided with a predetermined conductive portion, and a fixed contactor engageable with said surface and contacting said conductive portion at predetermined intervals as the switch device rotates, and in which the second-named pulse-generating means includes a second rotary switch device having a rotating contacting surface provided with a predetermined conductive portion, a contactor urged against said surface, frictional means normally rotating said contactor with said second rotary switch device, and controllable means holding said contactor in various fixed angular positions depending on the intelligence to be transmitted, whereby the time relationship between the contacting of the second contactor with the second rotary switch device, may be varied relatively to the contacting of the first fixed contactor with the first rotary switch device according to the intelligence character to be transmitted, and means rotating said rotary switch devices.

6. A transmission system according to claim 1, in which the first-named pulse-generating means includes a rotary switch device having a rotating contacting surface provided with a predetermined conductive portion, and a fixed contactor engageable with said surface and contacting said conductive portion at predetermined intervals as the switch device rotates, and in which the second-named pulse-generating means includes a second rotary switch device having a rotating contacting surface provided with a predetermined conductive portion, a contactor urged against said surface, frictional means normally rotating said contactor with said second rotary switch device, a ring surrounding the contactor of said second rotary switch device, a plurality of radially directed stop arms slidably mounted about the periphery of said ring, means normally urging said stop arms outwardly, and selective means for moving said stop arms inwardly in the path of

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the second contactor to hold it in the selective fixed angular position, whereby the time relationship between the contacting of the second contactor with the second rotary switch device may be varied relatively to the contacting of the first fixed contactor with the first rotary switch device, according to the intelligence character to be transmitted, and means rotating said rotary switch devices.

7. A method of intelligence-transmission comprising generating a series of pulses of predetermined frequency, generating a second series of sets of pulses of the same frequency, each pulse of said second series occurring between successive pulses of the first series and differing from the pulses of the other sets by a different time displacement from the pulses of the first series, whereby each pulse of each set of said second series may represent a character to be transmitted, and the further step of varying said time displacement at will.

8. A transmission system comprising means for generating a series of synchronizing pulses, a series of devices each corresponding with a distinct intelligence-signifying character, means responsive to selective operation of one of said devices for generating a set of intelligence-significant pulses, means responsive to a succeeding selective operation of said devices for generating a further set of intelligence-significant pulses, the intelligence-signifying character of each set of pulses being dependent upon the timing of each pulse of said each set of pulses with respect to said synchronizing pulses, and controllable means for varying said timing at will.

NORMAN H. YOUNG, JR.

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