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APPARATUS FOR CODING AND DECODING TELEPRINTER MESSAGES

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FIG. 1

I	II	S	X	Und
+	+	+	+	+
+	+	-	-	+
+	-	+	-	+
+	-	-	+	-
-	+	+	-	+
-	+	-	+	-
-	-	+	+	-
-	-	-	-	-

FIG. 2

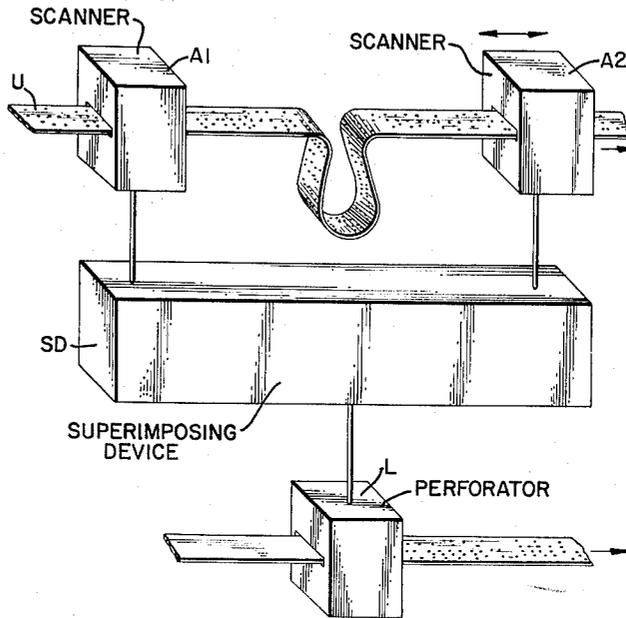
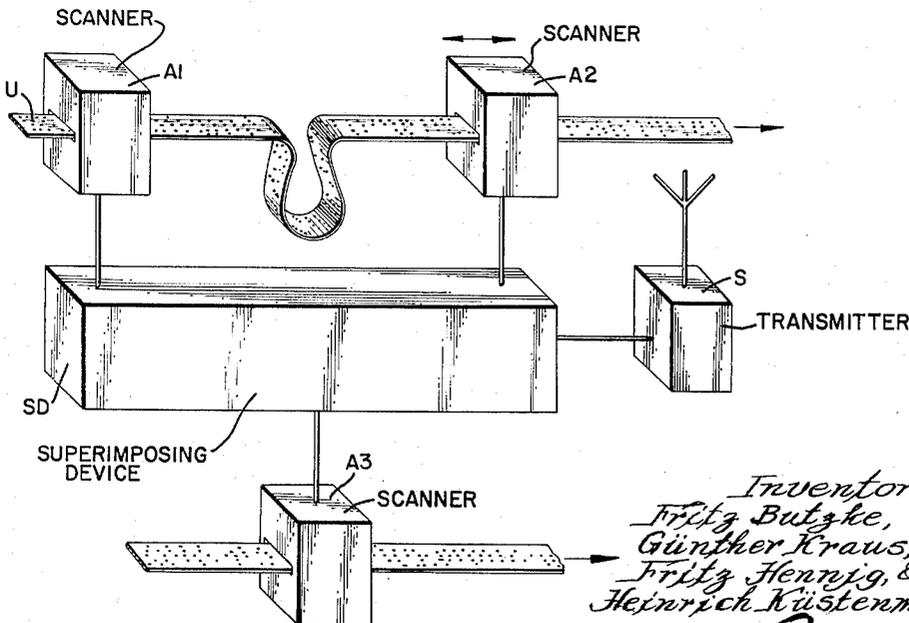


FIG. 3



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APPARATUS FOR CODING AND DECODING TELEPRINTER MESSAGES

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4 Claims. (Cl. 178—26)

This invention is concerned with apparatus for coding and decoding teleprinter messages.

It has become known to use for the coding of teleprinter texts coding signals taken from so-called "coding tapes." The term "coding tapes" is intended to mean punched teleprinter tape containing a purely incidental sequence of five element combinations without periodical recurrence. The sequence of the individual signals in such a tape therefore is entirely non-uniform. The coding of a teleprinter text is considered as secure when a single coding tape is used only once.

These punched coding tapes have heretofore been produced at central places, in pairs, because at each of two intercommunicating stations there must be, in operation, exactly corresponding copies of the punched coding tape. Upon transmission or reception, one of the two tapes is in each of the stations stopped by a punched combination, after each transmitted or received signal, so that new code signal, and at each station the same signal, is always available for the coding and decoding, respectively.

To take care of intensive traffic along certain teleprinter channels, it is necessary to keep a great many rolls of such punched tape in readiness for use. This results in considerable difficulties in transportation, because great distances may be involved, requiring particular security provisions against unauthorized copying of the rolls which are in this respect particularly vulnerable during transit.

The invention is concerned with the coding and decoding of teleprinter texts involving the coding of message signals with a sequence of coding signals which is identical in the transmitter and the receiver, by obtaining a new signal from the coding signal and the message signal. In contradistinction to known coding methods, the coding signal serving for the coding, is not taken from a centrally produced punched coding tape, but, according to the invention, each individual coding signal serving for the coding of a message signal, is obtained from a combination of at least two mutually different coding signal series which are identically present at the transmitter and the receiver.

Therefore, according to the invention, punched prototype or basic tapes are produced at central points, wound on rolls and respectively distributed to communicating teleprinter transmitting and receiving offices. The coding signals proper, which are to be used for the coding of messages, are directly derived from these punched basic tapes. Care must of course be taken to produce at the communicating offices always the same coding signal and to produce identical new coding tapes, and that the produced coding signals meet the purely statistical distribu-

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tion in accordance with the so-called "individual" signals.

The invention may be realized in various ways. In the simplest case, basic punched tapes will merely be supplied to a teleprinter subscriber and to the communicating station, respectively. From these basic tapes are then obtained the coding signals proper. It will be of advantage to produce first a punched coding tape again because, in such case, production during transmission, of the coding signal for the transmission and the supervising operations required therefor, may be omitted.

The invention offers in addition to security against decoding of message texts further advantages. It is thus, within the scope of the invention possible to use a basic punched tape repeatedly for a combined coding, that is, for the production of a coding signal by means of at least one second basic tape, whereby attention must of course be paid to assure that a certain sequence of coding signals can occur only once. It is within the scope of the invention entirely feasible to scan a basic tape together with a second basic tape repeatedly, effecting of course mutual displacement between the tapes. In the simplest case, with two basic tapes, the security diminishes relatively fast, but may be prolonged considerably by using a greater number of basic tapes. Spying agents could only then begin to work successfully but would have to have read the enormous amount of messages transmitted up to that point, which would be in practice very difficult.

A further advantage of the invention resides in the fact that a great number of coding combinations may be obtained with a relatively small number of basic tapes. Coded communication may therefore be maintained for a considerable time after interruption of transport facilities between communicating stations.

The operational course upon using the invention is as follows:

The various features and objects of the invention will appear in the course of the description which will be rendered below with reference to the accompanying drawings, wherein

FIG. 1 is a table to aid in explaining the coding procedure; and

FIGS. 2 and 3 show embodiments for carrying out the coding.

Referring now to FIG. 1, the first column shows the contacts taken from the basic tape I and the second column the contacts obtained from the basic tape II. The third column indicates the signal elements of the message to be transmitted. In each column, "+" indicates that a hole had been scanned in the corresponding punched tape, and "-" means that no hole had been present at the corresponding instant of scanning. The column marked "x" shows the results obtained in the case of a prefix multiplication and the column "Und" shows the results obtained with an evaluation method. As will be apparent from this last column, the signal elements employed for transmission are elements which are preponderant in the three combinations I, II and S.

In accordance with the invention, the coding signal sequences from which the coding signals for the coding and decoding are derived, are obtained by different scanning of one and the same basic tape. It is particularly simple and advantageous to scan simultaneously, step by step, a

punched coding tape in defined spacing, and to use the signals obtained by such scanning for the coding and decoding, respectively. Mathematical considerations show that all above explained advantages are in such case likewise obtained. It is for the end effect immaterial whether the coding signals reserved for the coding and decoding of a teleprinter signal are first combined to form a new coding signal or directly superposed with the teleprinter signal in the course of a common operation.

In accordance with the invention, the coding signal sequences can be obtained from a single basic tape in diverse manner. It is, for example, possible to scan always two or more directly adjacent coding signals in the basic tape, to superpose them for the coding and decoding, respectively, and advance the punched coding tape for the next scanning, preferably by a plurality of advance steps. A coding signal sequence may also be formed directly, for example, by stepwise scanning of the basic tape, and another sequence by scanning non-neighboring signals in uniform or if desired non-uniform spacing. There are in each case obtained two or more coding signal sequences exhibiting statistically at least the same quality as the statistic of the basic tape, the statistic of the newly obtained sequence being actually improved by the superposing of these coding signal sequences. Moreover, if the scanning scheme is unknown, decoding by an unauthorized person will be made impossible even if he is acquainted with the basic tape.

If, in accordance with another feature of the invention, the operatively effective spacing of the scanning devices for scanning the basic tape at two or more points, are varied, there will be obtained coding signal sequences with very long period. The variation of the operatively effective spacing of the scanning devices may be obtained either by relative shifting thereof or by varying the length of the punched tape loop extending between two scanning devices. If this variation of the spacing is effected in time increments which are smaller or at maximum equal to the running time of a loop formed by the punched coding tape, a period duration of the coding signal sequences will be obtained which is with certainty greater than the pauses occurring in the advance of punched coding tape in teleprinter operation. This period is at any rate very much longer than the length of the punched tape as such.

The devices for practicing the invention may be constructed in different ways. The only requirement is, that there are at least two scanning devices which are connected with the coding apparatus so that the coding signal can always be properly and accurately obtained. If the basic tape is to be scanned in uniform spacing, at least for a plurality of scanings, a simple tandem scanning device may be used which is already known for other purposes. If the scanning sequence for the different scanning operations is to be non-uniform, two scanning devices of desired and suitable kind must be used and between these must be provided, if required, a tape storage with variable capacity, for example, a reel device for winding up the punched tape from one side and taking it off independently from the other side. Such devices are in diverse embodiments sufficiently known.

FIG. 2 shows an as example a device for encoding messages. The device comprises two scanners A1 and A2 for scanning the signals of the encoding tape U, a scanner A3 for scanning the message signals, a superimposing device SD and a transmitter S. The encoding tape U is scanned at two different places by the scanners A1 and A2. The spacing between the two scanners can be changed as desired, such variable spacing being indicated by the double headed arrow in connection with the scanner A2. The code combinations derived by means of the two scanners from the coding tape U are in the superimposing device SD mutually intermixed and mixed with the respective code combinations of the message signal scanned with the aid of the scanner A3. The message signal which is thus encoded in the superimposing device SD is thereupon transmitted with the aid of the transmitter S.

FIG. 3 shows an arrangement which is in respect to the scanners A1 and A2 similar to the one illustrated in FIG. 2. The code combinations derived with the aid of the scanners A1 and A2 from the encoding tape U are however only mutually intermixed in the superimposing device SD but are not mixed with the code combinations of the message which is to be encoded. The new code combinations produced by this mixing are instead used for producing a new coding tape with the aid of the perforator L.

As already mentioned, the alteration of the scanning spacing may be non-uniform. This non-uniformity may be effected, in accordance with a further feature of the invention, by non-uniformly advancing, for example, suppressing the advance of at least one of the scanning devices, always when a certain element or step combination occurs in one of the scanning devices or in the superposed product.

The explanations of the invention proceeded largely from the thought that the supply of punched coding tapes should be greatly reduced, and that satisfactory transmission of coded teleprinter texts should be maintained even at times when delivery of punched coding tapes should fail.

The invention has, however, a further decisive advantage. The generators for producing arbitrary sequences do not as a rule operate faultlessly without considerable expenditures, that is, the sequences exhibit a more or less pronounced systemic error. This error becomes very much smaller upon producing the coding signals by superimposing at least two arbitrary sequences, even in the presence of similar error value of these sequences. For example, if the systemic error in an arbitrary sequence amounts to 1%, the error, upon superimposing two arbitrary sequences having such error, for example, in accordance with prefix multiplication or an addition modulus 2, would amount only to 0.01%. This advantage is of considerable importance; it makes it possible to employ for the preparation of basic punched tape, generators that do not operate with highest precision.

As described, this advantage may also be utilized in the preparation of punched coding tape at a central place, for delivery to communicating subscribers (transmitter and received). In the preparation, at a central place, the individual coding signals are accordingly obtained, as described, by superimposing at least two mutually different coding signal sequences.

Both operations may, of course, be combined, that is, the basic tapes may be prepared by superimposing coding signals delivered by at least one generator and, as explained before, at the transmitter and receiver, the coding signals may be obtained by repeated scanning of the corresponding basic punched tape and superimposing the scanned signals.

Changes may be made within the scope and spirit of the appended claims.

We claim:

1. Apparatus for coding and decoding messages consisting of code combinations, comprising at least two scanning means for simultaneously scanning one and the same coding tape along different areas thereof, means for mixing the scanned code combinations to produce new code combinations, and means for mixing said new code combinations with code combinations of the message to be respectively coded or decoded.

2. Apparatus for coding and decoding messages consisting of code combinations, comprising at least two scanning means for simultaneously scanning one and the same coding tape along different areas thereof, means for mixing the scanned code combinations to produce new code combinations, and means for producing a new coding tape containing said new code combinations.

3. Apparatus for coding and decoding messages consisting of code combinations, comprising at least two gen-

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erators for producing code signal sequences, means for mixing the code combinations derived from said code signal sequences, and means for producing a coding tape containing new code combinations formed by the mixing of said code combinations for cooperation with combinations of a message to be coded or decoded.

4. Apparatus for coding and decoding messages consisting of code combinations, comprising a generator for producing a code signal sequence, means for obtaining at least two sequences of code combinations by repeated scanning of said code signal sequence with selectable phase shift, means for mixing the obtained code combinations, and means for producing a coding tape containing new code combinations formed by the mixing of said code combinations.

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