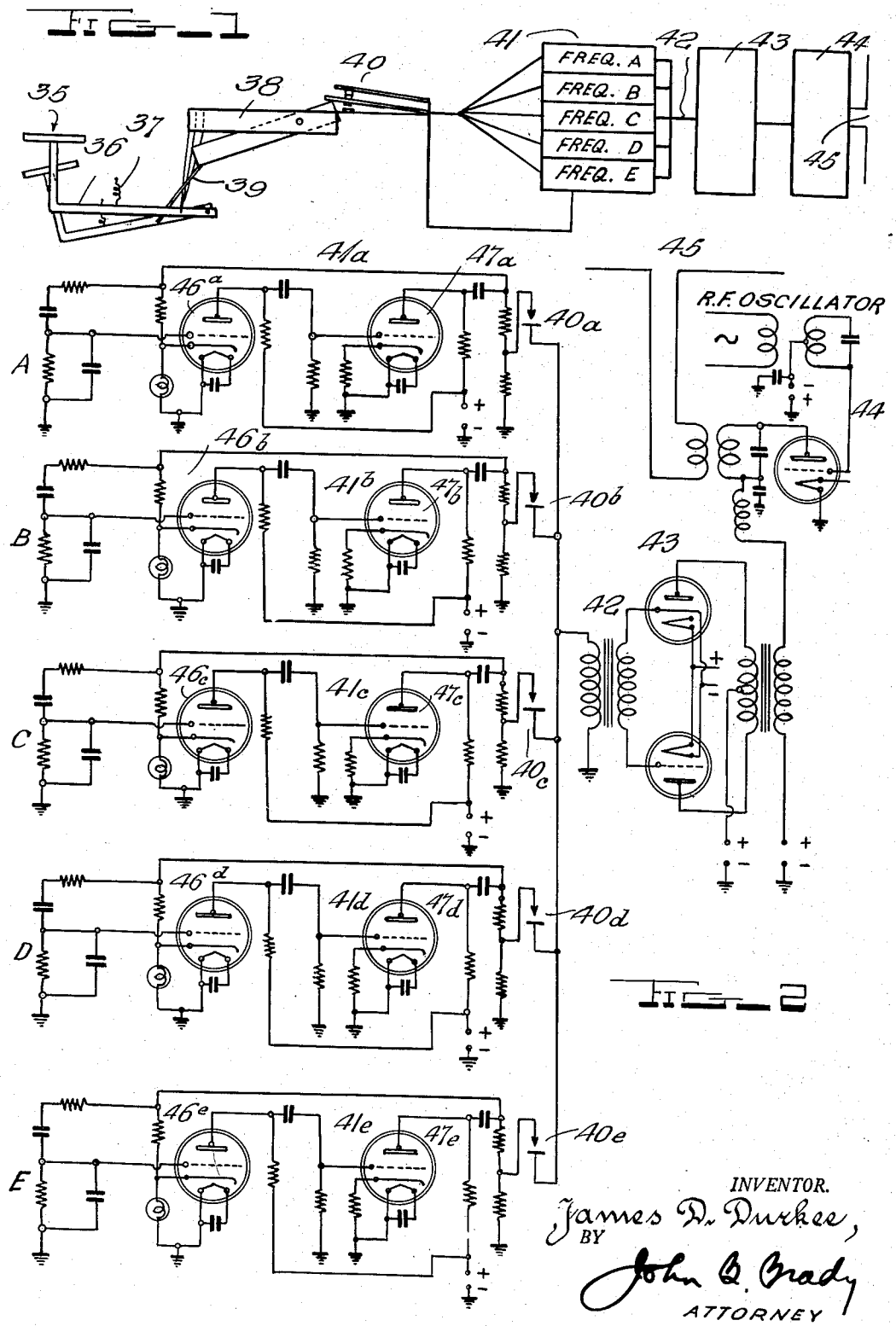
Nov. 10, 1953 J. D. DURKEE 2,658,942

PRINTING TELEGRAPH SYSTEM

Filed Aug. 11, 1949 3 Sheets-Sheet 1



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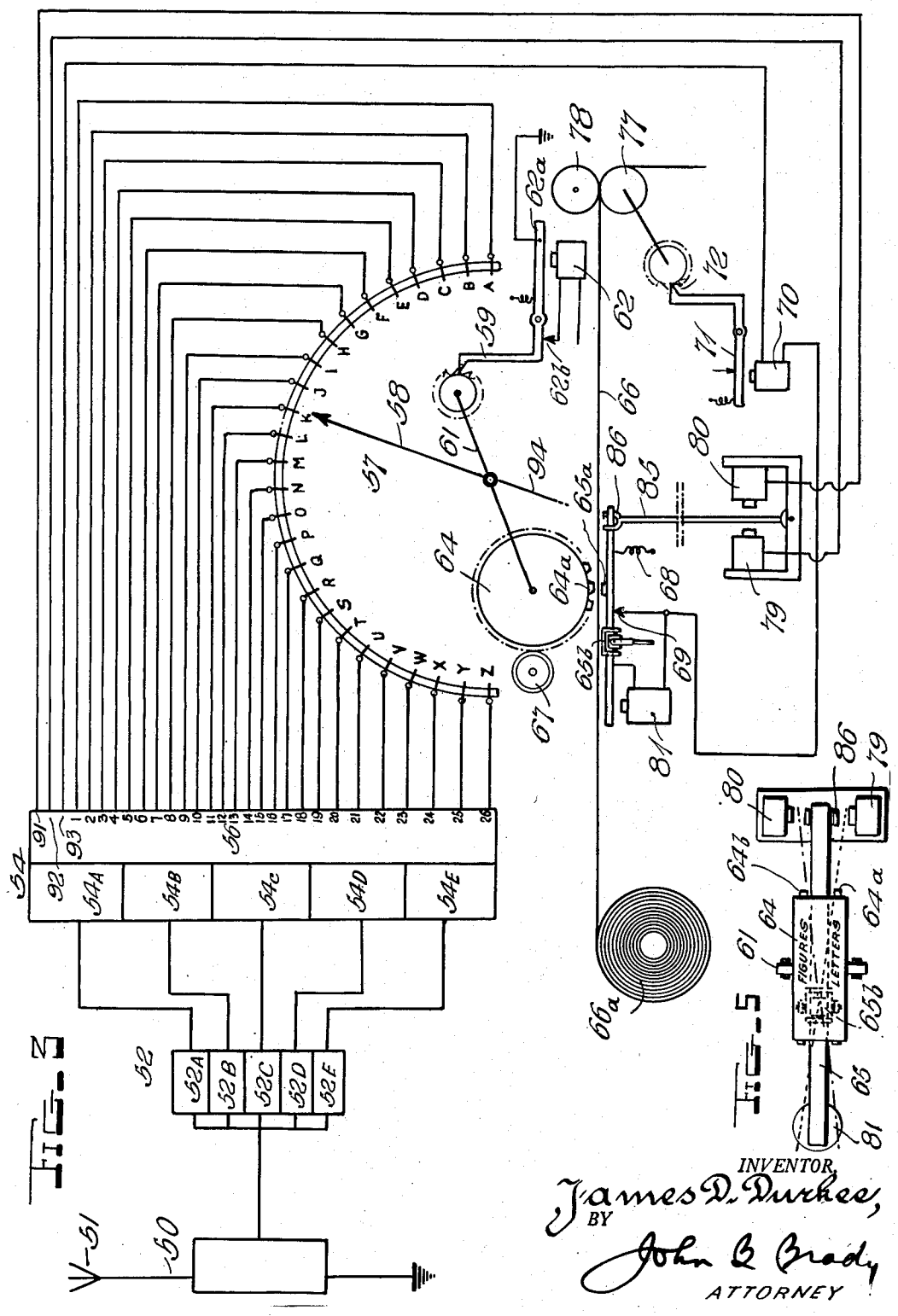


FIG. 2

FIG. 5

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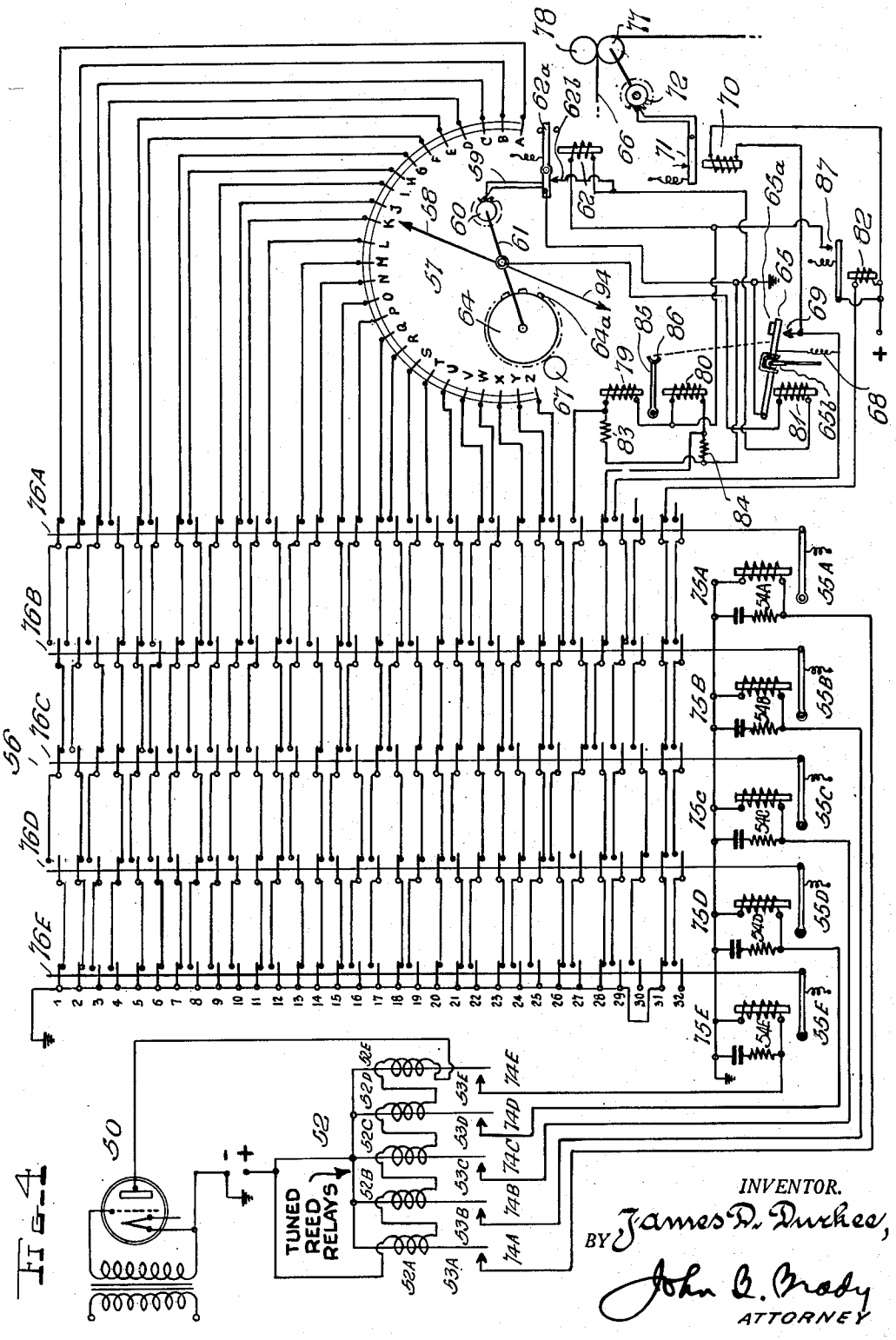


Fig. 4

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PRINTING TELEGRAPH SYSTEM

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Application August 11, 1949, Serial No. 109,648

12 Claims. (Cl. 178—23)

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My invention relates broadly to communication systems and more particularly to an improved system of printing telegraphy.

One of the objects of my invention is to provide an improved printing telegraph system particularly adapted for radio communication in which conditions of fading, interference, and static offer minimum detrimental effects upon the printing telegraph apparatus.

Another object of my invention is to provide a system of printing telegraphy operative at relatively high speed and with accuracy in the transmission of printed communications.

Another object of my invention is to provide a construction of improved printing telegraph system which involves a minimum of mechanical equipment, eliminating necessity for precise synchronism between transmitting and receiving stations.

A still further object of my invention is to provide a construction of printing telegraph transmitter and receiver embodying selective electrical circuits with a minimum of mechanical equipment for effecting high speed printing telegraph operations.

Still another object of my invention is to provide a printing telegraph system in which permutations and combinations of simultaneously applied coded signal impulses are established and impressed upon a vibrating reed converter including reeds resonant to the individual frequencies of the coded signal impulses with means for deriving from the converter system direct current pulses for controlling the selective operation of the printing telegraph apparatus.

Still another object of my invention is to provide a printing telegraph system including a prearranged matrix of electrical circuits individual to the characters to be printed and selectively operative under control of simultaneously applied coded signal impulses for controlling the printing telegraph mechanism.

Still another object of my invention is to provide a compact construction and arrangement of stepping relay, a printing telegraph mechanism controlled thereby, a matrix of electrical circuits for controlling the stepping relay, and a conversion system for operating the said matrix relative to simultaneously applied coded signal impulses for controlling the printing telegraph mechanism.

Still another object of my invention is to provide improved lightweight printing telegraph transmitting and receiving apparatus which may be used interchangeably in circuits now employing standard printing telegraph apparatus utilizing the international teletype code.

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Other and further objects of my invention reside in a construction and arrangement of step-by-step relay system for printing telegraph circuits as set forth more fully in the specification hereinafter following by reference to the accompanying drawings, in which:

Figure 1 schematically shows the transmission system of my invention; Fig. 2 is a diagrammatic view of the transmission system illustrated in Fig. 1; Fig. 3 diagrammatically shows the receiving system of my invention; Fig. 4 is a diagrammatic illustration of the conversion system, the electrical matrix, the step-by-step relay, and the control mechanism, associated therewith for operating the printing telegraph equipment; and Fig. 5 is a schematic view illustrating the manner of shifting the printing telegraph apparatus from "Figures" to "Letters" position in the course of operation of the printing telegraph apparatus.

The application of automatic and mechanical signalling systems to radio communication has been, in the past, limited to circuits, on which there is relatively little or no interference, fading or static. These systems have also been limited in speed of operation and dependability. Since circuits possessing these characteristics are seldom encountered, particularly in the aviation, maritime and land mobile services, the use of manual radio operators for radio telephone and telegraph communications has been necessary in the past.

The requirement for increased speed of operations, particularly in the aviation services, has created communication demands, which can no longer be met by manual operations. Also, the large growth of communications activities in general has placed a load on the presently available frequencies which exceeds the capabilities of these frequencies where manual methods of operation must be depended upon.

My invention is directed to a signalling system which, due to its ability to operate rapidly and accurately, even in the presence of fading and interference, will satisfy the demands for a high speed automatic communication system for all types of radio and wire communications.

Basically, my method of transferring intelligence from the transmitting point to the receiving point is by permutations or combinations of one or more audio frequencies, in accordance with a pre-arranged code, and simultaneously applying these permutations or combinations to a wire circuit or as modulation to a radio frequency

transmitter. The radio frequency wave containing the coded audio frequency permutation or combination is received by a radio frequency receiver which demodulates it into its audio frequency components and delivers them to the field coils of a series of tuned reeds or resonant relays as audio frequency impulses. These resonant relays, which are individually resonant with one of the audio frequencies contained in the permutation or combination, begin vibrating at the frequency to which they are resonant. When the vibrations of the individual resonant relays reach full amplitude, an impulse of direct current is applied to a relay or gas triode which stores the impulse, electromagnetically, until a mechanism for translating the code permutation or combination into printed characters is actuated.

While I have referred to the use of tuned reeds in the mechanism of my invention, I desire that it be understood that I may replace the tuned reeds by electrical filters, particularly at the higher frequencies for accomplishing a similar purpose.

Since the vibration of the tuned reeds of the resonant relays are affected primarily by the resonance of the impulses with the natural period of the reeds rather than by the amount of power in each impulse, the action of the reeds is not greatly affected by fading signals and, since impulses which are not resonant with the reeds, regardless of power, will not cause the reeds to vibrate at full amplitude, no direct current is transferred to the latching relay or gas tube, and thus no code permutation or combination is presented to the translating mechanism. Therefore, the system is substantially unaffected by interfering signals or static.

Conversely, if the audio frequency oscillations are continuously applied and the reeds maintained at full amplitude of vibration and the coded permutation or combination is formed by the discontinuance of combinations of the audio frequency oscillations, the vibration of the affected reeds will drop below the amplitude which maintain continuous flow of current to the relays, thus presenting coded combinations as represented by the reeds remaining in contact.

Practically all modern printing telegraph systems and equipment utilize the principle of sequential application of some form of coded permutations or combinations. These methods require accurate synchronism between transmitting and receiving points, in addition, the speed of these methods is limited by the requirement for linear translation of code permutations or combinations in terms of time. Thus, if each coded permutation or combination is spaced 1/5 second apart, the limit is five characters per second.

By the simultaneous application of the coded permutations or combinations, as accomplished by my invention, no limitation in time of translation is involved and the speed is limited only by the ability of the translation mechanism to function.

In the presently available printing telegraph systems and equipment, the sequentially spaced electrical or audio frequency impulses are transformed into coded mechanical positions which are mechanically translated into printed characters.

In the method of my invention, the coded audio frequency impulses are translated into direct current impulses which are electrically translated into printed characters, thus greatly speeding up all printing operations as well as providing complete flexibility of transference to any position.

Description of transmitting apparatus

The operation of the system of my invention as a printing telegraph device may be understood by reference to Fig. 1 in which a keyboard **35** is provided consisting of a group of letter, figure and functional depressible pivotally mounted keys **36**, each having a key-return spring **37**, and an associated set of five selector bars **38** connected to key **36** by wires **39**. Reference character **40** represents five sets of electrical contacts which are closed in permutations or combinations when a letter or other functional key **36** is depressed. Reference character **41** designates a multiple audio frequency oscillator-amplifier capable of generating five different audio frequency tones singly or in simultaneous permutations or combinations. Reference character **42** denotes a coupling transformer between the oscillator **41** and a modulator **43** which modulates the radio frequency carrier generated in the oscillator-amplifier equipment **44**, which in turn radiates a modulated radio frequency signal through antenna system **45**.

When key **36** is depressed the wires **39** pull down a combination of bars **38** which in turn close the electrical contacts **40**, associated with each bar. When the selected contacts **40** are closed the oscillators **41** associated with each set of contacts **40** which have been closed are caused to produce oscillations at the audio frequency to which they have been tuned. The output of the actuated oscillator **41** is then combined in coupling transformer **42** which drives modulator **43** causing the radio frequency output of amplifier **44** to be modulated at the selected audio frequencies and radiated into space through antenna **45**. In addition to the method described, the audio frequency tones may be impressed upon a pair of conductors or upon a carrier frequency which is transmitted by wire lines instead of radiated into space.

In Fig. 2 I have shown the schematic wiring diagram of the transmitter where the audio frequency oscillators are illustrated at **41***a*, **41***b*, **41***c*, **41***d* and **41***e*, including resistance capacity coupled oscillator circuits **46***a*, **46***b*, **46***c*, **46***d* and **46***e* associated with oscillator amplifiers **47***a*, **47***b*, **47***c*, **47***d* and **47***e* respectively. The contacts **40** are shown for each of the respective oscillator systems at **40***a*, **40***b*, **40***c*, **40***d* and **40***e* connected to the transformer system **42** through which the selected audio frequencies are impressed upon modulator **43** for keying oscillator system **44** and impressing the selected modulated frequencies on antenna system **45**.

Description of receiving system

Fig. 3 is a block diagram of the receiving system of my invention operating as a tape printing telegraph device. In operation the receiver **50** picks up the radio signal emitted by antenna system **45** of Figs. 1 and 2 on antenna system **51** and demodulates the signals and passes the rectified impulses through the field coils of tuned reed relays **52**A, B, C, D, and E. These impulses cause the selected tuned reed relay armatures **53**A, B, C, D, and E to vibrate in resonance with the audio frequency tones selected to produce the desired permutation or combination. When the vibrating relay armatures **53**A, B, C, D, or E reach their amplitude of vibration, direct current impulses are presented to the field coils of relays **54**A, B,

C, D, and E or a combination thereof, causing the associated armatures 55A, B, C, D, or E of these relays to close a series of contacts in the electrical matrix 56 which will close an electrical path to one position on the stepping relay 57, this position having been selected when the proper key 36 of Fig. 1 was depressed. When the position on stepping relay 57 is energized with electrical current, the arm 58 being impulsed by ratchet arm 59, ratchet relay 62, and ratchet wheel 60 connected to arm 58 through shaft 61 under control of the arm 58, starts stepping towards the energized position within a range of approximately 180°.

Upon arrival of arm 58 at position A, printing relay 81 is placed in short circuit across contacts 62*a*, 62*b* of ratchet relay 62, arresting the movement of arm 58. The drum 64, being directly coupled to the shaft 61 which carries arm 58 through its stepping cycle, has on its periphery the type characters of the alphabet in the lower case and the numerals and punctuation in the upper case as shown more clearly in Fig. 5. When arm 58 reaches the energized position A, drum 64 carries the type character 64*a* to a position immediately above printing arm 65 and tape 66. When relay 81 was energized by being placed in short circuit across contacts 62*a*, 62*b*, anvil 65*a* of arm 65 was caused to strike tape 66 which was in turn pressed against type character 64*a* causing that character to be printed on tape 66, the type having been previously inked by inking wheel 67.

Upon the release of key 36, Figs. 1 and 2, arm 65 is returned to a normally open position by spring 68, and contact 69 is closed, causing ratchet relay 70 to operate arm 71 moving ratchet 72 which in turn causes rollers 77 and 78 to turn, advancing tape 66 one step forward from supply reel 66*a*. The release of key 36 of Figs. 1 and 2 also removes the audio frequency tones thus returning all relays to their normal receiving position.

Fig. 4 is a schematic diagram of the electrical circuits used in the system described in Fig. 3, wherein 50 represents the output of a radio receiver or land-line amplifier, 52A, B, C, D, and E are the field coils of the five resonant relays, contacts 74A, B, C, D, and E are the contacts on the vibrating reeds 53A, B, C, D, and E of the resonant relay 52A, B, C, D, and E. Reference characters 75A, B, C, D, and E designate the field coils of the five relays 54A, 54B, 54C, 54D, and 54E which operate the moving armatures 55A, B, C, D, and E of the electrical matrix 56. This matrix consists of thirty-two channels made up by 160 mark and space contacts associated with the contacts on the five movable actuators 76A, B, C, D, and E. The "space" contacts are represented as being below the contact arms of the movable contact arm actuators 76A, B, C, D, and E, that are operated by armatures 55A, B, C, D, and E. The space contacts are normally closed when relay coils 75A, B, C, D, and E are not energized. The "mark" contacts are represented above the contact arms of the movable contact arm actuators 76A, B, C, D, and E and are normally open when relay coils 75A, B, C, D, and E are not energized. Energizing any one or a combination of relay coils 75A, B, C, D, or E will cause armatures 55A, B, C, D, or E and the contacts associated with the particular movable contact arm actuators 76A, B, C, D, and E to be moved and open all "space" contacts associated with the same arm.

The "make" and "space" contacts are arranged and permanently wired in such a manner that the movement of any one or a combination of moving actuators 76A, B, C, D, or E will provide an electrical path through one and only one of the thirty-two possible channels of the matrix 56. The provision of this electrical path through any one of the first twenty-six channels of the matrix 56, allows current from the negative side of the power source to be placed on one of the twenty-six positions of the stepping relay 57. Channels 27, 28 and 29 of the Fig. 4 are shown as being connected to the negative terminal or ground of the power source. They are used to actuate the "Letters" relay 79 or "Figures" relay 80 or the "space" relay 81. Channel 31 of the matrix 56 is likewise shown as connected to the negative source of battery or ground and is used to operate relay 82 for the control of a positive source of battery to the stepping relay coil 62.

Each position A–Z is arranged within an angular space of approximately 180° on the stepping relay 57 and is associated with a type character such as 64*a* on the drum 64, and when the arm 58 is in contact with a position A, the type character associated with that position or drum 64 is immediately above the printing arm 65 of relay 81.

"Letters" relay 79 and "Figures" relay 80 are normally energized through resistors 83 and 84 with only sufficient current to hold the armature 85 in position against the field magnet of the relay to which it was last attracted. When a combination of impulses are received which cause channels 27 or 28 of matrix 56 to be completed, the resistor 83 or 84 is shorted, causing the relay 79 or 80, whichever is associated with the shorted resistor, to attract armature 85 to the magnet of that relay.

Armature 85 is provided with a yoke 86 on the end associated with the armature 65 of relay 81, Figs. 3, 4 and 5, which moves the striking portion of armature 65 below the type character 64*b*, to the upper case or "Figure" position or in the lower case or "Letter" position 64*a* in accordance with the desired position as determined by the channel operated as represented in Fig. 5. The orientation of armature 65 to Figures or Letters position is represented in dash lines in one limiting position and dot dash lines in the opposite limiting position in Fig. 5. The orientation of the armature 65 is accomplished by yoke 86 which is moved under control of magnets 79 and 80 to swing armature 65 about the universal pivot 65*b* that allows the armature to pivot under control of relay magnet 81 and to orient under control of relay magnets 79 and 80. Relay magnets 79 and 80 are controlled by channels 91 and 92 responsive to code permutations and combinations for accomplishing Letters and Figures shift.

The armature 85 carrying yoke 86 that engages armature 65 is shown broken away in Fig. 3 to indicate that the yoke 86 has been oriented in position to explain the manner of engagement thereof with the end of armature 65. In practice it will be understood that magnets 79 and 80 would be viewed from the end thereof as will be clear by examining the plan view of Fig. 5.

Stepping relay contacts 1–26 disposed within an angular range of approximately 180° control the letters A–Z under control of contact arm 58. The arrangement of contacts on the stepping relay comprising contacts 1–26 control the figures and other symbols and punctuation and

other special characters such as weather symbols and the like under supervision of the second arm 94 extending in approximately diametrically opposite position with respect to arm 58 and also rotatable about shaft 61.

It may be observed that the stepping relay 57 is re-cycling and that the code wheel 64 has two complete alphabets, each occupying one-half the periphery of the wheel. The alphabets are associated with the respective arms 58 and 94. Since the device is re-cycling there is no need to reset the mechanism after the printing of each character since one of the rocking arms 58 and 94 steps forward to the next character from the position of the last printing. After one arm completes 180° travel the other arm picks up the rotation through 180°.

The mechanism of my invention is extremely compact in size because of the arrangement of the control system. The dimensional arrangement is such that the type wheel of drum 64 and the associated tape advancing mechanism and the ratchet mechanism for controlling the movement of arms 58 and 94 are all located substantially within the dimensional limits of the approximately 180° angular range of the stepping relay 57. Thus, the printer unit takes on the appearance of the substantially 180° contact system A–Z which is located closely adjacent the type wheel and the associated operating parts and substantially embraces the dimensional limits thereof.

Tape advance is accomplished by operating ratchet relay 20 which turns roller 77 by operating arm 71 to step ratchet 72 whenever contacts 69 are closed as a result of the release of armature 65 by the removal of energy from relay coil 81 or by the completion of channel 29 of matrix 56 as a result of the receipt of a "space" combination signal over channel 93.

Operation

The operation of the system of my invention is as follows: Assume it is desired to print the character Y which is represented by the simultaneous application of the tones produced by oscillators 41*a* and 41*d*.

The letter key "Y" of keyboard 35 of Fig. 1 is depressed causing contacts 40 associated with oscillators 41*b* and 41*d* to be closed. The output of these two oscillators causes modulator 43 to modulate amplifier 44 at the frequency tones produced by oscillator 41*b* and 41*d*. The amplifier in turn emits these tones on a radio frequency carrier.

Receiver and amplifier 50 pick up this emitted signal, demodulates and passes the rectified impulses as audio frequency tones to the coils of tuned reed relays 52B and 52D which begin vibrating at their resonant frequencies and when sufficient amplitude of vibration is attained, contacts are made at 74B and 74D which in turn causes field coils 75B and 75D of the relays 54B and 54D to move armatures 55B and 55D which moves extended actuators 76B and 76D to one limiting position thereof, closing the marking contacts and opening the spacing contacts of the arms associated with actuators 76B and 76D. With actuators 76B and 76D in the limiting position above described an electrical path is provided through channel 1 of matrix 56 from the negative side of the source of battery to relay coil 81 to contact 62*b* of stepping relay 62 on stepping switch 57.

When actuators 76B and 76D are moved from their original position, the path through matrix 56 provided by channel 31 was interrupted, causing current to be withdrawn from relay 82 allowing contact 87 to close. The closing of contact 87 supplies current to stepping relay 62 from the positive source of battery through the winding of relay 62 and contacts 62*b* to the negative source of battery and ground, causing ratchet 59 to start stepping arm 58. When arm 58 arrives at position A, the upward stroke of armature 62*a* does not break the source of current, since by the closing of electrical circuit through channel 1 of matrix 56, the coil of relay 81 was placed across contact 62*b*, keeping coil 62 energized which in turn stopped the movement of armature 62*a* and ratchet 59. When the movement of arm 58 was arrested the rotation of drum 64 was also stopped at a position where the letter "Y" was immediately above tape 66 and armature 65 striking surface 65*a*. The electrical energy which provided the holding current for relay 62 to arrest the movement of arm 58 also passed through relay coil 81 causing armature 65 to move upward which pressed tape 66 against the letter "Y," causing the letter "Y" to be printed on tape 66.

As previously described, the return of key "Y" to normal position on keyboard 35 of Fig. 1 removed the output of oscillators 41*b* and 41*c* from modulator 43 and amplifier 44, which in turn caused tuned reeds 52B and 52D to discontinue vibration, breaking contacts 74B and 74D allowing relays 54B and 54D to return to normal which moved actuators 76B and 76D to their original position. In this position channel 31 was closed which closed relay 81 removing the battery source from relay 81 and stepping relay 57. The removal of energy from relay 81 caused contacts 69 to close providing an electrical circuit from the positive side of the battery source through relay 70 to the negative battery supply which in turn caused relay armature 71 to operate ratchet 72 moving rollers 77 and 78 advancing tape 66 one step forward.

While my invention as hereinbefore described has been illustrated as applied to a tape type of printer, the operation may be applied to a page type printer by replacing the stepping relay 58 and associated apparatus with a conventional electric typewriter.

The thirty-two channels of matrix 56 are then used to provide an electrical circuit to a series of thirty two solenoids or relays which are used to operate the mechanism of the electric typewriter which performs the typing, carriage return, line feed, spacing and upper and lower case functions.

In applications where more or less than thirty two operations are required, the number of oscillators, tuned reeds and associated relays may be rearranged in a matrix which will perform the number of functions required.

One such application is in the use of drums to visually present pre-arranged or recorded information.

Where the number of displays to be presented are less than sixteen, four tones, four tuned reeds, a sixteen channel matrix and a sixteen position stepping relay with the messages printed on a cylindrical surface such as the drum 64 of Figs. 3 and 4, can be formed into a light weight system of visual telegraphy particularly adapted to aviation traffic control communications.

Another application of my invention is an arrangement of the matrix 56 where one channel is permanently wired in a fixed position in such

a manner that only when a signal consisting of the proper combination of tones is received will it pass through the matrix. Such an application being particularly adapted to selective calling systems illustrates the versatile character of the system of my invention.

The matrix **56** illustrated in Fig. 4 shows in diagrammatic form the graphic appearance of the code symbols used in the system of my invention. These are standard code characters of the international Teletype code with respect to the sequential arrangement of the mark and space signal impulses. The equipment of my invention is accordingly interchangeable with standard Teletype equipment and is operative over the same channels on which standard Teletype equipment is being operated.

I have found the equipment of my invention highly practical in construction and operation and while I have described my invention in certain preferred embodiments I realize that modifications may be made and I desire that it be understood that no limitations upon my invention are intended other than may be imposed by the scope of the appended claims.

As an example of one of the variations or modifications of my invention I may refer to any means for constantly activating the several reeds so that they are maintained in a state of vibration. Such constant rate of vibration is at an amplitude at which electrical contact is maintained by the reed contact. However, upon nonreceipt of a tone the reed resonant to such tone may be dropped in amplitude of vibration sufficient to effect the release of the associated contact. Thus a slight infinitesimal time lag incidental to building up the vibration of the reed is eliminated in such an arrangement by having the reeds operate at full amplitude of vibration which is interrupted by the displacement of a frequency or combination thereof.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. In a printing telegraph receiving system, means for receiving permutations and combinations of simultaneously applied multiple coded signal impulses, a ratchet controlled step-by-step selector system operative over a range of approximately 180°, a printing device including a type wheel wherein a complete alphabet appears on each 180° of the type wheel operatively controlled by said selector system, and electric circuit means for simultaneously applying said permutations and combinations of simultaneously applied coded signal impulses to said ratchet controlled step-by-step selector system for controlling said printing device by the conjoint action of simultaneously applied impulses.

2. In a printing telegraph receiving system, means for receiving permutations and combinations of simultaneously applied multiple coded audio frequency signal impulses, electric circuit means for translating said simultaneously applied multiple audio frequency signal impulses into simultaneous direct current impulses and means including a type wheel wherein a complete alphabet appears on each 180° of the type wheel and operative through a range of approximately 180° for electrically translating said simultaneous direct current impulses into printed characters.

3. In a printing telegraph receiving system, means for receiving permutations and combinations of simultaneously applied multiple coded signal impulses, a multiplicity of pre-arranged electric matrix circuits, including individual circuit connections establishing a signal combination representative of a predetermined character, a multiplicity of relays controlled by said simultaneous applied multiple coded signal impulses for rendering said electric matrix circuits individually and selectively effective, a printing control mechanism including a type wheel wherein a complete alphabet appears on each 180° of the type wheel, and a stepping relay associated with said printing control mechanism and operative through a range of approximately 180° under control of said simultaneously applied multiple coded signal impulses for selecting one of said electric matrix circuits and effecting thereby the printing of a selected character by said printing control mechanism.

4. A printing telegraph receiving system as set forth in claim 3 wherein the simultaneously applied multiple coded signal impulses are received at audio frequencies and effect the establishment of circuits through the electric matrix circuits for the passage of direct current pulses to said printing control mechanism.

5. A printing telegraph receiving system as set forth in claim 3 in which the simultaneously applied multiple coded signal impulses are received at audio frequencies and effect resonant vibration of a multiplicity of reeds and which in turn control direct current relay circuits for selectively conditioning an individual electric matrix circuit representative of the selected character in said multiplicity of electric matrix circuits.

6. A printing telegraph receiving system as set forth in claim 2 in which said translating means include a multiplicity of reeds individually resonant to the individual frequencies of said simultaneously applied multiple coded signal impulses and direct current actuated relay circuits controlled subsequent to the attainment of a predetermined amplitude by said reeds.

7. A printing telegraph receiving system as set forth in claim 1 including a tape feed mechanism for advancing a tape longitudinally of the path of both of the alphabets on said type wheel and a striker bar selectively orientatable to a position aligned with either of said alphabets for presenting the tape to either row of alphabets on said type wheel.

8. In a printing telegraph receiving system, means for receiving permutations and combinations of simultaneously applied multiple coded signal impulses, a selector switch controlled by said impulses, a printing device including a type wheel wherein a complete alphabet appears on each 180° of the type wheel, and means disposed within dimensional limits of approximately 180° and controlled by said selector switch for controlling said printing device said means also including a matrix of electrical circuits beyond the aforesaid dimensional limits containing prearranged circuits individual to the permutation and combination signal impulses representative of each of the characters being printed.

9. In a printing telegraph receiving system, means for receiving multiple permutations and combinations of simultaneously applied multiple coded signal impulses, a converter including a multiplicity of individually resonant reeds, responsive to the multiple coded signal impulses, individual relay contacts controlled by each of said reeds and operative to establish closed electrical circuits when said reeds are vibrated substantially at resonance, separate relays controlled by each of said relay contacts, an armature and actuator individual to each of said last mentioned

relays, a multiplicity of contact arms controlled by each of said actuators, an electric matrix including contacts associated with each of said contact arms and connected in circuits corresponding in number to the number of electrical pulses being transmitted, a stepping relay having a multiplicity of radially disposed contact positions disposed within an angular range of approximately 180° corresponding in number to the number of electrical circuits through said electric matrix and electrically connected to the contacts thereof, a stepping relay arm operative over said radially disposed contacts within an angular range of approximately 180° and a printing device including a type wheel wherein a complete alphabet appears on each 180° of the type wheel and selectively controlled by said stepping relay arm and responsive to selected signal permutations and combinations established through said matrix.

10. In a printing telegraph receiving system, a receiving circuit responsive to a predetermined range of audio frequency permutations and combinations of signal impulses, a multiplicity of tuned reed relays individually responsive to audio frequency signal impulses within said predetermined range of audio frequency, said tuned reed relays each including a vibratory armature and a contact member spacially related thereto whereby selected electrical circuits are closed through said armatures and their associated contacts when the vibration of said armatures reaches a predetermined amplitude, direct current relays each having relay windings electrically connected with the aforesaid contacts and a source of direct current, an armature associated with each of said direct current relays, a movable actuator connected with each of said last mentioned armatures, a multiplicity of contact arms controlled by each of said movable actuators, said contact arms corresponding in number to the number of signal permutations and combinations incident upon said receiving circuit, contact elements associated with each of said contact arms, electrical circuit connections extending from the contact elements associated with the contact arms controlled by one of said actuators with the contact arms controlled by the adjacent actuator and forming an electrical matrix having circuit paths therethrough individual to each of the signal permutations and combinations incident upon said receiving circuit, a stepping relay including individual contacts connected to the aforesaid circuit connections, contact arms movable over said individual contacts, a printing telegraph device including a type wheel wherein a complete alphabet appears on each 180° of the type wheel, and means for selectively connecting said printing telegraph device with said last mentioned contacts and effecting the printing of a character corresponding to the signal permutation and combination established by individual paths through said electrical matrix.

11. A printing telegraph receiver comprising a step-by-step selector having a multiplicity of contacts forming circuit terminals or permutation and combination direct current pulses corresponding to signals and arranged in a curved path extending through approximately 180°, a pair of rocking arms selectively movable over said contacts, a type-wheel having a double alphabet printing face thereon, one alphabet of which extends over 180° of the type wheel and the other alphabet of which extends over the other 180° of the type wheel, means for driving said type wheel in timed relation to the movement of said rocking arms, a tape movable adjacent the double alphabet printing face of said type wheel, and means for selectively moving said tape into register with either alphabet on said double alphabet type wheel, said double alphabet type wheel being mounted within the curved path of said multiplicity of contacts.

12. A printing telegraph receiver comprising a step-by-step selector having a multiplicity of contacts forming circuit terminals for permutation and combination direct current pulses corresponding to signals and arranged in a curved path extending through approximately 180°, a rocking arm movable unidirectionally step-by-step for selectively sweeping said contacts, a shaft extending from said arm, a ratchet mechanism connected with said shaft for imparting unidirectional step-by-step movement thereto, a type wheel connected with said shaft and carrying type designations constituting a complete alphabet appearing on each 180° of the periphery thereof, a tape movable tangentially to the designations on the periphery of said type wheel, and means for selectively moving a tape into register with the designations on the periphery of the type wheel.

JAMES D. DURKEE.

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