The Early Years of Teletype Development
A Patent History

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(Document Notes)

1901 - The Beginnings

The initial event in the chain of circumstances that led to the successful development of Teletype printing telegraph systems was the appearance in Chicago of young Frank D. Pearne, originally from Nebraska. He had come to enlist support for his "inventions." An article published in the Sunday Feature Section of the Chicago Tribune dated March 3, 1901 gives a brief sketch of Pearne's history and ideas. (A photocpy of the article was sent to Teletype Museum storage.)

Pearne apparently had two objectives: (1) to provide remote operation for a Mergenthaler typesetting machine, for the newspaper field; (2) to get direct printed copy, for the telegraph field. Some of his equipment, described in the story as having been made in Chicago and Syracuse, New York is shown in a picture accompanying the article. Apparent are: (1) A keyboard sender which the inventor is operating, specially designed, it seems, to provide separate electrical circuits attached to each key; (2) A distributing device, or selector, consisting of large polar relays, shown at the front; (3) A set of intermediate relays, entitled "switches," that were mounted to the side of the typing unit which they controlled; (4) A modified magnet- controlled typewriter (apparnetly a Remington No. 6) used as the typing unit.

In the article Pearne claims that his sending principle uses electrical currents of different combinations of polarity and strength for the determination of individual characters to be transmitted and received. This method is spelled out in detail in Patent No. 894,044 which he filed in 1904 and was granted in 1908. (See page 4.)

Frank Pearne was able to interest Mr. Joy Morton of the Morton Salt Company in his work, and he secured a limited amount of financial support. He was given working space in the attic of Mark Morton's Western Cold Storage plant office (Mark was Joy's brother), and Charles Krum, Vice-President of the Cold Storage Company, a trained mechanical engineer experienced in the design of mechanisms, was enlisted to provide practical guidance. This apparently happened in 1901, since the first record of the association of Pearne and Krum is a patent filing made early the next year.

1902 - Krum and Pearne Joint Developments

On February 3rd, Peirce and Fisher, attorneys, who subsequently represented Frank Pearne, Charles and Howard Krum, and the Morkrum Company in most of their patent work, filed a patent application on an "Electrical Sensitive Apparatus" in the name of both Pearne and Krum.

This patent was issued on March 15, 1904 as No. 754,689* and was assigned to the "Pearne Electric and Manufacturing Company" of Chicago, which was apparently the corporate entity set up by Morton and Pearne to support the work then underway. The patent itself covered a relay having a locking feature which could be set into two or three different positions, to be used to control signals from a main telegraph circuit to two or three branch circuits for signaling and for controlling separate parts of a printing telegraph set or an electrical typewriter.

This type of circuit formed the basis for early Pearne and Krum selectors by the way in which it set up paths to typing unit control magnets. (Patent No. 888,335, to Charles Krum, shows five of these relays in its Figure 29 -- see page 3.) The relay itself was a two- or three-position device with two branch outputs having locking magnets for each of the side outputs and means for releasing the lock. Thirteen claims were granted. Two models are in the Teletype Museum storage.

Another device on which Pearne and Krum cooperated at about this time was a keyboard transmitter unit. One Model has survived and is in Museum storage. It is marked "THE KRUM-PEARNE TELEGRATYPE" and "Patents Applied For." No patents have been found covering the keylever and codebar arrangement of this unit. It may be that this part of the unit was not an improvement over the prior art. A transmitting relay bank was mounted behind the keyboard, and its circuitry and components are described in Patent No. 929,603 (Page 6). It thus appears that the keyboard served as a model for testing circuitry ideas, and that the assembly was later "worked over" to include the relay bank.

The keyboard itself is a four-row instrument with each key operating a linkage mechanism which selects a code pattern through a group of U-shaped code bars. The code bars in turn control the closing of corresponding telegraph signal transmitting contacts. A locking magnet, claimed in Patent 929,602 (Page 4), held the contacts in position during the transmitting interval. (This feature may not have been claimed in the original patent applications on the TELEGRATYPE. It also may be that the word TELEGRATYPE ws the inspiration of the name TELETYPE when the latter was submitted in a contest to rename the Morkrum-Kleinschmidt Company several years later.)

The frame of the device consists of carefully designed castings but the levers and bars are somewhat flimsy. The code bars have been reinforced by soldering on flat metal strips, indicating an attempt at solving the weakness.

Sometime during this early period, Frank Pearne lost interest in the work, going off to teach at the Armour INstitute of Technology (now IIT) and his association with Charles Krum was

severed. Krum continued, however, and within a few years had made such progress that a separate corporation, the Morkrum Company, was formed to develop and produce printing telegraph products.

1903 - Krum Continues Alone

The first recorded patent granted solely to Charles Krum was filed January 10th and issued February 5, 1907 as No. 843,283. This was an "Electrical Signal," a telephone style ringer which used a permanent magnet for bias and an electromagnet for operation. It worked on square wave AC signals which were applied to the electromagnet coil. This method was claimed to be suitable for party line telephone ringing. While not used in the telegraph art, it demonstrated Charles Krum's interest and rapidly developing ability in the electrical design field. Six claims were granted.

On August 22nd Charles Krum filed an application that covered a "Printing Telegraph." As Patent No. 888,335 it was issued on May 19, 1908. This covered a keyboard sending, typebar receiving style of printer, with the printer design closely related to that of a conven- tional typewriter. Individual magnets were used to operate the typing keylevers when receiving copy, and solenoids or magnets supplied power for character spacing and line feed. Carriage return was magnet tripped, with spring power providing the return itself. The spacing mechanism was locked out during the return interval and then reactivated at the end of the carriage travel.

The shock of stopping the carriage was cushioned by "dash pots", and it was stated that this was a preferred method. Ribbon feed was incorporated into the mechanism. The ribbon shifted to follow carriage shift in printing any of three cases of characters. (Many of the typewriters of that day had three different cases: CAPITALS, FIGURES and LOWER case.) Copy was made visible for the printer operator by having the ribbon move out of the way between typing operations. Carriage shift occurred with each CAPITALS or FIGURES character, and unshifting occurred immediately. (The use of separate code permutations for SHIFTing and UNSHIFTing was a later development.)

In the keyboard the key levers controlled circuit closures, directly energizing typing unit selecting relays and sending-to-line relays. At the bottom of each key stroke, a universal-bar circuit provided a lockout so that transmission did not reoccur on the key return stroke. The signaling code was similar to the Pearne code, with each pulse having one of two strengths and one of two polarities. The Pearne-Krum relay, Patent No. 754,689 is shown in the circuit diagram. The 16 claims cover the carriage and ribbon shifting, the ribbon feed, the carriage return, and the line feed functions, all of which had been problems when trying to use a typewriter as a telegraph printer. The keyboard is much simpler than the TELEGRATYPE and apparently incorporates improvements gained by experience with the latter. No model has been preserved.

1904 - Separate Krum and Pearne Applications

The first of three telegraph patent applications during this year was filed by Charles Krum on April 11th. It issued July 27, 1909 as No. 929,602 and covered a "Transmitter for Electric Telegraph." It consisted of a keyboard transmitter, much simpler than the TELEGRATYPE, which used relay distributing chains for transmission. The operation of each finger key set up electrical circuits for sending trains of pulses, with the circuits locked in until the transmission was finished. Each train could be of several types (in "any suitable code"), according to the specification.

For example, in the original Pearne system, which was closely related to the French Baudot, each train consisted of pulses separated by no-current intervals, the pulses themselves having either one of two polarities and either one of two strengths within those polarities. In this application, Krum states that in addition to the above, the pulses may also be of variable time duration, as in Morse, or that the pulses may be prolonged to the point of having no gaps between them. A finger key, once operated, was free to prepare to set up the next character, but all others were locked out until the previous character had been transmitted. (This feature was included in the TELEGRATYPE).

If a key was held down, it caused the transmission of repeated characters until released. If two or more character keys were held down simultaneously it appears that an error could be sent. Further improvements over the mechanism shown in Patent No. 888,335 are apparent. The 49 claims granted cover the transmitting relays, the keys and contacts, and the locking mechanism. No model has been preserved.

On July 11th, Frank Pearne filed on his original signaling ideas, assigning the device to a Mr. M. E. Stewart of Chicago, who apparently was financing him at that time. This Patent issued July 21, 1908 as No. 894,044. The title was "Electrical Selective System," and covered the relay network used by Pearne for generating and receiving signals. The signals themselves consisted of trains of pulses with intervals of no-signal between the individual pulses. Each pulse was either of positive or negative polarity, and of greater or lesser strength. With three successive pulses, each able to be put in one of four signaling conditions, 64 code combinations signifying 64 individual characters or operations could be established.

The claims cofer a combination of line circuits and branch circuits, with switches (relay chains) controlling sequential operation of the branch circuits for transmission or reception. At the end of each pulse transmission, the system connections were transferred to the next condition. A reset occurred at the end of each pulse train. The first of five pulses started the selecting process, while the second, third, and fourth pulses caused the actual selection. The fifth pulse completed the operating, started the printing cycle at the receiving terminal, and brought about the resetting of all circuits at both terminals to the idle condition.

Weaknesses of the design were: (1) Two current levels of different polarities had to be detected which was difficult on "open wire" lines subject to current fluctuations with variations in the

weather; (2) The relay chains could not provide precise timing of transmitted and received trains of signals. The single current START-STOP system invented by Howard Krum overcame the first problem, and motor driven distributors which were eventually developed solved the second. This patent covers Pearne's early work, and the equipment described is similar to that shown int he Tribune picture of March 3, 1901. Charles Krum used related signaling principles until the START-STOP system was invented but deliberately did not make any claims in this particular area. Pearne was granted 35 claims on the selective system.

On October 6th, Charles Krum filed on a "Printing Telegraph," which Patent was subsequently issued on August 6, 1907 as No. 862,402. This covered a solenoid powered typewheel page printer with the typewheel mounted on a horizontal axis. The wheel was to move back and forth horizontally, and also rotate about its axis, in order to select the various characters for printing. Selections were made through the positioning of stops which prevented the wheel from moving or rotating further. The wheel and an associated ribbon were located in front of the paper for visibility of copy. A hammer with magnet drive was located behind the paper.

Printing occurred on a "print through" basis as in the Hammond typewriter which was in current use at that time. The drive magnet started the hammer on its printing stroke, but completion of the stroke was by intertia after the electrical power had been expended. The hammer opened a contact at the end of its stroke, resetting the electrical circuitrty and preparing the mechanism to receive the next character. The received signal is the three-impulse, four current condition of the Pearne selector (Patent No. 894,044), and specific selecting circuits are not claimed. The signal source for printer oepration may have been the TELEGRATYPE keyboard or one of its successors.

32 claims were granted, covering the typing mechanism and control circuits. No model has been found of the printing mechanism, but a model of a relay bank selector of about this date with connections almost as shown in the patent has been preserved. Some relays in this bank are of the same design as those mounted behind the TELEGRATYPE.

Charles Krum continued his work during the next year, gradually putting together the elements required to provide a practical printing telegraph system that could be marketed.

1906 - Howard Krum Joins Charles Krum

On August 31st, Charles Krum filed on a "Transmitter for Automatic Telegraph," which was issued as Patent No. 929,603 on July 27, 1909. This was a keyboard transmitter that used relay distributing chains and which was controlled from a typewriter-like keyboard. Cooperation with a receiving printer or typewriter having three cases of type is indicated. Operation of each finger key moved code bars and contacts to send a train of three pulses, each being in one of the usual four conditions of polarity and strength. A magnet held the keylever locked up until character transmission was completed. Meanwhile all other key levers were locked out.

Case shifting, instead of being "on-the-fly" with the transmission and reception of each

CAPITAL or FIGURES character, was now by manipulation of one of two separate keys which was held depressed while sending in that particular case. This caused the sending of a special SHIFT code when the key was first depressed and of a different UNSHIFT code when the key was released. 58 claims were allowed. No model of the keyboard design shown in the patent spec- ification has been preserved, but a model of the transmitting relay bank is mounted at the rear of the TELEGRATYPE keyboard in museum storage.

Howard Krum graduated from the Armour Institute of Technology that year and was employed during the summer to undertake field testing of a set employing many of the principles described above. The first test was on the Chicago and Alton Railroad between Chicago and Bloomington, Illinois. While a successful demonstration was accomplished, it was realized that many deficiencies remained in the equipment, so Howard went to work full-time with his father Charles to see if these could be overcome.

On September 6th, Charles Krum filed on a "Printing Telegraph." This was issued as Patent No. 1,004,038 on September 26, 1911. It consisted of the relay circuits that were being used to decode the complicated line signals so that a signle magnet would be selected for each chacter sent. In turn, the magnet would cause the selection of the proper typebar lever in the associated typewriter printer, causing the printing of the letter. 30 claims were allowed.

1907 - Morkrum Company Founded

A year's work produced results that were promising enough to justify formation of a manufacturing company. The Morkrum Company was accordingly founded on October 5, being chartered in the State of Maine. The new firm took over the patents previously issued, as well as rights to applications being processed for Charles Krum. The Morton family provided the major part of the financing, with joy Morton, Mark Morton, Sterling Morton, Charles Krum, and Daniel Peterkin, Sr., all having interests. (The name MORKRUM was derived from MORton and KRUM.) Work continued on new developments.

1908 - The Krums at Work

An application was filed jointly by Charles and Howard Krum on January 22nd covering a "Printing Telegraph." This applicaton was renewed on February 14, 1916 and issued on September 19, 1916 as Patent No. 1,199,011. It covered the controlling relay bank for the first printing telegraph set developed by the Krums, a set that operated in conjunction with an OLIVER typewriter through an adapter unit from Patent No. 1,137,146, to be described later. The relays were used for both sending and receving, and the line signal consisted of five successive line current impulses of either positive or negative polarity (MARK or SPACE) with no-current intervals between the pulses.

Distributing relay chains formed or followed the pulses, as was appropriate for transmission or reception, and storage relays held received permutations. When all pulses had been detected at the receiver, the permutation was transferred to a "fan" or "Christmas tree" decoding network, and one of the 32 printer control magnets was energized. (This was covered by Patent No. 1,004,038 described above.) The printing operation or other function was then accomplished under the control of strong power magnets within the typewriter. Functions included either of two SHIFTS, UNSHIFT, CARRIAGE RETURN and LINE FEED. Operaton was on a "overlap" basis with a printing or operating function being performed as the subsequent character was being received.

The patent specification shows a Krum relay, Patent No. 1,172,294 (described below) connecting the receiving line to the set; this was the only polar relay used. The printer drive circuitry and the keyboard sending circuitry were from patent 1,137,146. Operation of either SHIFT key injected a special signal, following which either the CAPITALS or FIGURES case characters were sent and recorded until the key was released. A RELEASE (UNSHIFT) was then inserted, and subsequent printing was in LOWER CASE letters. This feature was covered in Patent 929,603. The 55 claims granted covered distribution of signals, selection of signals, storage, and the overlap principle. Two models have been preserved. Relays from Patent No. 1,220,433 (described below) were used throughout.

On June 1st, Charles Krum filed an application on the polar relay mentioned above. This patent, entitled "Relay", was issued February 22, 1916 as No. 1,172,294, and covered a relay using a polarizing winding instead of a conventional permanent magnet. The relay operated on either polar or neutral input signals, and was claimed to be easily manufactured and adjusted. 30 claims were allowed.

On the same date Charles and Howard Krum filed an joint application for another type of relay called an "Electromagnet." This application was renewed on August 18, 1916 and issued as Patent No. 1,220,433 on March 27, 1917. The device was a neutral relay of special design, both rugged and sensitive, which could be cheaply manufactured with common tools. Ten claims were allowed. It was the only kind of relay used in the relay bank covered in Patent No. 1,199,011 for the first complete Krum printer set. It was used extensively thereafter, especially in the GREEN CODE and BLUE CODE printer sets.

1909 - The OLIVER and BLUE CODE Printers

On February 4th, Charles Krum filed on a "Printing Telegraph Apparatus," covering an adapter unit for controlling an OLIVER or other typewriter. This Patent was issued on April 27, 1915 as No. 1,137,146. The adapter unit included code bars for operating trans- mitting code contacts (same code as used in Patents 929,602 and 929,603) and included receiving magnets for operating the key-typebars for printing both sent and received copy. The double-shift typewriter principle, described in Patent 929,603 was utilized. In the patent specification, a good discussion was given of the problems encountered in coupling into the functions: LINE FEED, character SPACING, and CARRIAGE RETURN. The associated relay controls were covered by Patent

No. 1,199,011. 31 claims were allowed. One model has been preserved, attached to an OLIVER typewriter with a special base casting.

On November 29th, Charles and Howard Krum filed on a "Selective Telegraph System and Apparatus," covering a magnet- and solenoid-powered typewheel page printer and associated keyboard transmitter. Patent No. 1,232,045 was subsequently issued on July 3, 1917 and a subdivision was refiled on June 19, 1917, issuing as Patent No. 1,305,225 on May 27, 1919. This was the first successful typewheel Page Printer designed by the Krums for telegraph service, and became the so-called BLUE CODE and GREEN CODE printers of subsequent years.

Originally the typewheel contained three rows of type, for the three cases: CAPITALS, FIGURES and LOWER. Later models had only two rows, dispensing with the LOWER case. The typewheel was mounted on a vertical axis and was rotated by magnet power to the right or left in accordance with the polarity of the fifth pulse of the code used. Its rotation was blocked by stops which were selected by the first four pulses of the code. On encountering the closest stop, the typewheel was roughly in position for printing the selected character. A "corrector" (notched wheel) similar to that on a Blickensderfer typewriter of the same vintage (models in storage) provided exact align- ment of the printed characters during the printing process.

Printing was accomplished by swinging the typewheel to the rear against the paper and platen as in the Blickensderfer, one model of which had an electric motor and was thus the first electric type- writer known to be in use. the wheel face was rubbed against an inked felt roller enroute to the paper, thereby providing ink for printing, the same as in the typewriter. A spring returned the wheel to the neutral position after the printing was finished. Stops were inserted momentarily for quick completion of the resetting operation. Magnets lifted the wheel to one or the other of the SHIFTed positions and locked it in that position until a release to the UNSHIFTed position was required.

The wheel was mounted on a carriage that progressed across the page in column SPACE order and returned to the left margin upon receipt of the CARRIAGE RETURN signal. The machine was thus a "fixed paper" type, with a minimum of paper feeding problems. Signaling, selecting and control magnets were mounted within the machine, and the circuit was described as an improvement over the original printer bank, Patent No. 1,199,011, and its successor, Patent No. 1,286,351 which first used the START-STOP principle.

In the present instance, the line signal consisted of five successive code pulses, without gaps between pulses, and slow-operating relays were used to time individual pulse transmissions. A similar relay chain operated in synchronism with received signals, while quick-acting relays "sampled" the center of the received pulses. The keyboard was largely covered by patent No. 929,603. 35 claims covered the typewheel print mechanism, the carriage, and related functions. The stored model is a GREEN CODE version, with two rows of type on the typewheel. It has "slip connections" for attachment to a table set, and does not include a keyboard.

The split-off from the previous patent, issued as No. 1,305,225 on May 27, 1919 was entitled "Printing Telegraph." It covered a variation of the typing unit wherein there was division between the selecting and printer controlling circuitry which permitted "overlap." The earlier unit

operated to print a received character and then was reset before the next character was applied. The new unit allowed the printing of one character simultaneously with the reception of the next character, obviously a much faster procedure. Eight claims were allowed.

1910 - The START-STOP Principle

On May 31st, Howard Krum filed his basic patent on the START-STOP telegraph signaling system. This application was renewed on February 11, 1918 and issued as Patent No. 1,286,351 on December 3, 1918. Entitled "Electric Selective System," the patent covers a relay bank that is similar to Patent No. 1,199,011 but has the new START-STOP line signal arrangement. The relay bank was used for both sending and receiving and in the latter case made sleections near the mid-point of each of the line signal impulses. It was stated that this process overcame the problems of line current variations and disturbances, especially those due to changing weather conditions. One problem encountered was that of "tuning" the various distributing relays so as to maintain synchronism of the distributing chains. (Motor driven "cam-and-contact" or "burhs-and-segment" distributors solved that problem later.)

The keyboard shown in the patent is from Patent No. 1,232,045 and the receiving printer is the OLIVER typewriter shown in Patent No. 1,137.146. The 38 claims cover the START-STOP principle. They state that the transmitter is independent of the line conditions and that the receiving selector, once started in response to a START signal runs independently of the received signals until the STOP signal is detected. Two models have been preserved. The relays are all designed per Patent No. 1,220,433. Tapped holes in the relay mounting plate indicate that the relay banks were originally per patent No. 1,199,011 and subsequently were worked over to include the START- STOP principle.

With basic patent coverage in process, the krums were now able to produce complete and practical printing telegraph sets for the communications field. The first set, called a BLUE CODE, was developed for teh Postal Telegraph Company and sold to them this year. Postal messenger boys' uniforms, telegraph blank headings and apparatus were all colored blue, so the color code was a natural selection. A GREEN CODE set with olive drab color was likewise developed for the Western Union Telegraph Company, and was named for the same reason. The sets had most features in common, differing only in minor details.

1912 - The First Keyboard Perforator

On June 18th, Charles and Howard Krum filed on an "Apparatus for Forming Telegraph Tape" which was the first keyboard perforator made by the Morkrum Colmpany. Patent No. 1,174,427 was issued on March 7, 1916 covering this unit. In the perforator, each keylever selected a combination of code bars, to each of which a contact was attached. The contacts in turn energized solenoids which controlled interponents between a solenoid-driven hammer and a set

of punch pins. Operation was "upside down" in that a selected magnet withdrew its interponent from engagement with its punch pin so that no hole was punched. Unselected magnets left their interponents unmoved, with consequent hole perforation. Tape stepping was by pawl and ratchet. The punched holes were at a slight diagonal, as aligned across the tape, with a feed hole in line with the center line of the cod holes.

The intent was to move the tape at a constant speed during subsequent sensing, rather than to make a quick move and then leave the state stationary during sensing. This is the so-called "drag-reading" principle. the punch block had spring return of the selected punch pins via a "stripper plate." The magnets were included so that the unit could also serve as a reperforator on signals received from a distant source. 15 claims were allowed. This is the first patent application filed after the legal firm had become Fisher and Clapp.

The museu model in storage has an interesting addition not covered in the patent specification or drawings: an inking roller is attached to the CARRIAGE RETURN key and marks the tape with an ink smudge whenever the key is depressed. This mark appears about seven inches before that point on the tape reaches the punch block. It apparently serves as a crude character counter to help the operator prepare tape for transmission to a page printer that types a 72 character line. An apparent weakness is that the operator had to keep moving his (or her) gaze between the tape and the copy being read. (The successor perforator, the GPE, was designed with an END- OF-LINE counter mechanism and warning lamp.)

1914 - The GREEN CODE Perforator

On September 8th, Charles and Howard Krum filed an application on a "Perforator for Forming Telegraphic Tape." The Patent was issued May 9, 1916 as No. 1,182,179. This is the GREEN CODE PERFORATOR (GPE) in its final form of which 6173 units were to be made and sold over an interval of some 50 years! Keylevers operated groups of code bars, extensions of which pulled bell-cranks linked to interponents that moved in and out between the solenoid-driven hammer and the punch pins. This eliminated the contacts and solenoids found in Patent No. 1,174,427 and made for a simple, rugged unit. A back-space mechanism, and an end- of-line indicator lamp were added.

A horizontally mounted supply tape holder turntable was included on top of the keyboard assembly, with a spring loaded tension arm buffering the stripping of blank tape from the roll on its way to a simplified feed mechanism. 12 claims were allowed. The original model, which was mounted on a flat plate, and later models having castings, have been preserved. One has a "rule-and-pointer" type character counter mounted above and to the rear of the keys, where it can be easily seen by the operator.

The first models perforated at a slight diagonal across the tape, for use with BLUE CODE and GREEN CODE transmitting units. Subsequent production units had the perforated holes aligned perpendic- ular to the center line of the tape, the accepted standard for sensing stationary tape. Western Union preferred an "advanced" feed hole, the left edge of which was in line with the left

edge of the larger "code" holes. Other customers, including the Bell System, specified or accepted the Morkrum "in-line" feed hole, the center line of which was the same as that of the "code" holes. This was a slightly easier pattern to design, manufacture and inspect.

* REFERENCES: The Patents listed are in Teletype Patent Organization archives, as follows:

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DATE.FILED...PATENT.NO....DATE.ISS.....PATENTEE(S)..........MODEL....CLAIMS
-------------------------------------------------------------------------
...2-03-02.....754,689.....3-15-04...F.Pearne/C.Krum........Relay.Des....13
...1-10-03.....843,283.....2-05-07...C.Krum.................Ringer........6
...8-22-03.....888,335.....5-19-08...C.Krum.................Ptr..Set.....16
...4-11-04.....929,602.....7-27-09...C.Krum.................Keybd........49
...7-11-04.....894,044.....7-21-08...F.Pearne...............Relay.Sel....35
..10-06-04.....862,402.....8-06-07...C.Krum.................Page.Ptr.....32
...8-31-06.....929,603.....8-27-09...C.Krum.................Keybd..Tr....58
...9-06-06...1,004,038.....9-26-11...C.Krum.................Relay.Ckt....30
...1-22-08...1,199,011.....9-19-16...C.Krum/H.Krum..........Relay.Ckt....55
...6-01-08...1,172,294.....2-22-16...C.Krum.................Polar.Rel....30
...6-01-08...1,220,433.....3-27-17...C.Krum/H.Krum..........Relay........10
...2-04-09...1,137,146.....4-27-15...C.Krum.................Oliver.Typ...31
..11-29-09...1,232,045.....7-03-17...C.Krum/H.Krum..........BLUE.Code.P..35
..11-29-09...1,305,225.....5-27-19...C.Krum/H.Krum..........BLUE.Code.P...8
...5-31-10...1,286,351....12-03-18...H.Krum.................ST/SP.Sel....38
...6-18-12...1,174,427.....3-07-16...C.Krum/H.Krum..........Keybd..Perf..15
...6-18-12...1,326,456....12-30-19...C.Krum/H.Krum..........Tape.Trans...21
...3-07-14...1,360,231....11-23-20...C.Krum/H.Krum..........S/R.Dstrs....55
...9-08-14...1,182,179.....5-09-16...C.Krum/H.Krum..........GPE.Perf.....12
...5-17-15...1,366,812.....1-25-21...C.Krum/H.Krum..........Tape.Trans...51
...6-30-16...1,434,290....10-31-22...H.Krum.................K/T.Trans....27
...6-30-16...1,635,130.....7-05-27...H.Krum.................Kbd..Trans...21
...6-30-16...1,635,131.....7-05-27...H.Krum.................Kbd..Trans...13
...9-18-16...1,374,152.....4-05-21...C.Krum/H.Krum..........Kbd..Trans...15
..10-13-19...1,738,777....12-10-29...C.Krum/H.Krum..........GREEN.Code...50
..12-23-19...1,635,129.....7-05-27...C.Krum/H.Krum..........M11.Kdb..T...37
..12-23-19...1,635,486.....7-12-27...C.Krum/H.Krum..........M11.TD/SMS...79
..12-23-19...1,676,448.....7-10-28...C.Krum/H.Krum..........M11.Select....6
...1-21-21...1,419,677.....6-13-22...C.Krum/H.Krum..........Tape.Trans...10
...6-13-21...1,570,633.....6-26-26...H.Krum.................M11.Select...14
...6-18-21...1,791,740.....2-10-31...S.Morton/H.Krum........M12.Select...54
..12-28-21...1,485,212.....2-26-24...J.Brady................M11.-.Radio...8
..12-28-21.....Reissue....11-23-26...J.Brady................M11.-.Radio..13
...8-23-22...1,764,316.....6-17-30...H.Krum/J..Carr.........Mux..Fork....51
...8-14-23...1,523,377.....1-13-25...J.Brady................M11.-.Radio..11
...8-22-23...1,562,820....11-24-25...J.Brady................M11.-.Radio...3
..11-07-23...1,665,594.....4-10-28...H.Krum.................M12.Printer..15
..12-23-24...1,745,633.....2-04-30...S.Morton/H.Krum........M14.Printer..52
...7-16-26...1,783,382....12-02-30...H.Krum.................M14.Select...22
...6-19-26...1,769,834.....7-01-30...W.Harding..............GPE.EOL.Ind..28
...4-09-27...1,796,378.....3-17-31...H.Krum.................M14.6-level..19
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Document Notes

Note by Jim Haynes: Above document received from Bill Lill 8 Nov 1999. Ran Slayton started at Teletype about 1946, after working for Western Union. He died in 1998.

This document was formatted by Gil Smith, July 2001. The original file, slayton--tty-patents.txt, is courtesy of Jim Haynes.
Pardon all the periods in the patent table -- I needed to space it out, and pasting together a proper html table seemed like too much work today.