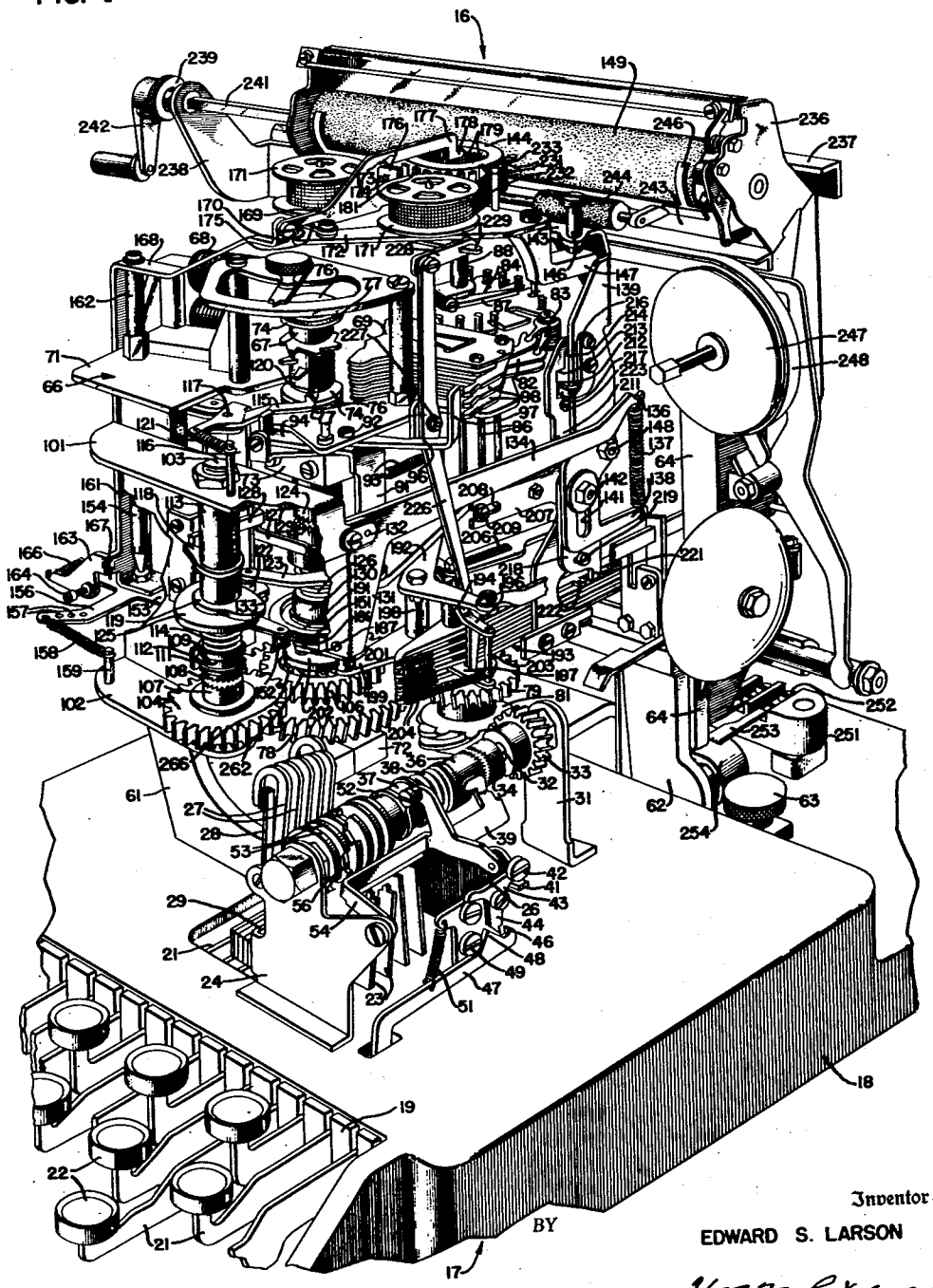
July 8, 1941. E. S. LARSON 2,248,097

PRINTING TELEGRAPH APPARATUS

Filed May 19, 1938 2 Sheets-Sheet 1

FIG. 1




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PRINTING TELEGRAPH APPARATUS

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FIG. 4

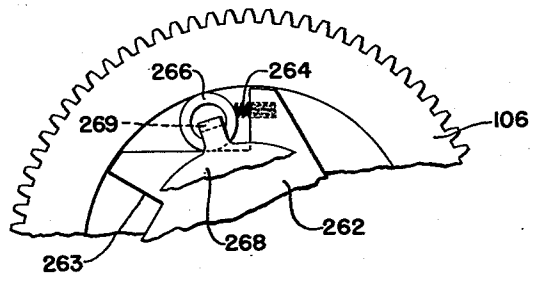



FIG. 2

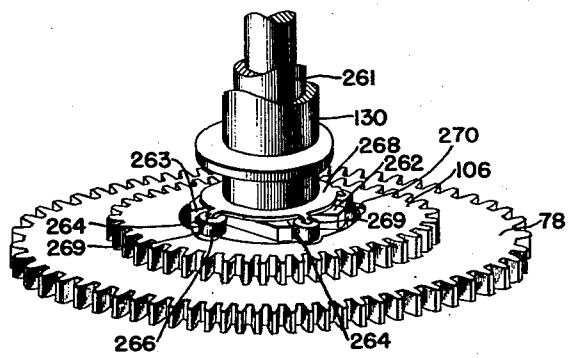
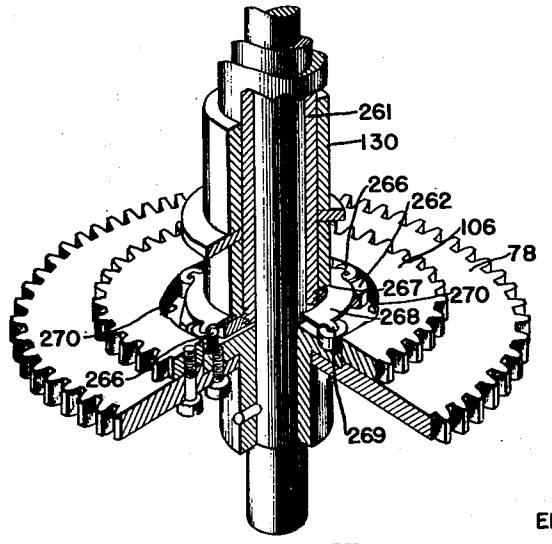



FIG. 3




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Patented July 8, 1941 2,248,097

# UNITED STATES PATENT OFFICE

2,248,097

## PRINTING TELEGRAPH APPARATUS

Edward S. Larson, Chicago, Ill., assignor to Teletype Corporation, Chicago, Ill., a corporation of Delaware

Application May 19, 1938, Serial No. 208,761

8 Claims. (Cl. 197—53)

This invention relates to printing telegraph apparatus and particularly to printing telegraph apparatus in which the characters are printed in page form from type elements carried upon the periphery of a rotatable and selectively arrestable wheel.

An object of the invention resides in the provision in a printing telegraph receiving unit embodying a type wheel having radially movable type elements, of instrumentalities for actuating said type elements including a print hammer effective by overtravel produced by kinetic energy of the print hammer and of part of the lever system by which motion is transmitted to the print hammer.

Another object of the invention resides in an improved and simplified method of assembling a roller bearing grip clutch.

The invention features, in a printing telegraph receiving unit embodying a type wheel having independently reciprocable character elements, a cam controlled system of levers for imparting reciprocatory movement to a print hammer which reciprocates the type pallets. A yieldable element is included in the system of levers which permit the print hammer and a portion of the lever system to overtravel after the control by the cam has been completed, the yieldable element allowing the print hammer to actuate the selected type element and immediately retracting the print hammer to unoperated position even though the member immediately controlled by the cam may remain in fully operated position.

The invention also features the use of a spider for simplifying the assembly of a roller bearing clutch mechanism, the fingers of the spider receiving the rollers and enabling the compression of springs for the individual rollers by a single operation whereby the roller assembly may be worked into a ring member as a unit without necessitating manipulation of the rollers individually. The spider becomes a permanent part of the assembly and serves as a retainer for the rollers.

In a copending application, Serial No. 77,796, filed May 4, 1936, by Albert H. Reiber, there is disclosed a type wheel printer with reference to which the present invention stands as an improvement. According to the disclosure of that application the displaceable type elements carried by the type wheel are individually actuated by a pivoted actuating member which is operated by a pivotally mounted impact member or hammer. Operation of the hammer through a full stroke sufficient to cause the printing of a character is effected by a cam operated bail.

According to the present invention, a reciprocable printing member is provided for actuating the type elements individually. A bail carries a follower roller which engages the periphery of a printing cam, the bail being biased into engagement with the cam by a tension spring. Operation of the printing member is effected when the printing bail cam follower roller rides down an abrupt drop in the printing cam. The distance through which the printing bail is operated by its spring is insufficient to bring the printing member into engagement with a type element. A spring is interposed between the printing bail and a bell crank to which the printing member is articulated. The combined inertia of the printing member and of the bell crank to which it is articulated causes those elements to overtravel, the interposed spring yielding and permitting the overtravel. The amount of overtravel is sufficient to cause a selected type element to effect printing and the spring which yields and permits the overtravel immediately retracts the printing element to unoperated position, thereby clearing the path of unoperated type elements so that the type wheel may be rotated to a new position.

The copending application above-identified discloses a main operating cam assembly which is driven by a continuously rotatable shaft through a spring loaded jaw clutch capable of driving in one direction only. In a copending application, Serial No. 193,642, filed March 3, 1938, by Albert H. Reiber, there is disclosed a similar main operating cam assembly similarly driven by a jaw clutch. The cam assembly has secured thereto the inner element of a roller bearing grip clutch the outer element of which is a ring gear which is secured to the driving gear for the main operating shaft. Roller bearing members are urged by compression springs into gripping engagement with the inner and outer members of the roller bearing grip clutch, the purpose of the assembly being to limit the speed of rotation of the main operating cam assembly to that of its driving shaft, should it tend to accelerate under conditions of negative load. The roller bearing grip clutch is arranged in compact relation to the main cam assembly, which necessitates placement of the roller bearing members substantially in proper position with respect to the inner member, with the compression springs interposed between the inner member and the

rollers, whereupon the inner member and rollers are worked into position in the outer member.

In order to simplify the assembly of the roller bearing clutch member and obviate the individual handling of the rollers during insertion into the outer member, a method of assembly has been developed which involves the use of a spider having fingers for receiving the rollers. The spider is supported by the cam assembly above the inner roller bearing clutch member and is freely rotatable upon the cam assembly but is not movable axially thereof. After the compression springs have been placed in sockets in the inner clutch member and the rollers have been placed upon the fingers of the spider, the spider may be rotated relative to the inner clutch member in the direction to compress the springs whereby the rollers are worked in close to the surface of the inner clutch member and are prevented from being thrust outwardly by the compression springs. The compression springs exert a frictional retaining force upon the rollers and prevent them from falling from the fingers. The assembled inner clutch member, spider and rollers may then be inserted into the outer member of the roller bearing clutch and the spider serves as permanent retainer for the rollers.

Certain features of invention disclosed but not claimed herein are also disclosed and are claimed in copending application, Serial No. 193,642 filed March 3, 1938, by Albert H. Reiber, Serial No. 203,021 filed April 20, 1938, by Berthel F. Madsen, Serial No. 204,038 filed April 25, 1938, by Carl A. Levin, Serial No. 210,816 filed May 31, 1938, by Carl W. Swan, and Serial No. 211,496 filed June 3, 1938, by Herman Lotterman.

For a complete understanding of the invention reference may be had to the following detailed description to be interpreted in the light of the accompanying drawings, wherein—

Fig. 1 is a perspective view of the combined transmitting and receiving mechanism according to the present invention, certain portions being broken away to clarify the showing;

Fig. 2 is a perspective view to illustrate the method of assembling the roller bearing grip clutch, showing the subassembly of inner clutch member, retaining spider, and rollers about to be inserted into the outer clutch member;

Fig. 3 is a perspective view partly in section showing the completely assembled roller bearing grip clutch; and

Fig. 4 is a detail view of the roller bearing clutch mechanism.

Referring now to the drawings and particularly to Fig. 1, the reference numerals **16** and **17** designate generally the typing unit and keyboard transmitter unit respectively, of a printing telegraph apparatus embodying the present invention. The keyboard transmitter unit **17** is generally similar to the transmitter disclosed in copending application Serial No. 77,796, filed May 4, 1936 by Albert H. Reiber, and typing unit **16** embodies improvements on the typing unit disclosed in the copending application.

The foundation of the keyboard transmitter unit is the base casting **18** to the forward vertical wall of which is secured a slotted comb **19**. A plurality of key levers **21** are pivoted within the casting **18** for rocking movement in a vertical plane, and these key levers protrude from the interior of base **18** through a slot in comb **19**. The key levers **21** are provided with keytops **22** and are arranged to impart characteristic settings to permutation code bars contained within base **18** as fully disclosed in Patent No. 1,595,472 granted August 10, 1926, to Howard L. Krum. To the code bars are articulated lock levers **23** pivotally supported intermediate their ends and projecting above the upper surface of base casting **18** through apertures therein. The lock levers **23** are therefore subject to permutative setting by the code bars under the control of key levers **21**.

The upwardly projecting portions of the lock levers **23** are disposed between brackets **24** and **26** secured to base **18**, and aligned with each of the lock levers **23** is a contact controlling lever **27**, the levers **27** being pivotally supported by a pivot rod (not shown) extending between brackets **24** and **26**. A transmitting contact spring **28** individual to each of the levers **27** is mounted between insulating strips upon laterally extending portions of brackets **24** and **26**, as indicated at **29**. The upper end of each contact spring **28** engages a gooseneck portion of lever **27** and the flexing of contact spring **28** into and out of engagement with a shorter associated contact spring is controlled by gooseneck lever **27**. The rocking of the gooseneck lever **27** is, in turn, controlled by the lock levers through blocking lugs (not shown), a lever **27** being unblocked when its corresponding lock lever is presented in extreme clockwise position and being blocked when its corresponding lock lever is in extreme counterclockwise position.

Bracket **24** and another bracket designated by the reference numeral **51** rotatably support a signal transmitting distributor shaft **32**. Near one end shaft **32** has secured thereto a gear **33** to which rotation is continuously imparted by another gear as will presently appear. Adjacent to gear **33**, shaft **32** has secured thereto the driving element **34** of a jaw clutch. A driven clutch element **36**, slidable upon shaft **32**, is keyed to a cam sleeve **37** and is urged toward clutch driving element **34** by a compression spring **38**. A pivoted clutch throwout lever **39** normally holds driven clutch element **36** out of engagement with driving element **34** against the force exerted by compression spring **38**. Clutch throwout lever **39** has an arm **41** which terminates substantially in engagement with an abutment screw **42** carried by a clutch tripping bell crank **43**. A depending arm **44** of bell crank **43** has its outer end disposed in the path of a lug **46** carried by a link **47** which enters the keyboard base **18** and is there connected to a universal bail (not shown). When link **47** is shifted forwardly of the keyboard transmitter base by operation of the universal bail under the control of one of the key levers **21**, it rocks bell crank **43** clockwise which, in turn, trips clutch throwout lever **39** and permits spring **38** to shift driven clutch element **36** into engagement with driving element **34**. As link **47** is moved forward, it is cammed downwardly by cooperation of a cam projection **48** with the head of a screw **49** carried by a forwardly extending portion of bracket **26**. The camming of link **47** downwardly permits the free end of arm **44** of bell crank **43** to escape from lug **46** so that bell crank **43** may return immediately to its extreme counterclockwise position and permit clutch throwout lever **39** to return immediately into position for arresting the clutch comprising elements **34** and **36** at the conclusion of one revolution thereof, even though a key lever should be held depressed and link **47** retained in its forward position for a prolonged interval of time. Thus the operation of cam sleeve **37** by the jaw clutch is confined to a single revolution in response to each operation of a key lever. A tension spring **51** maintains en-

gagement between cam projection 48 of link 47 and the head of screw 49.

The cam sleeve 37 carries a lock bail operating cam 52 and a plurality of impulse timing cams 53. Cam 52 controls the operation of a lock bail 54 pivotally supported by brackets 24 and 26, lowering the bail into blocking relation to the lock levers 23 as the cam sleeve 37 begins to rotate, and lifting it at the end of a cycle. The function of the lock bail 54 is to prevent the shifting of lock levers 23 during a cycle of rotation of the impulse timing cams 53 and thus prevent mutilation of a signal combination established by the depression of a key lever 21. Each of the cams 53 is aligned with one of the transmitting contact control levers 27 and is engaged by a portion of the aligned lever. Each of the cams 53 has a notch 56 in the periphery thereof which, when presented to the associated transmitting contact control lever 27, releases that lever for rocking movement in counterclockwise direction, and the lever 27 rocks unless restrained by its associated lock lever 23. The recesses 56 in the several cams 53 are arranged spirally about the cam assembly so that the levers 27 are released for rocking movement successively. When a lever 27 is permitted to rock counterclockwise by its cam 33, its contact spring 27 flexes into engagement with the associated short contact spring and a current impulse is impressed upon the telegraph line, the duration of which corresponds to the interval in which the lever 27 remains in its counterclockwise position. The cams 53 thus distribute to the telegraph line the signal impulses corresponding to a character represented by a key lever depressed. One of the contact controlling levers 27 has no lock lever associated with it and operates invariably once in each cycle of operation of the transmitting cam for impressing on the line the stop impulse.

The principal foundation element of the typing or receiving unit is a casting which mounts on the keyboard base 18 and has a portion 61 located centrally of the base 18 and a portion 62 extending transversely of the base 18 in proximity to the rear edge thereof. Thumb screws are employed for securing the casting comprising portions 61 and 62 to the base 18, one of those screws being indicated at 63. A secondary casting 64 extends transversely of the keyboard base 18 and is secured to portion 62 of the primary casting by any desired means, such as screws. The primary casting supports all of the power driven shafts, the operating cam assemblies, the selector mechanism, the printing mechanism, and the ribbon feed mechanism. The secondary casting 64 supports the platen carriage and associated mechanism, the signal bells, and a set of levers by which various functions are performed.

The primary selector mechanism which integrates the signal combinations generated in the keyboard transmitter mechanism, hereinbefore described, or in a remote transmitter, is indicated generally by the reference numeral 66 and is generally similar to the primary selector mechanism disclosed in the hereinbefore identified copending application of Albert H. Reiber, Serial No. 77,796. The principal elements of the selector mechanism 66 are a selector cam assembly 67, a selector magnet 68, and a sword and T-lever assembly 69, the last mentioned assembly as well as the selector magnet being supported by a mounting plate 71 carried by the forwardly extending portion 61 of the primary casting. The selector cam assembly 67 is carried by the upper end of a vertically positioned shaft which is rotatably supported in bearing blocks 72 and 73. The selector cam assembly 67 has flanges 74 secured thereto at opposite ends, and in spaced relation to each flange 74 is a flange 76 secured to the shaft which supports the cam assembly 67. A friction disc 77 occupies the space between each of the flanges 74 and the adjacent flange 76. Considerable friction is generated between the discs 77 and those positioned on either side of them so that selector cam assembly 67 will rotate with its supporting shaft except when restrained under the control of selector magnet 68, as is well known in this type of single magnet selector mechanism.

Just above the point at which it enters lower bearing block 72, the shaft has secured thereto a gear 78. An electric motor (not shown) drives a pinion which meshes with gear 78 so that the shaft to which the gear 78 is secured is continuously rotated. It may be added at this point that a gear 79 carried by a stub shaft meshes with gear 78 and that a spiral gear 81 also secured to the stub shaft meshes with gear 33 carried by the transmitter shaft 32. Thus rotation is imparted to the transmitting distributor shaft 32 from the motor pinion through gears 78, 79, 81, and 33.

The sword and T-lever mechanism 69 is actuated under the joint control of selector cam assembly 67 and the selector magnet 68 to interpret or integrate a series of impulses representing a signal combination preparatory to setting T-levers 82 in accordance with the signal combination. Each of the T-levers 82 engages one arm of a transfer bell crank 83, the other arm of which is articulated to one of the notched code discs of a code disc selector mechanism indicated generally by the reference numeral 84.

The code disc selector mechanism 84 has a circular arrangement of vertically positioned stop pins 86 which project through slots in the topmost plate of the mechanism. Stop pins 86 are biased inwardly radially of the code disc selector mechanism and near their upper ends they rest against the edges of shiftable notched code discs as is fully disclosed in the copending application of Albert H. Reiber, Serial No. 77,796. The notching of the code discs is such that for any permutative setting of the discs under the control of T-levers 82 one only of the stop pins 86 finds presented to it an alignment of notches, whereupon the pin therefor enters the alignment of notches under the influence of its biasing spring, its upper end moving inwardly. A type wheel stop arm 87 clamped to type wheel shaft 88 is of such length that in revolving, it just clears those of the stop pins 86 which are held in their outermost positions by the code discs, but finds blocking its path any pin 86 which has entered an alignment of notches in the periphery of the code discs. The type wheel shaft 88 extends downwardly through the code disc selector mechanism 84 coaxially thereof and receives a continuous torque from the driving motor through any convenient means, such as a gear carried by the shaft 88 and connected thereto by friction discs, the gear being continuously in mesh with the motor pinion. With this arrangement, the shaft 88 is always prepared to rotate and is free to do so when any stop pin 86 which had been previously selected is moved out of the path of the stop arm 87 upon the resetting of the code discs. With this arrangement, shaft 88 may be

arrested in any angular position in which stop arm 87 encounters a stop pin 86.

The setting of the T-levers 82 according to the operation of the sword lever mechanism 69 is controlled by a transfer bail 91 which is cam operated as will presently appear. Transfer bail 91 is pivotally supported by an upper mounting screw 92 and by a lower mounting screw which does not appear in Fig. 1. Transfer bail 91 is biased in counterclockwise direction by tension spring 93 and has oppositely extending arms 94 and 96, the former of which is only partially indicated in Fig. 1 but which supports transfer springs, as is clearly indicated in the copending application Serial No. 77,796, and the latter of which carries a locking blade 97 that cooperates with extensions 98 of T-levers 82. Locking blade 97 ordinarily blocks the extensions 98 of T-levers 82 whether they be presented in extreme clockwise or counterclockwise position. The rocking of transfer bail 91 in clockwise direction to effect the resetting of T-levers 82 is accompanied by withdrawal of locking blade 97 out of the path of movement of T-lever extensions 98. When the transfer has been completed, transfer bail 91 returns to its extreme counterclockwise position and locking blade 97 is restored to locking position with respect to extensions 98.

The front portion 61 of the primary foundation casting for the typing unit has secured thereto spaced brackets 101 and 102. A shaft 103 is rotatably supported in vertical position between brackets 101 and 102. Shaft 103 has secured thereto near the lower end a gear 104 which permanently meshes with a gear 106 supported by gear 78 and secured thereto by any desired means, such as screws. The hub of gear 104 has secured thereto the driving portion 107 of a positive engagement clutch mechanism, the driven portion of which is indicated by the reference numeral 108. The driven element 108 may be of the type disclosed in copending application Serial No. 165,437, filed September 24, 1937, by B. F. Madsen, having in its periphery a groove designated 109 in the present application, which receives the portion 111 of the clutch throwout lever 112. The portion 111 of the clutch throwout lever 112 confines driven clutch element 108 to substantially complete engagement with driving element 107 during a cycle of operation following the tripping of the clutch, and prevents acceleration of the driven element of the clutch from the speed imparted to it by the driving element 107, should any torque generated by negative load resulting from the interaction of a cam follower and its cam be applied to the driven clutch element 108. Driven clutch element 108 is slidably splined or keyed to a cam assembly sleeve 113 and is urged into engagement with driving element 107 by compression spring 114.

Clutch throwout lever 112 is carried by the lower end of a pivoted bail 116, the upper pivot of which is indicated 117. At its upper end, bail 116 is provided with an arm 115, the free end of which is disposed in the path of the lowermost cam projection 120 of selector cam assembly 67. Bail 116 is biased in counterclockwise direction by tension spring 121. When cam projection 120 on selector cam assembly 67 encounters arm 115 of bail 116, the bail is rocked in clockwise direction, thus withdrawing clutch throwout lever 112 from restraining engagement with the driven clutch element 108 of the clutch on the front shaft, and permitting driven element 108 to move into engagement with driving element 107 whereby rotation is imparted to cam sleeve 113.

Cam sleeve 113 supports three cams designated 118, 119, and 125. Cam 119 is engaged by a follower roll 122 carried by an arm 123 secured to transfer bail 91. The direction of rotation of cam sleeve 113 is counterclockwise and cam 119, in being rotated, imparts clockwise rotation to arm 123 and therefore to transfer bail 91. Transfer bail 91, as previously set forth, effects the permutational rearrangement of T-levers 82 and therefore the notched code discs in the code disc selector mechanism 84 in accordance with a signal combination which has been integrated in the sword lever mechanism 69.

As previously set forth, there is a shaft rotatably supported in vertical position by bearing blocks 72 and 73 to which the gear 78 is secured. Below bearing block 73 the shaft has secured thereto the driving element 124 of a positive drive clutch, the driven element of which is indicated 129. Driven element 129 is slidably splined or keyed to a main cam assembly 130 and is urged into engagement with driving element 124 by a compression spring 126. The engagement and disengagement of the elements 124 and 129 of the main cam assembly driving clutch mechanism is controlled by a pivoted clutch throwout lever 127 to which is secured an arm 128 that extends forwardly of the typing unit and terminates in the path of the apex of cam 118 carried by cam sleeve 113 on the front shaft. As indicated in Fig. 1, in which the clutch mechanisms on the front shaft and on the main cam driving shaft are shown in their rest positions, the rest position of the apex of cam 118 is a small angular distance in counterclockwise direction from the end of arm 128 which effects the tripping of the main cam clutch comprising elements 124 and 129. Since, as previously stated, cam cylinder 113 rotates in counterclockwise direction, it will be apparent that cam 118 operates upon arm 128 to effect the tripping of driven clutch element 129 just before cam 118 reaches the end of a cycle of operation.

The bracket 101 which rotatably supports the upper end of shaft 103 pivotally supports a bail 131, the pivot being indicated 132. The bail 131 supports a cam follower arm which has been omitted from the showing of Fig. 1 for the reason that it would conceal substantial portions of the main cam assembly 130 carried by the rotatable shaft which is supported in bearing blocks 72 and 73. The cam follower arm carries at its free end a follower roll which engages cam 125 at a point between cam assemblies 113 and 124. The contour of cam 125 comprises a smooth gradual rise and a sharp drop-off, the drop-off being indicated by a reference numeral 133. As cam 125 rotates counterclockwise, it shifts its follower roll away from the axis of shaft 103 and thus imparts a counterclockwise rotation to bail 131. In the rest position of cam 125, the drop-off 133 is a small angular distance beyond the point of engagement of the cam follower roll with cam 125. The tendency of the cam 125 therefore is to permit bail 131 to return sharply to its extreme clockwise position just before cam 125 reaches its rest position. However, as will presently appear, a cam included in the cam assembly 130 assumes control of bail 131 just before the sharp drop-off 133 in cam 125 is presented to its follower, and the cam in cam assembly 130 holds bail 131 in extreme counterclockwise position for a predetermined interval and thereafter

controls the restoration of bail 131 to its extreme clockwise position.

Bail 131 has integral therewith an arm 134 which extends toward the rear of the typing unit and terminates in a spring hanger hook 136. Hook 136 supports one end of a tension spring 137, the opposite end of which is connected to an arm 138 of a type wheel supporting frame 139.

Frame 139 is provided with a vertically disposed slot 141, through which extends a stud 142 supported by a portion of the frame of the typing unit. At the top, frame 139 has a horizontally extending portion 143 through which type wheel shaft 88 passes and in which is rotatably held the hub of a type wheel 144. Vertically disposed guide pins 146, only one of which appears in Fig. 1, are supported by a stationary bracket 147 at the top of the typing unit and pass through apertures in the horizontal portion 143 of type wheel supporting frame 139. The pins 146 and the cooperating elements comprising slot 141 and stud 142 permit oscillatory movement of frame 139 vertically, and guide the frame in that movement. Frame 139 is provided with an abutment screw 148 against which arm 134 of bail 131 rests when the bail 131 is in extreme clockwise position and frame 139 is in the lowermost position. When bail 131 is rocked in counterclockwise direction by cam 125, bail arm 134 tends to move out of engagement with abutment screw 148 and spring 137 tends to be distended. Spring 137, in turn, lifts frame 139, and thus type wheel 144, the normal position of which is below the printing line, is elevated so as to bring character elements carried upon the periphery of the type wheel into position to effect printing in a line upon a page carried in engagement with cylindrical platen 149. When bail 131 is restored to its extreme clockwise position, arm 134 engages abutment screw 148 and restores frame 139 to its lowermost position which, in turn, restores type wheel 144 to its lowermost position, whereby each character becomes visible immediately after being printed.

As previously set forth, main cam sleeve 130 is set in operation by the tripping of clutch throwout lever 127 by cam 118 included in front cam assembly 113 just before cam 118 reaches its rest position. The uppermost of the cams carried by cam assembly 130, designated 151, is engaged on the periphery thereof by a follower roll 152 carried at the end of a lever 153 which is pivoted at 154. Lever 153 has integral therewith an arm 156 which is provided near its outer end with a plurality of spring connection apertures 157. Any one of the apertures 157 is adapted to receive one end of a tension spring 158, the other end of which is supported by a spring post 159. Spring 158 biases lever 153 in counterclockwise direction, thus urging cam follower roll 152 into engagement with the periphery of cam 151. The several spring mounting apertures 157 in arm 156 of lever 153 are at different distances from spring post 159 so that the tension exerted by spring 158 and therefore the torque applied to lever 153 may be varied.

A print hammer operating bail 161 is pivotally supported by pivot 154 and coaxially mounted pivot 162. At its lower end, bail 161 is provided with an arm 163 which supports adjustable abutment screw 164 and also one end of a tension spring 166. The inner end of abutment screw 164 engages an arm 167 of lever 153 and the rearmost end of tension spring 166 is also connected to arm 167 of lever 153. With this arrangement, bail 161 tends to occupy an extreme clockwise position with respect to lever 153, the extremity of the position being determined by abutment screw 164.

Print hammer operating bail 161 has integral therewith at its upper end a lever arm 168. At its free end, lever arm 168 is loosely articulated to a print hammer 169. Print hammer 169 extends between ribbon spools 171, rotatably mounted upon a ribbon feed mechanism supporting plate 172. Print hammer 169 is provided with upper and lower arms 173 and 174, respectively, which are disposed in the same vertical plane. Lower arm 174 enters a slot in a bracket 176, carried by ribbon feed mechanism foundation plate 172, and by means of slotted bracket 176, print hammer 169 is held in a vertical plane and is guided in reciprocatory motion imparted by arm 168 of bail 161. The upper arm 173 of print hammer 169 is longer than the lower arm 174 and extends across the periphery of type wheel 144 and across the upper end of type wheel shaft 88. At its free end, arm 173 is provided with a depending portion 177 which, in turn, is provided with an arm 178, the location of which is in alignment with the foremost portion of platen 149, which portion is at the level where printing occurs. Print hammer 169 is provided in its lower edge with a shallow recess 170, the base of which rests upon and slides upon a retainer bar 175 secured to ribbon mechanism base plate 172. The motion of print hammer 169 to effect printing is limited by engagement of one end of recess 170 with bar 175, and the restorational motion may, if desired, be limited by engagement of the other end of recess 170 with bar 175.

The print hammer 169 may be lifted out of its position above the type wheel 144 to permit adjusting or changing the type wheel, by springing the free end of print bail arm upwardly until the rearmost end of recess 170 clears bar 175, whereupon arm 174 of the print hammer may be drawn clear of slotted bracket 176, and the print hammer may be rotated upwardly in a vertical plane about its pivot of articulation with bail arm 168.

Type wheel 144 may be generally similar to the type wheel disclosed in the hereinbefore identified application of Albert H. Reiber, Serial No. 77,796, and also in application Serial No. 77,794, filed May 4, 1936, by Howard L. Krum et al. As shown in those copending applications and as clearly indicated in Fig. 1 of the present application, type wheel 144 is provided with a plurality of radially disposed type pallets 179 which are reciprocably mounted in radial slots in type wheel 144, and are provided at their outer ends with type elements 181. There may be two superposed rows of type pallets 179, and by means of the lifting of type wheel supporting frame 139 by lever 134, either of the rows of type pallets may be brought into alignment with rearwardly presented portion 178 of print hammer 169. For any angular position of arrestment of type wheel 144 by the cooperation of type wheel stop arm 87 with a selected stop pin 86, two of the type pallets 179 will be directed toward platen 149 in the same vertical plane as print hammer 169. According to the distance that type wheel 144 has been lifted by lever arm 134, the distance being controllable, as will appear later, one or the other of the type pallets 179 will be disposed directly in the path of portion 178 of print hammer 169.

Cam 151, in its normal or rest position, holds

print bail operating lever 153 in extreme clockwise position in opposition to the tension of spring 158. Spring 166 holds print hammer bail 161 in extreme clockwise position with its abutment screw 164 in engagement with arm 167 of print bail operating lever 153. Thus, print hammer 169 is held in retracted position. At a predetermined time in the operation of cam 151, a sharp drop-off is presented to follower roll 152 of print bail operating lever 153. When the drop-off is encountered, lever 153 is rocked sharply in counterclockwise direction by spring 158. Lever 153 imparts counterclockwise movement to bail 161 through abutment screw 164. The angular distance through which lever 153 rocks, as cam follower 152 descends to the lowest or innermost point on the periphery of cam 151 is just short of sufficient to drive print hammer 169 positively against the type pallet 179 aligned therewith. However, the inertia of bail 161 and print hammer 169 causes spring 166 to yield and abutment screw 164 to move out of engagement with arm 167. Thus print hammer 169 overtravels or moves a greater distance than it would if positively interconnected with lever 153, the overtravel being caused by the inertia of bail 161 and print hammer 169, and being permitted by spring 166.

As soon as the energy generated by the inertia of bail 161 and print hammer 169 has been expended, spring 166 withdraws print hammer 169 in the direction of its retracted position until abutment screw 164 returns into engagement with arm 167 of lever 153. The remainder of the movement of print hammer 169 to its rest position is effected by the restoration of lever 153 to its extreme clockwise position by cam 151. The overtravel in the movement of print hammer 169 is sufficient to reciprocate the aligned type pallet 179 radially of type wheel 144 to effect printing. During the period of overtravel and restoration, the free end of arm 173 of print hammer 169 is presented between the type pallets adjacent to that which is being operated, so that the type wheel 144 could not be rotated, even if permitted to do so by arm 87, due to the fact that interference between arm 173 of print hammer 169 and adjacent unoperated type pallets would occur. Spring 166 withdraws print hammer 169 from a position of interference with unoperated type pallets much more rapidly than it could be withdrawn if positively connected to print hammer bail operating lever 153. Thus, with the arrangement hereinbefore described, the print hammer 169 is projected and retracted in the shortest possible interval of time so that more time may be allowed for the rotation of type wheel 144 to the position corresponding to the next selection.

In a preceding paragraph, the lifting of the type wheel to bring either of its two rows of type pallets into printing position was described. The lifting is accomplished by the counterclockwise rocking of bail 131 which has an arm 134 interconnected with the type wheel supporting frame 139 by spring 137. It was stated that the lifting of the type wheel supporting frame 139 is effected by a cam 125 on the front shaft. It was also stated that the lowering of type wheel supporting frame 139 is controlled by a cam included in the cam assembly 130 on the main shaft. This cam is indicated by the reference numeral 186, and is of the internal species having its cam surface on the inside of a depending peripheral flange. The internal cam surface is engaged by a follower roller carried at the free end of an arm 187, secured to type wheel lifting bail 131. Spring 137 biases bail 131 in clockwise direction as previously set forth and, in so doing, urges the follower roller carried by arm 187 to seek engagement with the internal cam surface of cam 186. Cam 186 does not have a restricting channel, so that the follower carried by arm 187 is free to be moved away from engagement with the interior of the depending flange of cam 186 when bail 131 is rocked in counterclockwise direction by cam 125. During the initial stages of the lifting of frame 139 by cam 125, cam 186 may be stationary.

About the time that cam 125 has rocked bail 131 to its extreme counterclockwise position, and before the drop-off of the cam is presented to its follower roller, the innermost portion of the cam surface of cam 186 is presented in engagement with the follower roller carried by cam follower arm 187. During the engagement of the follower roller carried by arm 187 with whatever dwell there may be at the innermost portion of the internal cam surface of cam 186, bail 131 will be held in extreme counterclockwise position and lever arm 134 will be held in a corresponding position. As cam 186 continues to rotate and the receding cam surface is presented to its follower (the recession being radially away from the axis of the cam), bail 131 will be restored by a controlled motion to its extreme clockwise position, and type wheel supporting frame 139 will be restored to its lowermost position to render visible the character just previously printed. It will be apparent that when the type wheel frame 139 is being elevated, the cam follower, by means of which the lowering of the frame will subsequently be controlled, is moved out of engagement with its cam surface, and that when the frame 139 is being held in elevated position, and is being lowered, the cam follower by which its elevation was accomplished will be held out of engagement with the elevating cam.

Of the principal mechanisms of the typing unit 16, there remains for consideration only the function mechanism. This mechanism is, in general, similar in construction and operation to the function mechanism disclosed in the copending application of Albert H. Reiber, Serial No. 77,796. The function mechanism may be understood to include those mechanisms by which such operations as shift, unshift, carriage return, line feed, signal bell operation, and transmitter disablement are selected and accomplished. Those functions which are materially different from the corresponding functions, as disclosed in the copending application of Albert H. Reiber, Serial No. 77,796, and which will be described in detail, are shift and unshift, by means of which selection of characters in the letters or figures bank of type pallets is accomplished.

The selection of a function is accomplished by means of a testing mechanism which is cam controlled. Since the testing operation can be conveniently performed by a groove or channel cam, a channel 191 is provided in the upper surface of print bail operating cam 151. A cam follower, which could not be shown in Fig. 1, is fitted into the groove or channel 191 in cam 151, and the follower arm is part of a bail 192 which is operated to test for the selection of functions, and to condition in accordance with the selection one or more of a plurality of function bars, indicated generally by the reference numeral 193. The manner in which the presence of a function is

tested and in which the function bars 193 are conditioned is fully disclosed in the copending application of Albert H. Reiber, Serial No. 77,796.

The function bars 193 are pivotally mounted upon rod 194. Rod 194 is supported between spaced arms 196 and 197, which comprise a function bail pivoted upon pivot rod 198. The lower arm 197 of the function bail has integral therewith an arm 199 at the free end of which is supported a cam follower roller 201. A function cam 202, carried by the main cam sleeve 130, has its periphery engaged by roller 201, and when cam 202 occupies rest position, arm 199 and the function bail comprising arms 196 and 197 are disposed in extreme clockwise position.

At their free ends, the arms 196 and 197 support a spring post 203 to which is hooked one end of each of a plurality of tension springs 204. Each of the springs 204 has its other end connected to one of the function bars 193. Thus, the function bars 193 are biased in counterclockwise direction, and movement of any of them in clockwise direction is opposed by its particular tension spring 204.

The conditioning of function bars 193, under the control of bail 192 in response to a function selection, is manifested by rotation of one or more of the function bars 193 through a small angular distance in clockwise direction. Such rotational movement brings the conditioned function bar out of alignment with the unselected function bars and into position to initiate or perform its assigned function. Immediately after the conditioning of one of the function bars 193, cam 202 rocks its follower arm 201 and the function bail comprising arms 196 and 197 in counterclockwise direction. Since the function bars 193 are pivotally mounted upon rod 194, carried by bail arms 196 and 197, they are moved endwise toward the rear of the printer as cam follower roller 201 is moved to its outermost position with respect to cam 202. Those of the function bars 193 which have not been conditioned by being rocking in clockwise direction are reciprocated idly while one conditioned function bar 193 initiates or performs the assigned function as a result of the reciprocatory movement. The rod 194, carried by function bail arms 196 and 197, also is pivotally engaged by a spacing pawl 206 which is reciprocated to effect spacing of the platen carriage as the function bars 193 are reciprocated rearwardly of the printer. The spacing operation and the performance of the several functions excepting shift and unshift are sufficiently similar to those disclosed in the copending application Serial No. 77,796, that it is considered unnecessary to describe them in detail here. However, the shift and unshift functions will now be described.

The hereinbefore identified stud 142, which guides the type wheel supporting frame 139 in its upward and downward movements, extends through a horizontally extending slot in a slide member 207. The slide member 207 is also provided with an open ended slot 208 through which extends a screw 209, carried by the frame of the typing unit. The stud 142 and screw 209 support the slide member 207 and guide it throughout a limited sliding movement forwardly and rearwardly of the typing unit.

The slide member 207 has integral therewith a vertically extending arm 211. The arm 211 is provided near its upper end with a step cut aperture 212. By virtue of the step cutting, two abutments or stop surfaces are provided, the lower of which is indicated by the reference numeral 213, and the upper of which is indicated by the reference numeral 214 and is the upper end of the aperture 212. The type wheel supporting and lifting frame 139 has adjustably secured thereto a bracket 216, which has an arm 217, extending into the aperture 212 of the slide member 207. When the type wheel lifting frame 130 is lifted by bail arm 134, operating through spring 137, arm 217 of bracket 216 may encounter either of the stop surfaces 213 or 214, depending upon whether the slide member 207 is presented in its rearmost or foremost position, and thereby the type wheel lifting frame 139 will be arrested in either of two positions of elevation while bail arm 134 continues to be rocked to its extreme counterclockwise position. When the type wheel lifting frame 139 is arrested by the lower stop surface 213 of slide member 207 the upper row of type pallets carried by type wheel 144 is presented in alignment with the operating extension 178 of print hammer 169, and when the frame 139 is permitted to be lifted until its arm 217 encounters the uppermost stop surface 214, the lower row of type pallets will be presented in alignment with the print hammer 169, and with the character impression level of the platen 129.

The movement of slide member 207 from one to the other of its two positions is accomplished by two levers pivoted upon stud 142, one of the levers being pivotally supported between slide member 207 and the frame elements which support stud 142 and which, therefore, is behind slide member 207 and cannot be seen in Fig. 1, and the other of which is pivotally supported between slide member 207 end type wheel lifting frame 139 and is indicated by the reference numeral 218 in Fig. 1. A screw 219 establishes a pivotal interconnection between the slide member 207 and its operating lever 218. Lever 218 is provided with a depending finger 221. The first and second of the function bars 193, counting from the top, each have extending laterally therefrom a lug, one of which appears in Fig. 1 and is indicated by the reference numeral 222. The depending finger 221 of lever 218 occupies a position directly in the path of lug 222 when the function bar which carries lug 222 has been conditioned for function performance by being rocked in clockwise direction preparatory to being moved endwise by cam 202, operating through arm 201 and bail arms 196 and 197. When lever 218 is in its extreme counterclockwise position, which is the condition when slide member 207 occupies the rearmost of its possible positions, finger 221 is disposed substantially at the limit of movement of lug 222 so that it will not be affected if the function bar by which lug 222 is carried is conditioned and reciprocated. When however, the slide member 207 occupies the foremost position, lever 218 will be presented in extreme clockwise position and its depending finger 221 will be positioned to be engaged by lug 222, early in the cycle of movement of that lug rearwardly of the typing unit. Under these conditions, counterclockwise movement of lever 218 by lug 222, as it moves rearwardly of the typing unit, will result in rearward movement of slide member 207 which is articulated to lever 218 by screw 219, whereby slide member 207 will be shifted to its rearmost position with stop surface 213 in the path of arm 217 carried by type wheel lifting frame 139. It will be understood that the timing of the apparatus is such that type wheel supporting frame 139 is held lowered by bail arm

134 when slide member 207 is shifted so that there shall be no interference between arm 217 and the step-cut portion of aperture 212 during the movement of slide member 207.

The restoration of the slide member 207 to its forward position is accomplished by the lever which corresponds to lever 218 and which is pivoted between slide member 207 and the frame member which supports stud 122 so that it does not appear in Fig. 1. A screw 223 establishes a pivotal connection between this lever and the slide member 207. This pivotal interconnection is above stud 142 so that when the lever is rocked in counterclockwise direction, the slide member 207 will be moved forwardly of the typing unit to its foremost position. The lower end of the lever which is pivoted to slide member 207 at 223 may be similar to the lower end of lever 218 so that when it is in extreme clockwise position, it will be disposed in the path of the laterally extending projection of that one of the function bars 193, the function of which is to shift the slide member 207 to its foremost position to permit the type wheel lifting frame 139 and the type wheel 144 to be lifted to their uppermost position whereby printing may be effected from the lower row of type pallets.

It will be apparent from the foregoing description of the levers which control the shifting of slide member 207 that both of these levers effect control by being rocked in counterclockwise direction, one being operative to shift the slide member 207 rearwardly and the other being operative to shift it forwardly. It will also be apparent that as either is rocked in counterclockwise direction by its assigned function bar 193, the motion which it imparts to the slide member 207 will cause the other lever to be rocked in clockwise direction so that they will be presented alternately in position to be operated by their respective function bars.

In addition to operating the function levers 193 and the spacing pawl 206, the function bail also operates a ribbon feed lever 226. This lever is pivoted upon a stud 227 fixed to a stationary portion of the typing unit and its lower end engages the arms 196 and 197 of the function bail. At its upper end, lever 226 is articulated to a link 228 which has a slot in which is disposed one end of a ribbon feed lever 229. The ribbon feed mechanism which is operated by lever 229 may be substantially identical with that disclosed in the copending application of Albert H. Reiber, Serial No. 77,796. The ribbon feed mechanism supporting plate 172 supports pairs of vertically disposed pins 231 which serve as guides for the inked ribbon 232, and there is also a semicircular ribbon guide which is supported by the type wheel lifting frame 139 in spaced relation to the type wheel 144 between the type wheel and the platen 149. Thus, the ribbon guide 233 is lifted each time the type wheel 144 is lifted, and a portion of the ribbon 232 is always positioned between the type wheel 144 and the platen 149 so that inked type impressions may be produced upon a page carried by platen 149.

The platen 149 is rotatably supported by the opposed ends of a carriage 236. The carriage is supported for movement transversely of the typing unit by rails, one of which is indicated as 237, secured to the rear casting member 64. The casting 64 also supports near the top thereof a bracket 238 which has a threaded aperture in coaxial relation to the platen 149. A bushing 239 threadedly engages the aperture in bracket 238 and rotatably supports a square rod 241 which enters platen 149 through one of the hubs therein and passes through a square portion of a tube which extends from end to end of the platen 149. The square shaft 241 is of sufficient length that it may extend into or through the square portion of the tube on the interior of platen 149 in any position which carriage 236 may occupy in its travel back and forth upon its supporting rails. Square shaft 241 has secured thereto a crank 242 which may be rotated manually to impart rotation to square shaft 241 and, through its cooperation with the square portion of the tube into which it extends, rotation may be imparted to platen 149.

Carriage 236 also supports a paper guiding plate or basket 243 which is disposed below the platen for guiding a page in the printing position and which, in turn, supports pressure rolls 244 and paper guide fingers 246. Carriage 236 may have associated therewith character spacing mechanism and line feeding mechanism in accordance with the disclosure of the copending application of Albert H. Reiber, Serial No. 77,796. A rotatable drum 247 is provided for housing a carriage return spring. A carriage return belt 248 has one end secured to the periphery of drum 247 and the other end secured to carriage 236.

Terminal blocks and slip connections are provided for connecting the various electrical circuit elements in the keyboard transmitter mechanism and in the typing unit to external circuits. The reference numeral 251 indicates a terminal block which is mounted on the keyboard base casting 18 behind the typing unit. Terminal block 251 has terminals 252 individually engaged by slip connection tongues 253 carried by a slip connection block 254. Slip connection block 254 is secured to the rear portion 62 of the primary typing unit casting below the secondary or carriage supporting casting 64. The contacts 252 and tongues 253 may form electrical connections between the electromagnet 68 carried by the typing unit and the transmitting contact springs 27 carried by the keyboard base and between the selector magnet and external circuit. Thus, the secondary casting and all of the elements which it supports may be removed from the typing unit without disturbing the electrical connection between the selector magnet 68 and the transmitting contacts and between the external circuit and both the selector magnet and the contacts. Also the entire typing unit may be removed from the keyboard base by removal of the thumb screws 63 whereby the slip connection tongues 253 will be removed from engagement with contacts 252 without disturbing the electrical connections between the transmitting contacts and external circuit.

The general operation of the typing or receiving unit hereinbefore described is as follows: Permutation code signals impressed upon a telegraph line to which the receiving unit is connected enter the receiving unit at terminals 252 and slip connection 253 and are impressed upon the selector magnet 68. Gear 78 and the shaft which it drives, being in operation, selector assembly 67 which is friction driven is released for a cycle of operation by the start impulse of a signal combination in accordance with the well-known practice employed in the operation of single magnet selector mechanisms controlled by start-stop signals. As the selector cam assembly 67 rotates, the sword levers contained in the sword lever mechanism 69 are set in character-

istic positions according to the signal combination received. Just before the selector cam assembly 67 completes a cycle of rotation, its cam projection 120 engages arm 115 of bail 116 and rocks the bail in clockwise direction whereby clutch throwout lever 112 is withdrawn from restraining engagement with driven clutch element 108, carried by the front shaft, whereupon the driven element 108 is shifted into engagement with driving element 107, and cam sleeve 113 is set in operation for a cycle comprising one revolution.

The first operation performed after cam sleeve 113 is set in operation is the clockwise rocking of transfer bail 91, by transfer cam 119, operating through cam follower roller 122 and follower arm 123. Transfer bail 91 operates to set the code discs contained in the code disc selector mechanism 84 in correspondence with the setting of the sword levers. The shifting of the code discs to accomplish the selection of a new stop pin 86 is accompanied by the camming of the previously selected stop pin into unselected position whereby the restraint upon type wheel stop arm 87 is removed and shaft 84 and type wheel 144 rotate to seek a new stop position. At this time, the type wheel 144 is held in its lowermost position by the type wheel lifting bail 131 and bail arm 134.

As soon as the transfer has been accomplished, the selector cam barrel 67 may be released for rotation to effect the setting of the sword levers according to a new signal combination. The timing of the operation of selector cam assembly 67 and of cam sleeve 113 carried by front shaft 103 is such, with respect to the speed of operation of transmitting apparatus, in response to which this receiving mechanism is intended to operate, that the transfer has been effected before the selector cam barrel is released by the start impulse of the next signal combination.

A predetermined interval after the transfer operation has been performed, cam 125 begins to rock type wheel lifting bail 131 in counterclockwise direction and the type wheel 144 is elevated into printing position. The position in which the type wheel will be arrested will be determined by the position occupied by slide member 207. Bail 131 will, however, be rocked to extreme clockwise position regardless of the position in which type wheel 144 is arrested, spring 137 yielding to permit the motion of bail 131 to be completed.

A short angular distance before cam 125 has rocked bail 131 to extreme counterclockwise position, cam 118, carried by cam sleeve 113, engages clutch throwout lever 128 of the clutch which comprises driving element 124 and driven element 129 on the main shaft or inner cam shaft, whereby the main assembly 130 is set in operation. By the time cam 125 has rocked type wheel lifting bail 131 to extreme counterclockwise position, internal cam 186, included in the main cam assembly 130, has assumed control of its follower arm 187, which is carried by bail 131, so that type wheel lifting bail 131 is held in extreme counterclockwise position after cam 125 has come to rest and has relinquished control over bail 131.

The front shaft may be rotated at the same speed as the main shaft so that in the reception of signals continuously transmitted, the cam sleeve 113, carried by the front shaft 103, will have a rest period between cycles of operation equal to the rest period of selector cam assembly 67 between successive code combinations. Cam sleeve 113 may, therefore, begin its next cycle of rotation before the cam assembly 130, carried by the main or inner shaft, has completed much of its cycle of operation. While cam 186 is holding type wheel 144 elevated, and before cam sleeve 113 can have rotated sufficiently far in the next cycle to operate the transfer bail, the print cam 151 brings its sharp drop off into alignment with roller 152, carried by the print bail operating lever 153, whereupon spring 158 rotates lever 153 sharply in counterclockwise direction and this movement is imparted to print bail 161, which drives print hammer 169 into engagement with the selected type pallet and which overtravels sufficiently to produce an impact between the selected type pallet and a message page carried by platen 149. At substantially the same time that print cam 151 permits print bail operating lever 153 to be rocked counterclockwise by its spring 158, cam groove 191, in the upper surface of cam 151, operates its associated bail 192, which tests for function selection as disclosed in the copending application of Albert H. Reiber, Serial No. 77,796. The effect of such testing is that a function bar 193, which corresponds to a function that may have been found to be selected is rocked clockwise through a small angular distance in opposition to its biasing spring 204, to bring it into position to initiate or perform its function.

Since tension spring 166 is effective substantially instantaneously after the printing of a character to withdraw print hammer 169 to its retracted position, which operation can be performed much more rapidly by spring 166 than it could be by cam 151, operating through bail operating lever 153, the transfer of the next signal combination can be performed sooner after the print operation than it could be with positive printing and retraction of the print hammer. The sooner after the printing operation that the transfer of the next signal combination may be performed, the greater is the interval of time that may be allotted for rotation of the type wheel into a new stop position corresponding to the new selection and, therefore, the slower can be the speed of rotation of the type wheel shaft 88. The maintenance of minimum rotational velocities consistent with efficient operation is desirable in order to minimize inertia effects.

Internal cam 186 is required to hold type wheel 144 elevated only until the print operation has been performed. As cam 151 continues to rotate and restores print bail operating lever 153 to its extreme clockwise position, cam 186 permits bail 131 and bail arm 134 to return to extreme clockwise position, the restoration not being abrupt nor violent but rather being controlled and gradual.

As set forth in the description of apparatus, cam 202 operates function bail lever arm 199 to reciprocate the spacing pawl 206 and the function bars 193. Immediately after the printing of a character has been accomplished, the carriage 236 may be spaced to bring a blank portion of the page into position to receive the next character. If instead of a character having been selected for printing a function has been selected, and the selection evidenced by the clockwise rocking of the particular function bar by operation of bail 192 substantially simultaneously with the operation of print bail lever 153, the apparatus is conditioned for the performance of the function.

The operation of lever 199 by cam 202 is gradual so that there is no abruptness in the performance of the function. As the function bars 193 are moved rearwardly of the typing unit by operation of function lever 199, the one of the function bars 193, which has previously been rocked into effective position, initiates or performs the function such as shift, unshift, line feed, carriage return, and various other desirable functions as disclosed in the copending application of Albert H. Reiber, Serial No. 77,796. The operation of function bail lever 199 is the last operation performed by the cams on cam sleeve 124 before the cams return to rest position, at which point, clutch throwout lever 127 separates driven clutch element 129 from driving element 124.

From the foregoing it will be observed that during the reception of isolated or widely separated signal combinations, there occurs a train of operations for each signal combination which begins with the setting in rotation of selector cam cylinder 67 and which ends with the arrestment of main cam assembly 130. The selector cam cylinder cooperates with the selector mechanism to set up the signal combination received, trips off the cam sleeve 113 on the front shaft, and comes to rest. The cams carried by sleeve 113 transfer the signal combination to the code disc selector, elevate the type wheel to printing position under the control of the shift and unshift slide member 207, trip off the main cam assembly on the inner shaft, and come to rest. The cams on the main cam sleeve 130 effect the operation of print hammer 169, test for the presence of a function selection, control the lowering of the type wheel to its idle position, effect character spacing and the performance of any function selected, and come to rest.

When, however, signal combinations are being received at substantially maximum frequency, as is the case when the transmitter from which the signals are being received is operated by a perforated tape, or if it is a keyboard transmitter, being operated by a skillful operator, the stop time between cycles of operation of selector cam assembly 67 will be very brief. The stop time between successive cycles of the front cam cylinder 113 and the main cam cylinder 130 will be correspondingly brief, but definite phase relationships between all of the cam assemblies will be maintained. Thus, all of the cam assemblies may be rotating simultaneously, and no two of them may be at rest at the same time. However, the operations which they control will proceed in orderly fashion exactly in accordance with the planned timing of the receiving mechanism. Any signal combination introduced at the selector magnet 68, whether relating to the printing of a character or to the performance of a function, will have become effective for the purpose for which it was introduced before the completion of the operation initiated by the selector cam assembly 67, and there will be no storage of a signal combination requiring an additional cycle of operation of the selector cam barrel for its clearing out, as is the case in some printing telegraph mechanisms, in which the transfer and printing operations are not assigned to be performed by cams included in separate cam assemblies, but are performed by cams included in a single cam assembly, and in which there is insufficient time between the transfer operation and the end of the cycle of the single cam assembly for the completion of rotation of the type wheel, or other conditioning of the printing element and the actual printing operation. In some printing telegraph receiving apparatus having a single operating cam assembly, such for example, as that exemplified in the copending application Serial No. 77,796, the printing operation is timed to precede the transfer operation in each cycle of the cam assembly so that the printing operation always lags one cam cycle behind the transfer operation, and at the completion of any message, the signal combination for the last character or function remains in storage in the code disc selector mechanism and necessitates the introduction of an idle cycle of the selector cam assembly for its clearing out. In the printing receiver mechanism according to the present invention, the printing operation and also the operation of the function mechanism follows the transfer operation in the general cycle of operation of the mechanism which may be considered as beginning with the starting of the selector cam assembly 67 into rotation and terminating with the arrestment of the cam assembly 130 carried by the main or inner operating shaft. It will thus be apparent that the printer always clears out and prints in accordance with the last signal combination received and no signal combination is ever left in storage in the selector mechanism.

In the foregoing general description of the printing telegraph apparatus in accordance with the invention, certain details were not described because the description was restricted to Fig. 1 in which those details could not be clearly shown. They are, however, shown in Figs. 2 and 3 and will now be described having reference particularly to the detailed showings.

In Figs. 2 and 3 are shown the details of a roller bearing grip clutch mechanism which serves as a velocity limiter or brake for the main cam assembly. Interposed between the main cam sleeve 130 and the shaft by which it is supported, there is a sleeve 261 which is fixed to sleeve 130 and is threaded at its lower end. The inner member 262 of a roller bearing grip clutch is threadedly secured to the lower end of sleeve 261. Member 262 fits into the central aperture of ring 106 and is retained in close proximity to the hub of gear 78 as shown in Fig. 3. Inner clutch member 262 has a plurality of substantially right angled notches cut in the periphery thereof, the faces defining these notches being of unequal lengths, the shorter of the two faces of each notch, designated by the reference numeral 263, extending substantially radially of the member 262. The angularly disposed facese of the notches and the adjacent arcuate inner surface of ring gear 106 define recesses that are generally triangular, being bounded by two plane surfaces and a curved surface. Each of the short faces 263 of the notches in member 262 is recessed to receive and support one end of a compression spring 264. An axially drilled roller bearing 266 is disposed in each of the generally triangular recesses and the compression spring 264 tends to wedge the roller bearing between the long face of the notch and the arcuate internal surface of the ring gear 106.

The lower end of cam sleeve 130 is undercut to provide a shoulder 267 against which a retainer ring 268 is placed before member 262 is secured to sleeve 261. Retainer ring 268 fits loosely on the undercut portion of sleeve 130 and is not clamped in place but is free to rotate. Ring 268 serves as a partial cover for rollers 266 and prevents them from escaping from their respective recesses in the event that the entire

printing unit is inverted such as, for example, during packing or shipment. Ring 268 has an even more important function which will now be described.

Since roller bearings 266 cannot be inserted into their recesses after member 262 has been placed in position in ring gear 106, the retainer ring 268 preventing this, it is necessary to fit the member 262 and rollers 266 into position in ring gear 106 at the same time. Springs 264 tend to complicate the bringing of the member 262 and the rollers 266 into final position together, by thrusting the rollers 266 out of the positions in which they must be held in order to be inserted with member 262 into gear 106. The insertion of the rollers 266 and member 262 has been simplified by providing ring 268 with depending fingers 269 so that ring 268 may be employed as an implement for locating rollers 266 well into the notches in member 262 and for holding them in such positions in opposition to their compression springs 264 while the subassembly is being inserted into ring gear 106. The rollers 266 are provided with axial bores of sufficient size that the rollers may fit loosely on depending fingers 269 of ring 268.

When it is desired to fit the subassembly comprising clutch sleeve 130, its supporting sleeve 261, inner clutch member 262 and retaining ring 268, into final position with inner clutch member 262 seated inside ring gear 106, a roller 266 is placed upon each of the fingers 269 of ring 268. As each of the rollers 266 is placed upon its finger 269, its compression spring 264 moves it away from the surface which contains the spring socket. The roller, in being thus moved, may impart counterclockwise rotation to ring 266 until finger 269 has moved as near to the long surface of the notch in member 262 as the thickness of the wall of roller 266 will permit. Thereafter, spring 264 will frictionally engage the exterior of roller 266, and will also cause it to be gripped between finger 269 and the long face of the notch in member 262, so that the roller will not drop from finger 266 while the other rollers are being placed on their respective fingers, nor while the subassembly is being fitted into ring gear 106. After all of the rollers 266 have been placed upon the fingers 269 ring 268 may be rotated in clockwise direction to compress springs 264 to a considerable extent, thus bringing rollers 266 as close as possible to the radial faces of the notches in inner clutch member 262, at which point the recesses which will be formed when member 262 is lowered into ring gear 106 will be of greatest width. Rollers 266 do not need to be held nor manipulated individually, as ring 268 imparts to all of them the desired movement toward radial faces 263 of the notches. With rollers 266 held well within the confines of the notches in member 262 by ring 268 the assembly may be lowered into ring gear 106, after which the hold upon ring 268 may be released, thus permitting springs 264 to move rollers 266 into frictional engagement with the long faces of the notches and with the internal surface of ring gear 106, ring 268 rotating freely to permit this movement of rollers 266. The positioning of rollers 266 so that they will enter ring gear 106 readily will be simplified if rollers 266 are caused to seek continuous engagement with the long faces of the notches in member 262. This may be accomplished, as shown in Fig. 4, by disposing the sockets or recesses for springs 264 so that the axes of the springs shall be outside the plane in which the axes of the rollers 266 move as the rollers move in contact with the long faces of the notches. It may also be desirable to proportion retainer ring 268 so that its fingers 269 are always inside the axes of springs 264. The fingers may thus form fulcrums about which springs 264 may rock rollers 266 into engagement with the long faces of the notches, but whether or not the fingers form fulcrums for the rollers, the forces exerted by the springs 264 upon the rollers 266 have components which tend to keep the rollers in engagement with the long faces of the notches in member 262. The rollers 266 are thus forced inwardly sufficiently so that there will be no interference when the roller subassembly is fitted into the ring gear 106.

Further simplification of the insertion of the subassembly comprising inner clutch member 262, rollers 266, and ring 268 into ring gear 106 may be afforded by providing clearance recesses 270 in ring gear 106. Recesses 270 are cut partially into the inner surface of ring gear 106 and partially into the upper face thereof, thus providing inwardly sloping cam surfaces. Should there be any tendency of springs 264 to thrust rollers 266 outwardly during insertion of the subassembly into ring gear 106, the sloping cam surfaces will guide the roller 266 down into the interior of ring gear 106, it being understood that the spacing of clearances 270 corresponds with the spacing of rollers 266 and that the subassembly may be placed in such angular position with respect to ring gear 106 that rollers 266 are aligned with the clearances 270 before an attempt is made to insert the subassembly into the ring gear 106.

An understanding of the exact nature of the clutch by which cam sleeve 130 is driven is prerequisite to an understanding of the utility of the roller bearing grip clutch consisting of member 262, rollers 266, and ring gear 106, the roller bearing clutch being used in the present invention as a brake. Cam sleeve 130 is driven by driving clutch element 124 (Fig. 1) and driven element 129 as previously described. This clutch mechanism is of the well known one-way driving construction. Each tooth of both elements of the clutch has one surface substantially in a plane passing through the axis of the clutch and the other surface oblique thereto. Should any torque be applied to the driven element 129 of the clutch which exceeds the torque applied by the driving element 124, the sloping surfaces of the teeth of one clutch element may tend to slide upon the sloping surfaces of the teeth of the other clutch element, thus shifting driven element 129 axially away from driving element 124 and compressing spring 126. If the differential between the two torques is appreciable, the driven element may be rotated ahead of the driving element a distance equal to the extent of several teeth of the clutch member. A torque of sufficient magnitude to cause driven clutch element 129 to rotate more rapidly than driving element 124 and thus to gain upon it may be generated by a heavily biased cam follower such as the function cam follower 199 and roller 201 (Fig. 1) or the print cam follower 133 and roller 152 riding down a sharply descending slope of their respective cams and thus becoming a negative load upon the driven clutch element 129.

The roller bearing grip clutch hereinbefore described serves as a brake to prevent acceleration of cam assembly sleeve 130 under the influence

of negative load upon any of its cams. Whenever cam sleeve 130 is stationary and the gears 78 and 106 are rotating, inner roller bearing clutch member 262, which is secured to sleeve 261 and therefore indirectly to cam assembly sleeve 130, is also stationary and the frictional engagement between the inner surface of ring gear 106 and rollers 266 tends to move the rollers into the widest portion of the recesses in which they are seated, the rollers thus being moved substantially free of inner clutch member 262 so that there is no tendency of gear 106 to impart rotation to the inner clutch member. When cam assembly sleeve 130 is released for rotation and is rotating at the same speed as gear 106 there is no relative movement between roller bearing clutch member 262 and ring gear 106 and springs 264 tend to wedge rollers 266 between the long faces of the notches in inner clutch member 262 and the inner surface of gear 106. If cam sleeve 130 should be subjected to a torque which tends to rotate it faster than gears 78 and 106 the frictional engagement of rollers 266 with member 262 tends to increase the wedging of the rollers between member 262 and gear 106 so that a positive lock between inner roller bearing clutch member 262 and gear 106 is established and cam sleeve 130 is prevented from accelerating in response to the locally applied torque and is held to the speed of rotation of gear 78.

Although specific embodiments of the features of invention have been disclosed and described herein, it will be understood that the invention is not limited to such specific embodiments but is capable of modification, reorganization, rearrangement, and substitution of parts and elements without departing from the spirit of the invention and within the scope of the appended claims.

What is claimed is:

1. In a printing telegraph apparatus, a type wheel having movable type elements, a print hammer for actuating said type elements individually, a bell crank to which said print hammer is articulated, means for positively engaging and imparting motion in print hammer operating direction to said bell crank through a predetermined part of its operative stroke, and yieldable means interconnecting said motion imparting means and said bell crank for enabling said bell crank to overtravel said motion imparting means in print hammer operating direction and complete its operative stroke by inertia.

2. In a printing telegraph apparatus, a type wheel having movable type elements, a print hammer for actuating said type elements individually, means for actuating said print hammer, a cyclically operable cam, means controlled by said cam for positively engaging and imparting motion in print hammer operating direction to said print hammer actuating means through a predetermined part of its operative stroke, and yieldable means interconnecting said cam controlled means and said print hammer actuating means for enabling said print hammer actuating means to overtravel said motion imparting means in print hammer operating direction and complete its operative stroke by inertia.

3. In a printing telegraph apparatus, a type wheel having reciprocable type elements, means for imparting reciprocatory movement to said type elements, pivotally mounted means for actuating said type element operating means, a power driven cam follower means for positively engaging and operating said pivotally mounted means through a predetermined part of its operative stroke, and yieldable means interconnecting said cam follower means and said pivotally mounted means for enabling the pivotally mounted means to overtravel said cam follower means and complete its operative stroke by inertia.

4. In a printing telegraph apparatus, a type wheel having reciprocable type elements, means for imparting reciprocatory movement to said type elements, pivotally mounted means articulated to said type element reciprocating means for imparting movement thereto, a power driven cam, cam follower means engaging said cam and having abutting engagement with said pivotally mounted means through a predetermined part of the operative stroke of said pivotally mounted means, and extensible means interconnecting said pivotally mounted means and said cam follower means for enabling said pivotally mounted means to overtravel said cam follower means for imparting movement to said type elements and complete its operative stroke by inertia.

5. In a printing telegraph apparatus, a type wheel having reciprocable type elements, reciprocable means for engaging and imparting reciprocatory movement to said type elements individually, pivotally mounted means articulated to said reciprocable means, cam follower means having abutting engagement with said pivotally mounted means, cam means engaged by said follower means for controlling movement of said follower means through a predetermined distance less than that required to engage said reciprocable means with a type element, and extensible means interconnecting said cam follower means and said pivotally mounted means for permitting movement of said pivotally mounted means and said reciprocable means after movement of said cam follower means through said predetermined distance.

6. In a printing telegraph apparatus, a type wheel having reciprocable type elements, reciprocable means for engaging and imparting movement to said type elements individually, pivotally mounted means articulated to said reciprocable means, cam follower means having a portion abutting said pivotally mounted means, a spring connected between said cam follower means and a fixed part of said printing telegraph apparatus for actuating said cam follower means, cam means for timing the actuation of said cam follower means by said spring and for limiting said actuation to a distance less than sufficient to bring said reciprocable means into engagement with a type element and for restoring said cam follower means to unoperated position, and yieldable means interconnecting said cam follower means and said pivotally mounted means for permitting overtravel movement of said pivotally mounted means and said reciprocable means after actuation of said cam follower means to its limit.

7. In a printing telegraph apparatus, a type wheel having radially reciprocable type elements, a reciprocable member for engaging and actuating said type elements individually, pivotally mounted means articulated to said reciprocable member, cam follower means having a portion abutting said pivotally mounted means, a spring connected between said cam follower means and a fixed part of said printing telegraph apparatus for actuating said cam follower means, cyclically operable cam means for timing the actuation of said cam follower means and for limiting said

actuation to a distance less than sufficient to bring said reciprocable member into engagement with a type element and for restoring said cam follower means to unoperated position, and yieldable means interconnecting said cam follower means and said pivotally mounted means for permitting overtravel of said pivotally mounted means and said reciprocable member to effect printing from said type element, said yieldable means being effective to retract said reciprocable member independently of control of said cam follower means by said cam means.

8. In a printing telegraph apparatus, a type wheel, a plurality of radially reciprocable type elements carried by said type wheel and having operating shanks extending interiorly of said type wheel, reciprocable means for engaging the inner ends of the shanks of said type elements individually and imparting movement to said type elements, pivotally mounted means articulated to said reciprocable means for reciprocating said means, cam follower means having a portion abutting said pivotally mounted means, a spring connected between said cam follower means and a fixed part of said printing telegraph apparatus for actuating said cam follower means, cam means for normally holding said cam follower means in position to hold said reciprocable means clear of the shanks of said type elements, for timing the actuation of said cam follower means by said spring, for limiting said actuation to a distance less than sufficient to bring said reciprocable means into engagement with a type element and for controlling the restoration of said follower means, and yieldable means interconnecting said cam follower means and said pivotally mounted means for permitting overtravel movement of said pivotally mounted means and said reciprocable means after actuation of said cam follower means to its limit and for retracting said reciprocable means clear of the shank of said type element independently of restoration of said cam follower means to normal position by said cam means.

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