Nov. 22, 1966 H. SCHOENFELDER 3,286,806

ROTATABLE AND TILTABLE TYPE HEAD CONTROL APPARATUS

Filed March 12, 1965 4 Sheets-Sheet 1

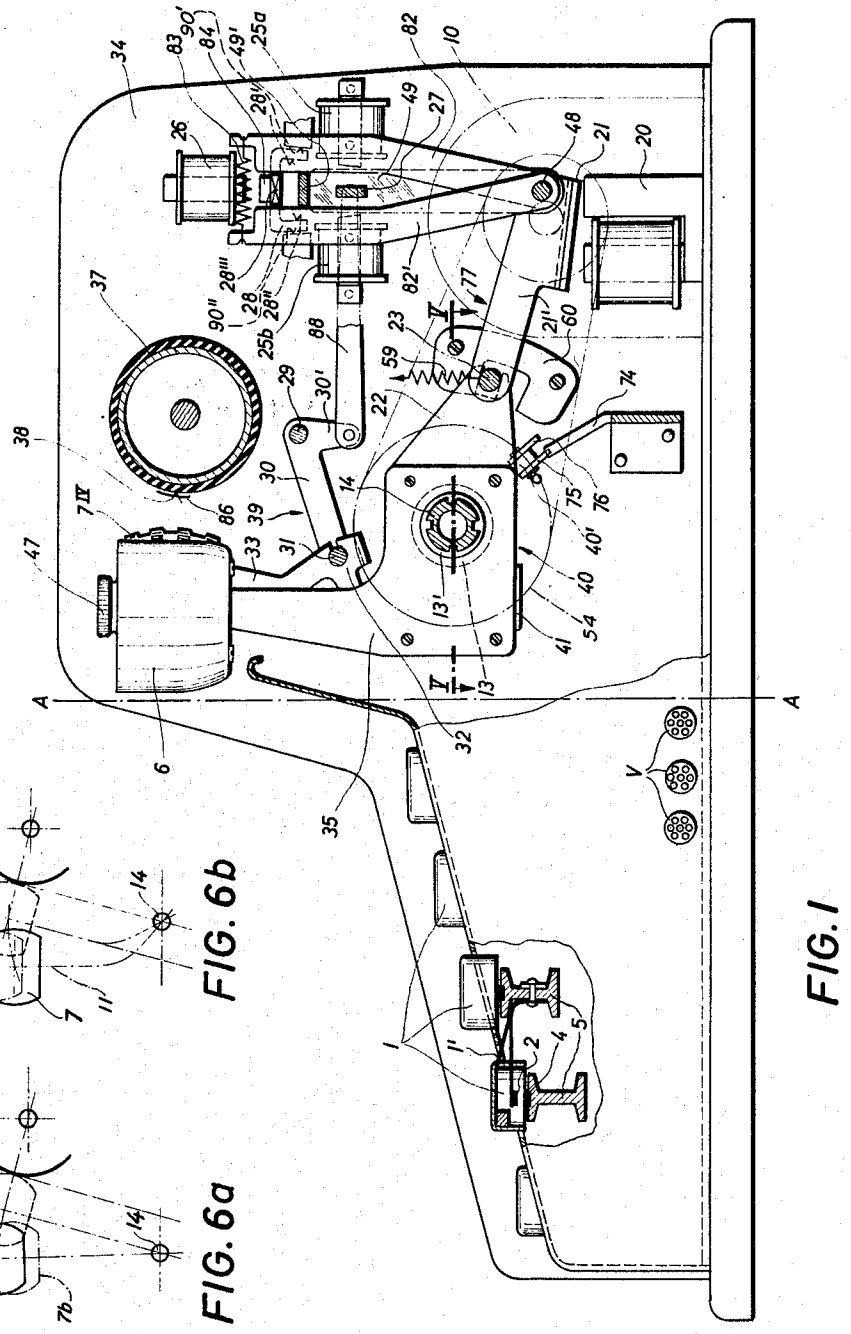

FIG. 1

FIG. 6b

FIG. 6a

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FIG. 2

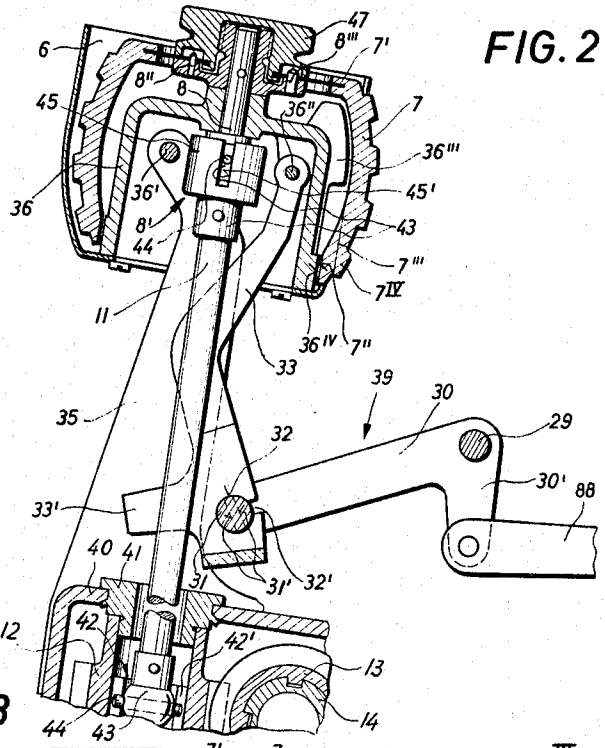


FIG. 3

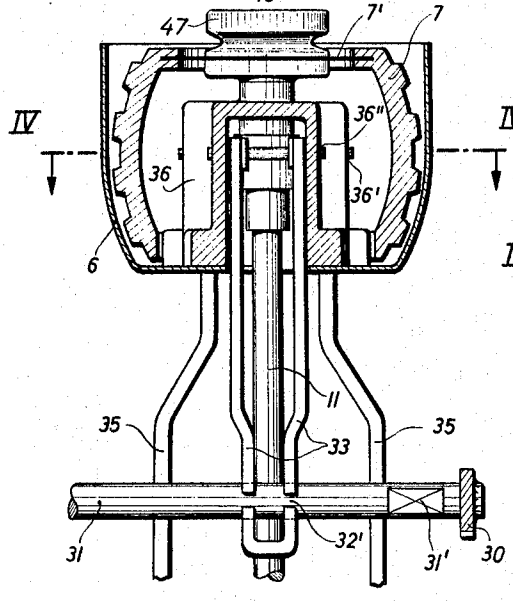
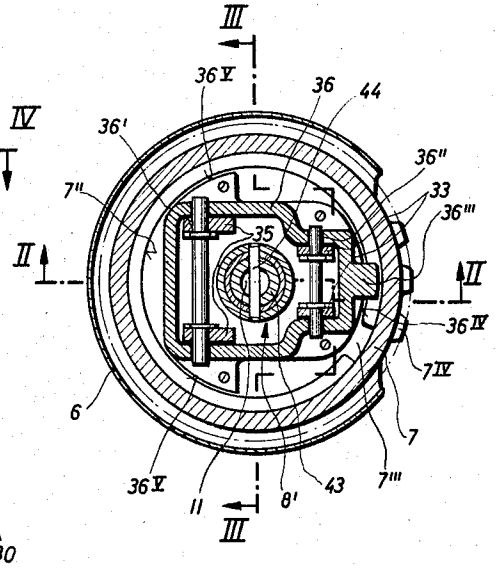


FIG. 4



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ROTATABLE AND TILTABLE TYPE HEAD CONTROL APPARATUS

Filed March 12, 1965 4 Sheets-Sheet 3

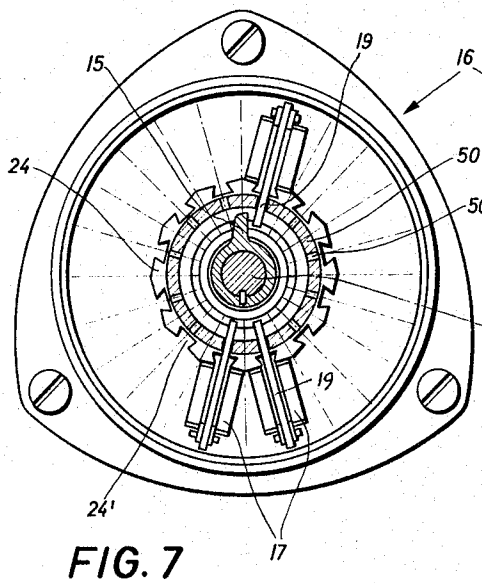

FIG. 7

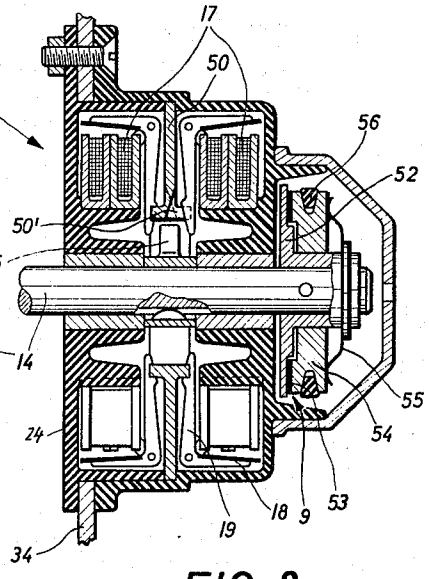

FIG. 8

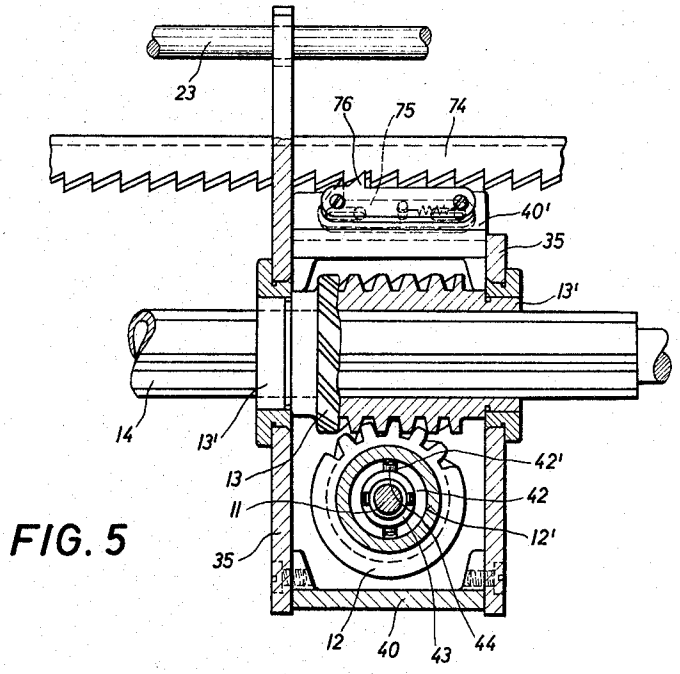

FIG. 5

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ROTATABLE AND TILTABLE TYPE HEAD CONTROL APPARATUS

Filed March 12, 1965 4 Sheets-Sheet 4

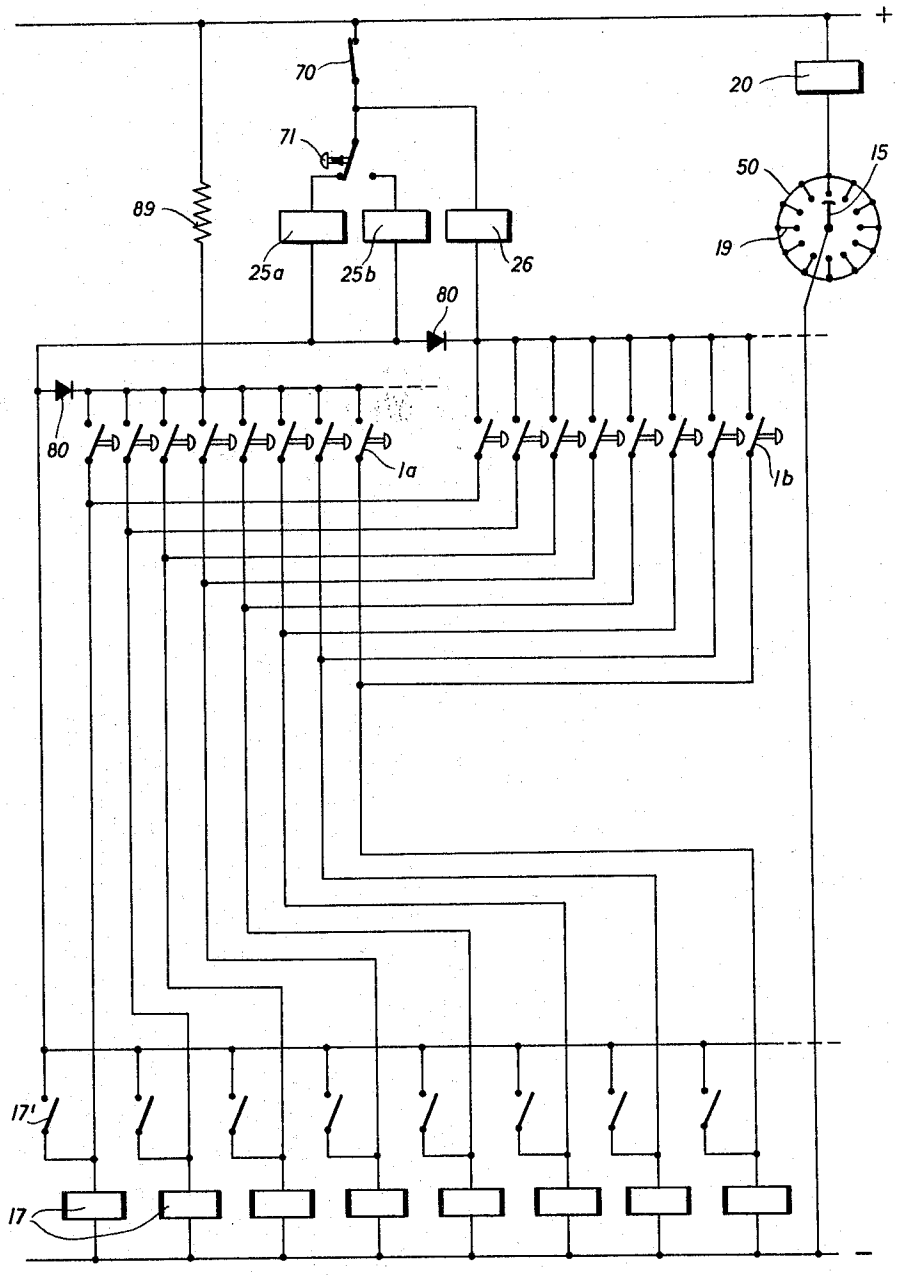

FIG. 9

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United States Patent Office 3,286,806
Patented Nov. 22, 1966

3,286,806

ROTATABLE AND TILTABLE TYPE HEAD CONTROL APPARATUS

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Filed Mar. 12, 1965, Ser. No. 439,203
23 Claims. (Cl. 197—16)

The present invention relates to a type head control apparatus, and more particularly to apparatus for controlling all motions of a type head used in a typewriter having no paper carriage.

Type heads are known which have an outer surface provided with types arranged in circular rows and forming columns located in axial planes. In order to select a column, the type head is rotated about the first axis until the respective column is located opposite the printing surface, whereupon the rotation is stopped. In order to select a type of the selected column, the type head is tilted about a second axis, and when the selected type is correctly positioned, the entire head is moved toward the printing surface for producing an imprint of the selected type.

The tilting and rotary motions of type heads according to the prior art are derived from coaxial hollow shafts. Since movement of the type head toward the printing surface, and also along the printing surface in a writing direction is also required, a very complicated apparatus consisting of a great many very sensitive parts results since the tilting and rotary motions, as well as the printing motion, must be transmitted from a motor to the type head during movement of the same in writing direction. Furthermore, in accordance with the prior art constructions, the type head is rotated in opposite directions of rotation out of a position of rest to place selected columns of type in the printing position opposite the printing surface. Some known constructions include springs for returning the type head to a position of rest between successive turning movements for the selection of columns of type, and these constructions have the disadvantage that the type head has to be accelerated and again stopped whereby the writing speed is reduced, and the parts of the apparatus are quickly worn out.

It is one object of the present invention to improve the known type head control apparatus, and to control all motions of the type head by a simple and compact apparatus comprising comparatively few parts, and being easily assembled.

Another object of the present invention is to provide a type control apparatus permitting selection of types at a very high speed so that the type head can be operated at a very high writing speed.

Another object of the invention is to mount a type head in such a manner that the printing surface on which the imprints are made are not covered by the type head in its retracted position, and can consequently be easily observed.

Another object of the invention is to transmit rotary motion, tilting motions, and printing motions to a type head moving in a writing direction along a printing surface.

Another object of the invention is to place the axis about which the type head turns during the printing motion in a tangential plane on the printing surface.

With these objects in view, one embodiment of the invention comprises bearing means, preferably a bell-shaped body having bearing faces; a type head mounted on the bearing means for rotation about a first axis; drive means, preferably a shaft located in the first axis; carrier means supporting the bearing means for tilting movement with the type head about a second axis crossing the first axis; and tilting means operable for tilting the bearing means with the type head about the second axis.

The type head has an outer surface with circumferential rows of types forming columns in planes passing through the first axis so that during rotation of the type head different columns are successively placed in a printing position opposite the printing surface. The tilting means tilt the type head about the second axis for placing a selected circular row of types containing a selected type opposite the printing surface. When rotation of the type head is stopped at the moment in which the column containing the selected type is located opposite the printing surface, the desired type is in printing position, and the type head is moved toward the printing surface to produce an imprint of the selected type.

In the preferred embodiment of the invention, the printing surface is located rearwardly of the type head, the second axis is located forwardly of the first axis, and the tilting means are connected with the bearing means for pivotal movement about a third axis located rearwardly of the first axis. The point of intersection between the second axis and a plane passing through the first axis and through a column of types in the printing position, is the center of curvature of the outer surface of the type head. In order to permit a movement of the type head in writing direction, the carrier means and the tilting means are mounted on guide means extending parallel to the printing surface and to the second axis about which the type head is tilted. In the preferred embodiment of the invention, the guide means include a longitudinally grooved guide shaft on which the carrier means is mounted for longitudinal movement to carry the type head along the printing surface, and also for limited turning movement for moving the type head to and from a printing position in which a selected type contacts the printing surface.

The guide means also includes a second guide shaft which supports the tilting means, preferably a pair of links pivotally connected with the bearing means and having openings through which the second guide shaft passes in sliding engagement. When the carrier moves along the first guide shaft, the tilting links move along the second guide shaft. To cause a tilting movement of the type head, the second guide shaft is displaced in a transverse translatory movement by suitable operating means.

The drive shaft which rotates the type head must remain in driving connection with a motor during the movement of the carrier means with the type head along the first guide shaft. A gear is mounted for movement along the first guide shaft and has projections engaging the grooves in the same so as to rotate with the first guide shaft which is driven from an electric motor. The gear on the first guide shaft meshes with another gear secured to the drive shaft of the type head, and universal joints are provided on the drive shaft so that the shaft portion of the same which is fixedly secured to the type head can be tilted with the type head without causing a displacement of the main portion of the drive shaft.

During operation of the typewriter, the type head is

continuously rotated in one direction of rotation. Electromagnetically operated stops are provided for each column of types, and stop the first guide shaft under the control of manually operated keys associated with the types of the respective columns. Each key also controls electromagnetic operating means by which the tilting means are actuated to place a circular row of types in the printing position.

The tilting angle of the type head is controlled by two pairs of stops, corresponding to the inner circular rows of types and to the outer circular rows of types on the type head. An inner pair of stops limits movement of the tilting means in positions in which the inner rows of types are located opposite the printing surface, and when an outer row of types is required for printing, an electromagnetic means is energized under the control of the respective key associated with one of the outer rows of types, and withdraws the inner pair of stops so that the outer pair of stops is rendered effective, and the tilting motion of the type head is stopped in a position in which the respective outer row of types is located opposite the printing surface. Since the grooved first guide shaft is used for transmitting the rotary motion to the type head during movement of the carrier with the type head in writing direction, and also for supporting the carrier for turning movement required for the printing movement of the type head, the construction is extremely compact. The second guide shaft permits the transmission of the tilting motion during movement of the type head in writing direction, and can be operated in a very simple manner by electromagnetic operating means stationarily mounted in the housing of the machine. It is advantageous to operate the second guide shaft by a rockable member having two arms engaging the end portions of the second guide shaft.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a side elevation of an apparatus according to one embodiment of the invention, partially shown in vertical section;

FIG. 2 is a fragmentary axial sectional view of the type head arrangement;

FIG. 3 is a fragmentary sectional view of the type head arrangement taken on line III—III in FIG. 4;

FIG. 4 is a cross-sectional view taken on line IV—IV in FIG. 3;

FIG. 5 is a cross-sectional view taken on line V—V in FIG. 1;

FIGS. 6*a* and 6*b* are fragmentary schematic side views illustrating the retracted and printing positions of the type head in accordance with the prior art and in accordance with the present invention;

FIG. 7 is a fragmentary cross-sectional view illustrating a device used in the apparatus of the invention for stopping rotation of the type head;

FIG. 8 is an axial sectional view of the device shown in FIG. 7; and

FIG. 9 is a diagrammatic view illustrating the electric circuit of the apparatus.

Referring now to the drawings, a barrel-shaped type head **7** is secured to a hardened or self lubricating shaft portion **8** by resilient connecting means which include an annular leaf spring **7'**, a flange secured by a pin to shaft portion **8**, and a nut **47** screwed onto a threaded portion of the flange and pressing the inner annular portion of spring **7'** against an annular abutment face of flange **8'**. Pins **8''** and **8'''** have different diameters and are secured to flange **8'** projecting from the same in corresponding bores of spring **7'** so that the angular position of the type head **7** relative to shaft portion **8** is exactly determined.

The type head has an inner cavity in which a bell-shaped bearing means **36** is located. A cylindrical inner surface **7''** of the type head surrounds the lower portion of the bell-shaped bearing means **36** which has a broad guide face 36^{iv} and two bearing faces 36^{v}, best seen in FIG. 4. Bearing means **36** has a supporting projection **36'''**, see FIGS. 2 and 4, which has an outer bearing surface curved in a plane passing through the axis of shaft **8** in such a manner as to match the corresponding curvature of the inner surface of type head **7**. When the type head is tilted about the leaf spring **7'** by the printing pressure acting to the left as viewed in FIG. 2 and FIG. 4, as will be described hereinafter, the inner surface of type head **7** abuts the bearing face of projection **36'''** and is supported by the same, and by the bearing surface 36^{iv}. In the normal position assumed by type head **7** under the action of spring **7'** the inner surface of the type head is spaced from the bearing surface a small distance.

Nut **47** permits an easy exchange of the type head, and spring **7'** dampens oscillations, and relieves the pressure on the bearings during the typing impact. In order to permit a removal of the type head, the lower portion of the same is provided with a slot **7'''** which is normally angularly spaced from projection **36'''** but permits the passage of projection **36'''** when the type head is turned after removal of nut **47** and detachment of leave spring **7'** from the pins **8''** and **8'''**.

A carrier **35** has two arms projecting into the interior of the bell-shaped bearing means **36**. A pivot pin **36'** passes through bores in the arms of carrier **35** and in the bearing means **36**, as best seen in FIGS. 2 and 4. Consequently, bearing means **36** is tiltable about the axis of pivot pin **36'**, and since the type head is supported on the bearing means, it performs the same tilting movement. As shown in FIG. 2, the axis of pivot pin **36'** is located in a plane of symmetry of the type head extending perpendicularly to the axis of shafts **11** and **8**.

A tilting means is provided for tilting the bearing means with the type head, and includes a pair of lever arms **33** provided with bores aligned with corresponding bores in bearing means **36**. A pivot pin **36''** passes through the bores, and permits relative angular displacement between the lever arms **33** and the bearing means **36**. When lever arms **33** are moved downward or upward as viewed in FIG. 2, the type head will be tilted about pivot pin **36'**.

A protective shell **6** is secured to the lower rim of bell-shaped bearing means **36** and covers the greater part of the outer surface of the type head, an opening being provided in shell **6** opposite the printing surface represented by the cylindrical platen **37** as shown in FIG. 1. An ink ribbon **86** is located between the type head and the platen, and when the type head is moved toward the platen, a type 7^{iv} will produce an imprint on the printing surface of a sheet of paper inserted between the platen and the ink ribbon.

The types 7^{iv} are arranged in four circular rows on the outer surface of the type head, and form columns of four types in planes passing through the axis of shaft **8**.

A drive shaft **11** is connected by a universal joint **8'** to shaft portion **8**, so that the type head is rotated about a first axis provided by shaft portion **8**. The second axis provided by pivot pin **36'** about which the type head is tilted, crosses the first action, and extends parallel to the printing surface.

The outer surface of the type head is circular in planes perpendicular to the first axis. The distance between a column of type located opposite the printing surface in the printing position and the point of intersection of the second axis of pin **36'** with a plane passing through the respective column of type and the first axis, is the radius of curvature of the outer surface of the type head in planes passing through the first axis.

During rotation of the type head, the columns of type will be successively located opposite the printing surface

in a printing position, and by tilting the type head about pivot pin 36', selected circular rows of type can be placed in a printing position opposite the printing surface provided by platen 37.

When the type head is tilted about the axis of pivot pin 36' by operation of the tilting means 33, as will be described hereinafter, a circular row of types, including the desired type, is placed opposite the printing surface, and when the rotation of the type head is stopped at the moment in which the desired type is located opposite the printing surface, the type head is ready to be moved toward the platen to produce an imprint of the selected type on a printing surface. Since the center of curvature of each column of type coincides with the axis about which the type head is tilted, each type of a column has the same distanct from the printing surface when in printing position.

After the type head has been tilted and stopped to place the selected type opposite the printing surface, it is moved by operation of carrier 35 toward the printing surface to produce an imprint. Carrier 35 is turned about a guide shaft 14 for this purpose. The two arms of carrier 35 have lower ends connected to each other to form a housing 40, as best seen in FIGS. 1 and 5. Shaft 14 has longitudinal grooves on which a worm gear 13 is mounted so that gear 13 turns with shaft 14, but is movable along the same in axial direction. Gear 13 has two journal projections 13' projecting into bearing bores in the arms of carrier 35 so that carrier 35 is turnable about the axis of shaft 14, and when gear 13 with projections 13' is moved along shaft 14 in axial direction, carrier 35 with bearing means 36 and type head 7 moves along the printing surface provided by the platen 37, since guide shaft 14 extends parallel to the axis of the platen. A spring, not shown, is connected in a conventional manner to carrier 35 to urge the same to move in the writing direction along the stationary platen. In contrast to typewriters in which the platen is mounted on a paper carriage, the platen is stationary in the typewriter of the present invention, and the type head is moved stepwise along the platen, which is accomplished by a pair of escapement pawls 75, 76 cooperating in a well known manner with an escapement rack bar 74. When a key 1 is operated, the pawls are actuated to release the rack bar so that the carrier 35 moves one step with the type head and is then stopped by the escapement pawl 75.

The rotary motion of the type head

Type head 7 rotates continuously in the same direction of rotation and is stopped for the printing movement. An electric motor 10 drives over a pulley, see FIGS. 1 and 5 and a belt 56, a pulley 54 which is connected by a slip clutch 9 to an end portion of shaft 14 in which no grooves are provided. Slip clutch 9 limits the force transmitted to shaft 14 when the type head is stopped since the disc 52 against which pulley 54 is pressed by a dished spring 55 slips on the pulley when shaft 14 is stopped.

Gear 13 meshes with another gear 12 which is mounted in housing 14 on hollow journals which are supported in bearing bores of horizontal walls of housing 40 and secured to the same by flanges 41. Gear 12 has an inner cylindrical bore 12' in which a slotted bushing 42 is mounted into whose slots 42' the end portions of a pin 44 project, pin 44 passing through a spherical head 43. This universal joint permits a longitudinal movement of the spherical head 43 in bushing 42, and two tilting movements in perpendicular planes, while the rotary motion of gear 12 is transmitted to shaft 11 which carries the spherical head 43 at the lower end thereof.

The upper end of shaft 11 is connected by a corresponding universal joint 8' to shaft portion 8. A spherical head 43 has a tranverse pin 44 projecting into slots 45' of the upper bushing 45 which is secured to the upper end of shaft 11. Universal joint 8' transmits the rotation of shaft 11 to shaft portion 8 and to the type head 7, while permitting tilting of shaft portion 8 in two perpendicular planes relative to shaft 11, and also axial displacements between shaft portion 8 and shaft 11.

During movement of carrier 35 with the type head, the driving connection between the driven guide shaft 14 and shaft 11 is maintained between the meshing gears 13 and 12 since the same move with carrier 35 along shaft 14.

The tilting motion of the type head

When one of the keys 1 is actuated, one of two electromagnetic means 25*a*, 25*b* is energized in a manner which will be explained hereinafter with reference to FIG. 9. A switch 71 has two positions, connecting either electromagnetic means 25*a* or electromagnetic means 25*b* to voltage, as shown in FIG. 9.

Electromagnetic means 25*a* and 25*b* are located on opposite sides of an armature 27 which is mounted between a pair of arms 49 which are tiltable about a shaft 48, as shown in FIG. 1. When electromagnetic means 25*a* is energized, members 49, 27 swing to the left, and when electromagnetic means 25*b* is energized, members 27, 49 swing to the right as viewed in FIG. 1. A link 88, shown partly broken off in FIG. 1, connects armature member 27 with a lever 30' which is secured to a shaft 29. A pair of arms 30 is secured to shaft 29 for turning movement therewith, one of the arms 30 being integral with arm 30'. Consequently, shifting of armature member 27 will cause a rocking movement of shaft 29 with arms 30.

Arms 30 act on a guide shaft or guide rod 31 which extends parallel to guide shaft 14.

The parallel arms of tilting means 33 are connected to each other at the lower end, as best seen in FIGS. 2 and 3, and have bores 32 slidingly receiving guide shaft 31. Slots 32' permit passage of flattened portions 31' of guide shaft 31 into bores 32 during assembly.

When the rocking means 39 is operated by electromagnetic means 25*a*, 25*b*, guide shaft 31 is displaced substantially in axial direction of shaft 11. The arms 33 have projections 33' located on opposite sides of shaft 11 so that during movement of carrier 35 with bearing means 36, type head 7, and shafts 8 and 11 along guide shaft 14, linking arms 33 are taken along and slide in longitudinal direction on guide shaft 31. During the translatory displacement of guide shaft 31 by the rocking means 39 for the purpose of tilting the type head, linking arms 33 turn a small angle about the axis provided by guide shaft 31. Up and down movement of linking arms 33 will cause displacement of pivot pin 36'' along a circular path whose center is located in the axis of pivot pin 36' so that bearing means 36 is tilted together with type head 7. The illustrated construction of the tilting means requires only small masses to be moved, and is entirely independent of the turning movement of carrier 35 during the printing motion.

The rocking motion of the armature 27, 49 is limited by a pair of stop surfaces 28', 28'' provided on a stop member 28. A stop member 49' connects the two arms 49 in the region of stop member 28, and when one of the electromagnetic means 25*a*, 25*b* is energized and the rocking armature 27, 49, 49' angularly displaced, stop faces 28' and 28'' define two positions of rocking member 39, guide shaft 31, and tilting means 33 which correspond to tilting angles of type head 7 about the axis of pivot pin 36' determined by the position of the two inner circular rows of type so that one of the inner rows of types is placed in a printing position opposite the printing surface of platen 37, depending on whether electromagnetic means 25*a* or electromagnetic means 25*b* was actuated.

The type head is normally in a position in which the circular area between the two inner rows of type is located opposite the printing face since the rocking armature 49, 27 is normally in the position shown in FIG. 1. A pair of lever means 82 and 82' are mounted on shaft 48 and have upper ends connected by a spring 83 so as to move toward each other until engaging stop member 49' on opposite sides. Members 82 and 82' are held in a cen-

tered position by a stationary abutment 28'''. When one of the electromagnetic means 25*a*, 25*b* is energized, the respective member 82 or 82' is displaced by stop member 49' while spring 83 resiliently yields.

In order to tilt the type head in opposite directions to positions in which the outer rows of types are located in the printing position, it is necessary to permit movement of the rocking armature 49, 27 for greater angles. This is accomplished by a second pair of stops having stop faces 90', 90'' located outwardly of stop 28. Stop 28 on which stop faces 28', 28'' are provided, is connected to the movable armature of another electromagnetic means 26, and can be shifted by the same to a retracted position located above the stop 49' so that stop faces 28', 28'' cannot be engaged by stop member 49', permitting movement of the rocking armature until stop member 49' engages one of the second stop faces 90', 90''.

When a key 1 associated with a type located in one of the outer circular rows of types is actuated, electromagnetic means 26 is energized in a manner which will be described hereinafter with reference to FIG. 9, and retracts stop 28, rendering stop faces 90' and 90'' effective. Which of the outer rows of types is selected, depends on the selection of one or the other electromagnetic means 25*a*, 25*b* by the respective actuated key 1.

Each of the four circular rows of type on type head 7 has 24 types. The most frequently used characters are preferably placed in the two inner circular rows of type so that during most actuations of the type head, only small tilting angles are required. Symbols and numbers are placed in the outer circular rows of types.

Stopping of the type head

An arresting device 16, best seen in FIGS. 7 and 8, is provided outwardly of the side wall 34 in the region of the end portion of shaft 14. A stationary casing supports two sets of twelve small electromagnetic means 17 which are arranged in circles about shaft 14 angularly staggered to each other. The armatures 18 of the stop magnets 17 control blocking members 19 which are pivotally mounted on stationary parts and are operated by the stop magnets to move between an inoperative position shown in FIG. 8 and a blocking position located in the circular path of a rotary stop finger 15 whose hub is secured to the end portion of shaft 14 for rotation therewith. Blocking members 19 are guided in axially extending slots of a circular inner flange 50' of a stationary part 50 which is secured to the housing of the device.

The hub of stop finger 15 is preferably provided with short vanes for producing an air movement for the purpose of cooling the stop magnets 17.

Stop magnets 17 have frame portions provided with dove-tail projections fitting into corresponding recesses of centrally located rings 24 which are secured to the housing. Each key 1 of the typewriter is electrically connected to one of the twenty-four stop magnets 17, and each stop magnet 17 is associated with a column of types located in an axial plane passing through the axis of shaft portion 18. When a corresponding key 1 is actuated, a stop magnet 17 is energized and attracts its armature so that the respective blocking member 19 is moved to the blocking position and stops rotation of shaft 14 when engaged by the rotating stop finger 15. When shaft 14 is stopped, pulley 54 slides on the flange 52 of the slip clutch 9, while the column containing the character associated with the respective actuated key, is located in the printing position opposite the printing surface.

When two keys 1 are successively operated, the type head 7 may have turned about the axis of shaft 8 only a small angle corresponding to a few types in circumferential direction, particularly, since the stop magnet 17 of the second selected key may be energized already during the printing motion of the type head caused by the first actuated key, or shortly before the termination of the printing motion. The control impulse given by the second actuated key may be stored in a well known manner, but it is also possible that the type head turns through an angle greater than 360° between two printing motions of the type head.

Stop magnets 17 and electromagnetic means 25*a*, or 25*b* are simultaneously energized by operation of a key, and consequently rotation of the type head is stopped practically at the same moment in which the tilting of the type head to the desired position is obtained.

Control of the printing motion

During the printing motion, carrier 35 turns about the journal portions 13' of gear 13, as explained above with reference to FIG. 5. As best seen in FIG. 1, a lever 22 projects from the housing portion 40 and has a fork-shaped end portion receiving a rod 23 which is mounted on a pair of arms 21' connected to each other by a yoke portion 21. A stationary stop member 60 provides two stop faces against which rod 23 abuts in two angularly spaced end positions of the rocking member 21, 21' and of carrier 35 with lever 22. A spring 59 is secured to rod 23 and urges the same against the upper stop face of stop member 60 as shown in FIG. 1 so that carrier 35 is in a position in which the type head is retracted.

When a key 1 is actuated, a printing magnet 20 is energized and attracts the yoke 21 which constitutes the armature of printing magnet 20. The rockable member 77 which includes members 21 and 21', performs an angular motion in counterclockwise direction so that rod 23 is lowered and carrier 35 turns in clockwise direction as viewed in FIG. 1 to the printing position in which a selected type is pressed against the ink ribbon 86 to produce an imprint on a printing surface of a paper sheet, not shown which is supplied from a roll to the platen 37.

The actuation may be modified by providing a power roll driven by motor 10, so that printing magnet 20 is used only for moving an eccentric drive member into engagement with the power roll, as is conventional in electric typewriters.

In the preferred embodiment of the invention, the axis of shaft 14 is located in a tangential plane on the printing area on platen 37 in the region of the impact area of the type head, as shown in FIGS. 1 and 6*b*. Consequently, the first axis of the type head which is determined by the drive shaft means 8 and 11, is spaced from the printing surface a distance corresponding to the maximum radius of the type head in a plane perpendicular to the axis of rotation, as shown in broken lines in FIG. 6*b*. When printing magnet 20 is de-energized, and spring 59 turns carrier 35 with type head 7 to the retracted inoperative position shown in solid lines in FIG. 6*b*, the top surface of the type head is lower than in the printing position, and consequently the printing area on the printing surface can be observed by the operator in the direction of the arrow in FIG. 6*b*. If the shaft about which the printing head turns during the printing motion is located in the plane of the axis of rotation of the type head, as shown in FIG. 6*a* representing the prior art, the top surface of the type head is located at the same high level as in the printing position, and consequently obstructs the clear view to the printing area. The inoperative position of the type head according to the prior art is shown in broken lines 7*a* in FIG. 6*b*, and the inoperative position of the type head in accordance with the present invention is shown in broken lines 7*b* in FIG. 6*a* to facilitate the comparison of the two constructions. Since the printing motion of the type head takes place at a very high speed in the arrangement of the present invention, the view at the printing area is only momentarily blocked while the type head is in the printing position.

Electric circuit

Referring now to FIG. 9, two sets of keys 1*a* and 1*b*

are provided. The set of keys 1*a* is associated with the types of the two inner circular rows, and a set of keys 1*b* is associated with the two outer circular rows of types of the type head 7.

Each key operates a spring 1' secured to an insulating member 5 and actuating a movable contact 2 to engage a stationary contact 4 on the insulating member 5. The key contacts are schematically shown in FIG. 9 associated with the sets of keys 1*a* and 1*b*. Pairs of key contacts 1*a*, 1*b* are connected to each stop magnet 17 of the twenty-four stop magnets described with reference to FIGS. 7 and 8. Each energized stop magnet 17 causes closing of a corresponding contact 17' which is connected by a line common to all contacts 17' to the tilting magnets 25*a* and 25*b*. A switch 71 has two positons in which tilting magnets 25*a* or 25*b* are connected to the positive voltage by a switch 70. The third tilting magnet 26 is connected to a point between switches 70 and 71, and also to the second terminals of the contacts controlled by the set of keys 1*b*.

The negative voltage is connected to the stop magnets 17, and also to the rotary stop fingers 15 described with reference to FIGS. 7 and 8. The blocking members 19 are schematically shown in FIG. 9 to be connected by the stationary member 50 to the printing magnet 20 whose other terminal is connected to the positive voltage.

Diodes 80 separate the two sets of the keys 1*a* and 1*b* from each other. Since the third tilting magnet 26 is only sometimes used, a resistor 89 is connected to the key contacts of the set 1*a* in the same manner as the third tilting magnet 26 is connected to the key contacts of the set 1*b*.

When a key contact 1*a* is closed, either tilting magnet 25*a* or tilting magnet 25*b* is energized in accordance with the position of switch 71, and the energized tilting magnet causes an angular displacement of the rockable armature means 27, 49, 49' until the same abuts one of the stop faces 28', 28'' whereby the type head is tilted by the tilting means 33 a small angle to place the respective inner circular row of types in the printing position. At the same time, stop magnet 17 places the corresponding blocking member in the path of stop finger 15 and stops rotation of shafts 14, 11, and 8 so that the type character associated with the actuated key is located in the printing position.

Engagement between blocking member 19 and stop finger 15 has closed the circuit of printing magnet 20 so that the rocking armature 77 is attracted, and carrier 35 is turned to move the type head in a printing motion toward the printing surface resulting in an imprint of the selected type character on the printing surface. When the respective key is released, key contacts 2 and 4 separate, the stop magnet 17 is de-energized, and blocking member 19 is retracted to an inoperative position by a suitable spring, not shown, so that the torque exerted by the driven pulley 54 is transmitted by the slip clutch 9 to shaft 14 resulting in rotation of the type head since the rotary motion of shaft 14 is transmitted to the printing head by gears 13 and 12, shaft 11, universal joint 8', and shaft portion 8.

The de-energized stop magnet 17 causes opening of the respective contact 17' so that the respective tilting magnet 25*a* or 25*b* is de-energized and permits the spring loaded arms 82, 82' to return the rockable armature member 49, 27, 49' to its normal position so that the tilting means 33 assume a position in which the center portion of the type head is located opposite the printing surface.

In the event that a key 1*b* is actuated which is associated with a character provided in one of the outer circular rows of types, the corresponding stop magnet 17 is energized as explained with reference to the keys 1*a*, and the type head is stopped by a blocking member 19, while the respective tilting magnet 25*a* or 25*b* tilts the type head. However, since the third tilting magnet 26 is also energized, stop 28 is retracted, so that the stop faces 90' and 90'' limit the tilting movement of the rockable armature 27, 49, 49' and of the tilting means, permitting a tilting of the type head through a greater angle for placing one of the outer circular rows of types in the printing position.

Upon each key actuation, the escapement pawls 75 and 76 are actuated in a conventional manner, and release rack bar 74 to permit a spring, not shown, to pull carrier 35 with bearing means 36, type head 7, shaft 11, and tilting arms 33 one step in writing direction until the escapement pawls again engage the rack bar 74. During such displacement in the writing direction along the printing surface, gear 13 slides in axial direction on the grooved guide shaft 14, tilting means 33 slide in the same direction on guide shaft 31, and lever 22 of carrier 35 slides on rod 23 so that in all displaced positions of the type head, driving connection with the printing magnet 20 and with the tilting magnets 25*a* and 25*b* is maintained.

The construction of the present invention in which the type head moves along a stationary platen, permits a separation of the keyboard from the type head control apparatus. It is preferred to use long rolls of writing paper which are unwound from a supply roll by a take-up reel. Paper rolls of substantial size and weight may be used, since they are stationarily mounted. The omission of a paper carriage reduces the depth of the apparatus as indicated by the line A—A in FIG. 1. The conductors can be placed at the bottom of the housing, as schematically indicated by the cables V in FIG. 1. The construction of the present invention results in extremely simple apparatus having only few parts as compared with typewriters using a movable paper carriage and type lever actions.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of type head arrangements differing from the types described above.

While the invention has been illustrated and described as embodied in a type head construction in which the type head is tilted about an axis crossing the axis of rotation of the type head, and is movable along a stationary printing surface, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. Type head control apparatus comprising, in combination, bearing means; a type head mounted on said bearing means for rotation about a first axis, said type head having an outer surface with circumferential rows of types forming columns in axial planes so that during rotation of said type head different columns are successively positioned in a printing position opposite a printing surface; carrier means supporting said bearing means for tilting movement with said type head about a second axis, said second axis extending through said type head and being located in spaced relation to said first axis and in a plane which is perpendicular to said first axis whereby said first and second axes are devoid of any common point; and tilting means connected with said bearing means spaced from said second axis and being operable for tilting said bearing means with said type head about said second axis for placing selected rows of types opposite said printing surface.

2. Type head control apparatus comprising, in combination, bearing means; a type head mounted on said

bearing means for rotation about a first axis, said type head having an outer surface with circumferential rows of types forming columns in axial planes so that during rotation of said type head different columns are successively positioned in a printing position opposite a printing surface located rearwardly of said type head, said circumferential rows of types being located on opposite sides of a plane of symmetry of said type head extending perpendicularly to said first axis; drive means for rotating said type head about said first axis; carrier means supporting said bearing means for tilting movement with said type head about a second axis, said second axis extending through said type head and being located in spaced relation forwardly of said first axis and in said plane of symmetry whereby said first and second axes are devoid of any common point; and tilting means for pivotal movement about a third axis parallel to said second axis and located in said plane of symmetry connected with said bearing means rearwardly of said first axis and being operable for tilting said bearing means with said type head about said second axis for placing selected rows of types opposite said printing surface.

3. An apparatus as set forth in claim 2 wherein said type head has four circular rows of types axially spaced from each other, and four corresponding tilted positions; and including four rows of keys arranged in a keyboard, each row of keys being associated with one of said circular rows of types, and including keys respectively representing the same characters as the types of the respective row.

4. A type head control apparatus as set forth in claim 2 including resilient means for mounting said type head on said bearing means; wherein said bearing means has on the outer surface thereof a supporting projection located in a plane passing through said first axis perpendicularly to said second axis and adapted to be located opposite said printing surface; and wherein said type head has a cavity in which said bearing means is located, said type head having an inner surface of revolution coaxial with said first axis and normally spaced from said supporting projection, but abutting said supporting projection when slightly tilted about said resilient means upon engagement of the outer surface thereof with said printing surface.

5. A type head control apparatus as set forth in claim 4 wherein said inner surface of said type head and the outer surface of said supporting projection are curved and have substantially the same curvature in said plane.

6. Type head control apparatus, in combination, bearing means; a type head mounted on said bearing means for rotation about a first axis, said type head having an outer surface with circumferential rows of types forming columns in axial planes so that during rotation of said type head different columns are successively positioned in a printing position opposite a printing surface, said circumferential rows of types being located on opposite sides of a plane of symmetry of said type head extending perpendicularly to said first axis; carrier means supporting said bearing means for tilting movement with said type head about a second axis perpendicular to and spaced from said first axis, said second axis being located in said plane of symmetry, said outer surface of said type head being barrel-shaped, curved in planes passing through said first axis and circular in planes perpendicular to said first axis, and wherein the distance between a column of types in said printing position and the point of intersection of said second axis with a plane passing through said column and said first axis, is the radius of curvature of said outer surface in planes passing through said first axis; and tilting means connected with said bearing means spaced from said second axis and being operable for tilting said bearing means with said type head about said second axis for placing selected rows of types opposite said printing surface.

7. Type head control apparatus, in combination, bearing means; a type head mounted on said bearing means for rotation about a first axis, said type head having an outer surface with circumferential rows of types forming columns in axial planes so that during rotation of said type head different columns are successively positioned in a printing position opposite a printing surface, said circumferential rows of types being located on opposite sides of a plane of symmetry of said type head extending perpendicularly to said first axis; guide means extending parallel to said printing surface and transverse to said first axis; carrier means mounted on said guide means for movement along the same and supporting said bearing means for tilting movement with said type head about a second axis parallel with said guide means and said printing surface, and crossing said first axis spaced from the same and being located in said plane of symmetry, said outer surface of said type head being barrel-shaped, curved in planes passing through said first axis and circular in planes perpendicular to said first axis, and wherein the distance between a column of types in said printing position and the point of intersection of said second axis with a plane passing through said column and said first axis, is the radius of curvature of said outer surface in planes passing through said first axis; and tilting means mounted on said guide means for movement along the same, said tilting means being connected with said bearing means spaced from said second axis and operable for tilting said bearing means with said type head about said second axis for placing selected rows of type opposite said printing surface whereby selected types are successively placed opposite different portions of said printing surface during movement of said carrier means and said tilting means along said guide means.

8. Type head control apparatus, in combination, bearing means; a type head mounted on said bearing means for rotation about a first axis, said type head having an outer surface with circumferential rows of types forming columns in axial planes so that during rotation of said type head different columns are successively positioned in a printing position opposite a printing surface located rearwardly of said type head, said circumferential rows of types being located on opposite sides of a plane of symmetry of said type head extending perpendicularly to said first axis; drive means for rotating said type head about said first axis; guide means extending parallel to said printing surface and transverse to said first axis; carrier means mounted on said guide means for movement along the same and supporting said bearing means for tilting movement with said type head about a second axis parallel with said guide means and said printing surface, said second axis being spaced forwardly of said first axis and being located in said plane of symmetry; and tilting means mounted on said guide means for movement along the same, said tilting means being connected with said bearing means rearwardly of said first axis for pivotal movement about a third axis parallel with said second axis, said tilting means being operable for tilting said bearing means with said type head about said second axis for placing selected rows of type opposite said printing surface whereby selected types are successively placed opposite different portions of said printing surface during movement of said carrier means and said tilting means along said guide means.

9. Type head control apparatus, in combination, bearing means; a type head mounted on said bearing means for rotation about a first axis, said type head having an outer surface with circumferential rows of types forming columns in axial planes so that during rotation of said type head different columns are successively positioned in a printing position opposite a printing surface located rearwardly of said type head, said circumferential rows of types being located on opposite sides of a plane of symmetry of said type head extending perpendicularly to said first axis; drive means for rotating said

type head about said first axis; first and second guide shafts extending parallel to each other transverse to said first axis and parallel to said printing surface; carrier means mounted on said first guide shaft for free turning movement and for movement along the same, said carrier means pivotally supporting said bearing means for tilting movement with said type head about a second axis parallel with said guide shafts and crossing said first axis spaced from the same and being located in said plane of symmetry, said outer surface of said type head being barrel-shaped, curved in planes passing through said first axis and circular in planes perpendicular to said first axis, and wherein the distance between a column of types in said printing position and the point of intersection of said second axis with a plane passing through said column and said first axis, in the radius of curvature of said outer surface in planes passing through said first axis; first operating means for turning said carrier means with said bearing means and said type head between a retracted position and a printing position in which said outer surface of said type head contacts said printing surface; tilting means mounted on said second guide shaft for movement along the same, said tilting means being connected with said bearing means for pivotal movement about a third axis located rearwardly of said first axis parallel with said second axis; and second operating means for displacing said second guide shaft so that said tilting means tilts said bearing means with said type head about said second axis for placing selected types successively opposite different portions of said printing surface during movement of said carrier lever means and said tilting means along said guide shafts.

10. An apparatus as set forth in claim **9** weherin said second operating means include two tilting magnets, a rockable armature between said tilting magnets; rockable means connected to said armature and including arms engaging said second guide shaft for displacing the same in accordance with the position of said rockable armature depending on the energization of one or the other tilting magnet whereby said bearing means and type head is tilted between two positions for placing two circular rows of types in the printing position opposite the printing surface.

11. An apparatus as set forth in claim **10** and including a first stop member having a pair of stop faces located on opposite sides of said rockable armature for limiting movement of the same in two end positions corresponding to the printing positions of said two circular rows of types; a second stop member having a pair of stop faces located in opposite sides of said rockable armature farther spaced from the same than said stop faces of said first stop member; and a third tilting magnet for moving said first stop member to a position in which the stop faces thereof no longer block movement of said rockable armature so that the same is stopped by said stop faces of said second stop member in angularly displaced positions causing a displacement of said tilting means, and a tilting of said type head to such an extent that two circular rows of types located outwardly of said first two circular rows of type are placed in a printing position by energization of one or the other of said first mentioned tilting magnets, and simultaneous energization of said third tilting magnet.

12. Type head control apparatus, in combination, bearing means; a type head mounted on said bearing means for rotation about a first axis, said type head having an outer surface with circumferential rows of types forming columns in axial planes so that during rotation of said type head different columns are successively positioned in a printing position opposite a printing surface located rearwardly of said type head, said circumferential rows of types being located on opposite sides of a plane of symmetry of said type head extending perpendicularly to said first axis; drive means for rotating said type head about said first axis; a shaft extending parallel to said printing surface and located in a tangential plane on the printing point, said tangential plane being spaced from said first axis; carrier means supporting said bearing means for tilting movement with said type head about a second axis crossing said first axis spaced from the same and being located in said plane of symmetry forwardly of the same, said carrier means being turnable about said shaft for tilting said bearing means with said type head about said second axis for moving said printing head toward and away from the printing surface; and tilting means connected with said bearing means rearwardly of said first axis and being operable for tilting said bearing means with said type head about said second axis for placing selected rows of types opposite said printing surface.

13. Type head control apparatus, in combination, bearing means; a type head mounted on said bearing means for rotation about a first axis, said type head having an outer surface with circumferential rows of types forming columns in axial planes so that during rotation of said type head different columns are successively positioned in a printing position opposite a printing surface located rearwardly of said type head, said circumferential rows of types being located on opposite sides of a plane of symmetry of said type head extending perpendicularly to said first axis; drive means for rotating said type head about said first axis; first and second guide shafts extending parallel to each other transverse to said first axis and parallel to said printing surface, said first guide shaft being located in a tangential plane on the printing point, said tangential plane being spaced from said first axis and slanted to vertical and horizontal planes; carrier lever means mounted on said first guide shaft for free turning movement and for movement along the same, said carrier lever means having a first arm pivotally supporting said bearing means for tilting movement with said type head about a second axis parallel with said guide shafts and crossing said first axis spaced from the same and being located in said plane of symmetry, and a second arm; first operating means acting on said second arm for turning said carrier lever means with said bearing means and said type head between a retracted position and a printing position in which said outer surface of said type head contacts said printing surface; tilting lever means mounted on said second guide shaft for movement along the same, said tilting lever means being connected with said bearing means for pivotal movement about a third axis located rearwardly of said first axis parallel with said second axis; and second operating means for displacing said second guide shaft so that said tilting lever means tilts said bearing means with said type head about said second axis for placing selected rows of type opposite said printing surface whereby selected types are successively placed opposite different portions of said printing surface during movement of said carrier lever means and said tilting lever means along said guide shafts, and whereby said carrier lever means in said retracted position supports said bearing means and said type head in a retracted position permitting observation of said printing surface.

14. Type head control apparatus comprising, in combination, a drive shaft; a type head secured to said drive shaft for rotation therewith about a first axis, said type head having an outer surface with circumferential row of types forming columns in axial planes so that during rotation of said type head different columns are successively positioned in a printing position opposite a printing surface located rearwardly of said type head, said type head having an inner cavity; a bearing member having a central bearing bore for rotatably supporting said drive shaft, said bearing member being located in said cavity and having bearing faces on the outer surface thereof for slidingly supporting said type head; a guide shaft extending perpendicularly to said drive shaft rearwardly of the same and parallel to said printing surface; carrier means mounted on said first guide shaft for movement

along the same, and for turning movement about the same; first pivot means for mounting said bearing member on said carrier means for tilting movement about a second axis crossing said first axis at right angles and being located forwardly of the same; a second guide shaft extending perpendicularly to said drive shaft rearwardly of the same and parallel to said second axis; tilting means having an opening slidingly receiving said second guide shaft so that said tilting means is movable along said guide shaft and turnable about the same; second pivot means connecting said tilting means with said bearing member for pivotal movement about a third axis located rearwardly of said first axis substantially symmetrical to said second axis and extending parallel to the same; rocking means cooperating with said guide shaft for moving the same and said tilting means with said bearing member during rocking movement so that said type head is tilted about said second axis, said rocking means including a rockable armature; resilient means for holding said rockable armature and said rocking means in a central position; a pair of tilting magnets located on opposite sides of said rockable armature and being selectively energizable for displacing the same between at least two positions in which different circular lines of type of said type head are located opposite said printing surface; a lever member secured to said carrier means and having an opening; a third guide shaft extending parallel to said first and second guide shaft and slidingly received in said opening of said lever member; a second rocking means connected with said third guide shaft for moving the same with said lever member with said carrier means so that said type head performs a printing motion toward and away from said printing surface; spring means acting on said third guide shaft, and stop means limiting movement of said third guide shaft under the action of said spring means in a normal position of said type head spaced from the printing surface; transmission means connecting said first guide shaft with said drive shaft and including a transmission member movable along said first guide shaft and operatively connected with said carrier means for movement with the same along said first guide shaft; a drive motor; slip clutch means connecting said drive motor with said first guide shaft for rotating the same, said transmission means, said drive shaft, and said type head; a stop finger secured to said first guide shaft for rotation therewith; a plurality of stationary stop magnets surrounding said first guide shaft, each stop magnet including a movable armature having an inoperative position and a blocking position located in the path of movement of said stop finger for stopping said first guide shaft, said drive shaft, and said type head; and a plurality of selector contacts respectively associated with said types on said outer surface of said type head; and circuit means connecting said contracts with said pair of tilting magnets, said stop magnets, and with said printing magnet for actuating the same in a timed relationship so that said type head is stopped and tilted to place a selected type opposite said printing face, and then moved toward the printing surface for producing an imprint.

15. A type head control apparatus as set forth in claim **14** wherein said circuit means includes a source of voltage connected to said rotating stop finger and to said printing magnet, said printing magnet being electrically connected with said armature members of said stop magnets so that said printing magnet is energized when said stop finger and said printing head are stopped.

16. A type head control apparatus as set forth in claim **14**, including a stationary shaft; and wherein said resilient means includes a pair of arms mounted on said stationary shaft; spring means urging said arms toward each other; a central stop member between said arms, said armature of said first rockable means being located between said arms and held by the same in a central position; and wherein said second rocking means is mounted on said last mentioned shaft for rocking movement.

17. A type head control apparatus as set forth in claim **14** wherein said transmission means includes a gear mounted on said first guide shaft for movement along the same and connected thereto for rotation, and a second gear connected with said drive shaft for rotation and meshing with said first gear; and wherein said carrier means is mounted on said first gear for turning movement, and for movement with the same along said first guide shaft.

18. A type head control apparatus as set forth in claim **21** and including a stop member having a pair of stop faces for limiting movement of said rockable armature of said first rocking means in two positions; and including a third tilting magnet for retracting said stop member out of the path of movement of said rockable armature; and a second stop member having a pair of stop faces located outwardly of said first mentioned stop faces for stopping said rockable armature into farther spaced positions when said first member is retracted by said third tilting magnet; said contacts including a set of contacts connected by said circuit means to said third tilting magnet, and being associated with types in the outer rows of types on said type head.

19. A type head control apparatus as set forth in claim **14** including a stationary rack bar; and escapement pawl means mounted on said carrier means and cooperating with said rack bar for causing stepwise movement of said carrier means with said transmission means along said first guide shaft, of said lever means along said third guide shaft, and of said tilting means along said second guide shaft while the actuation of said carrier means and tilting means is effected by said first and second rocking means.

20. A type head control apparatus as set forth in claim **14** wherein said outer surface of said type head is barrel-shaped, curved in planes passing through said first axis and circular in planes perpendicular to said first axis, and wherein the distance between a column of types in the printing position and the point of intersection of said second axis with a plane passing through said column and said first axis, is the radius of curvature of said outer surface in planes passing through said first axis.

21. A type head control apparatus as set forth in claim **14** and including a platen extending parallel to said second axis and providing said printing surface; and wherein the axis of said first guide shaft is located in a tangential plane on said platen in the region of said printing surface whereby said printing head in its normal position spaced from the printing surface is located lower than in the printing position whereby observation of the printing surface is facilitated.

22. A type head control apparatus as set forth in claim **14** wherein said drive shaft includes at least one universal joint and two shaft portions connected by said universal joint, said universal joint including a slotted member, and one of said shaft portions having a transversely projecting pin located in said slots.

23. A type head control apparatus as set forth in claim **14** wherein said tilting means includes a pair of arms, and a yoke portion connecting said arms, said opening being provided in both arms, said arms having cutouts in the edges thereof connected with said openings; and said second guide shaft having at least one flat portion permitting insertion through said cutout into said openings in said arms, said arms having projections located on opposite sides of said drive shaft so that said arms and said drive shaft move together during movement of said carrier means along said first guide shaft and of said arms along said second guide shaft.

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