United States Patent

Herterich et al.

[15] **3,677,386**

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[54] ELECTRICALLY OPERATED TYPEWRITER

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[30] **Foreign Application Priority Data**

June 26, 1969 Germany ..... P 19 32 481.3

[52] **U.S. Cl.** **197/53**, 197/18, 197/98

[51] **Int. Cl.** **B41J 1/22**

[58] **Field of Search** 197/18, 53, 98

[56] **References Cited**

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[57] **ABSTRACT**

An electrically operated typewriter in which type carried on the radially slotted circumference of a rotating disc is driven against paper by an electromagnetically operated hammer when a type selected by pressing a key of a keyboard is in the path of the hammer, and the disc is stopped momentarily and uncoupled from its drive motor when the hammer strikes.

10 Claims, 5 Drawing Figures

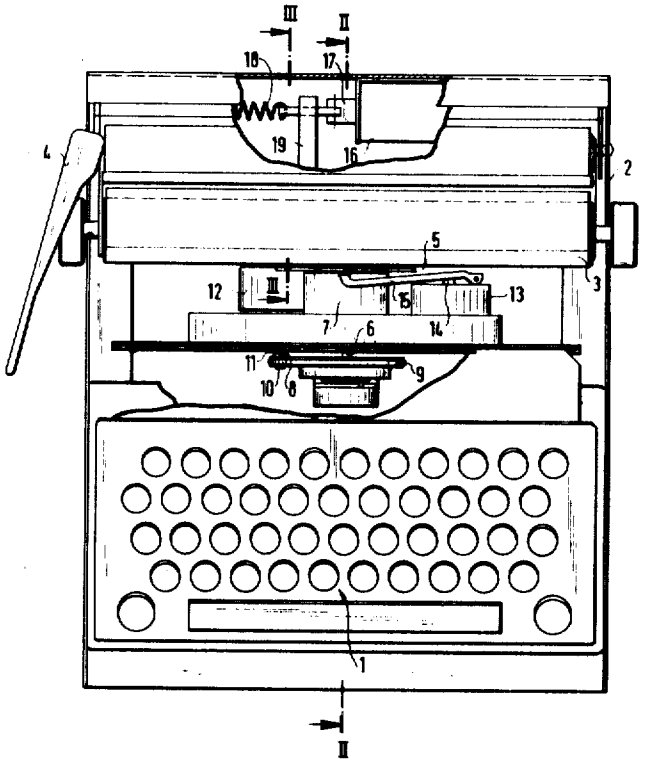

Fig. 1

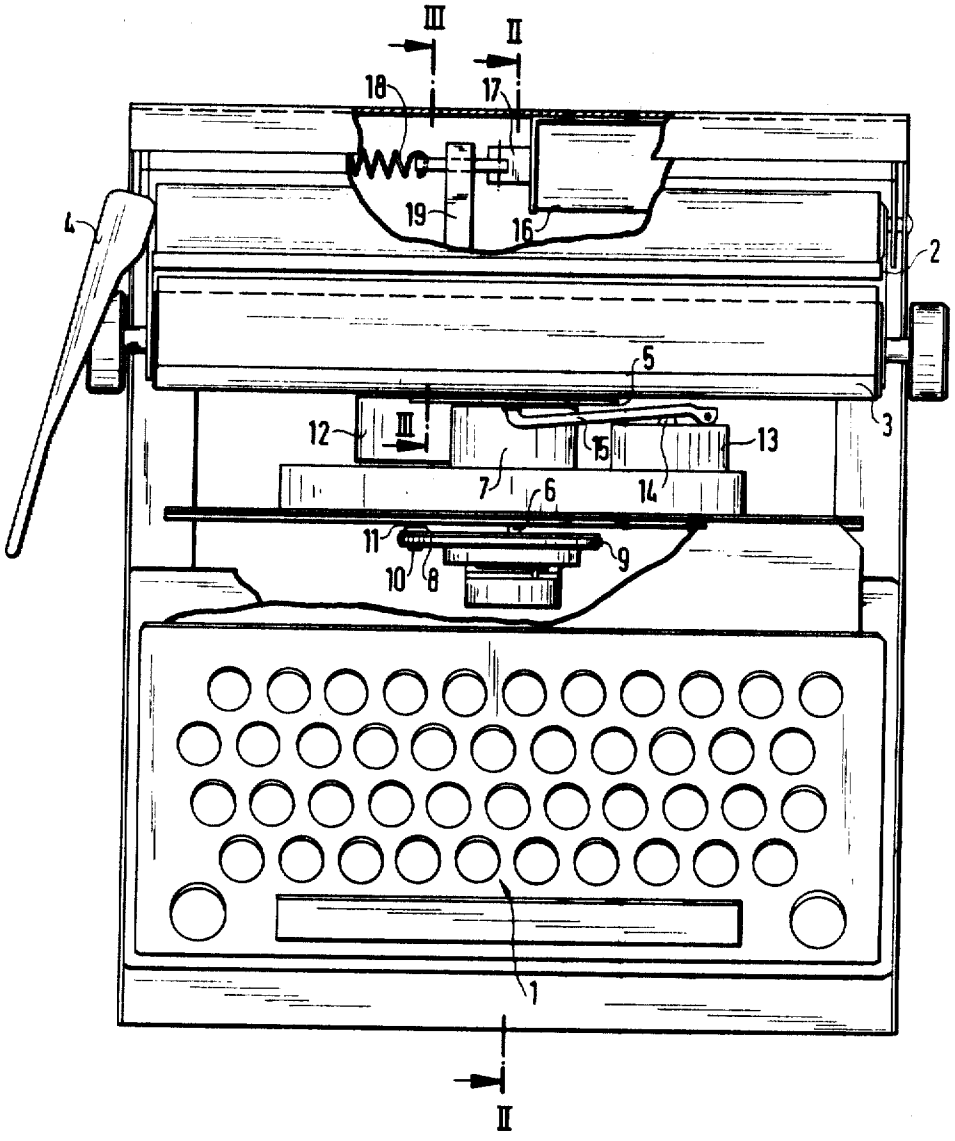

Fig. 2

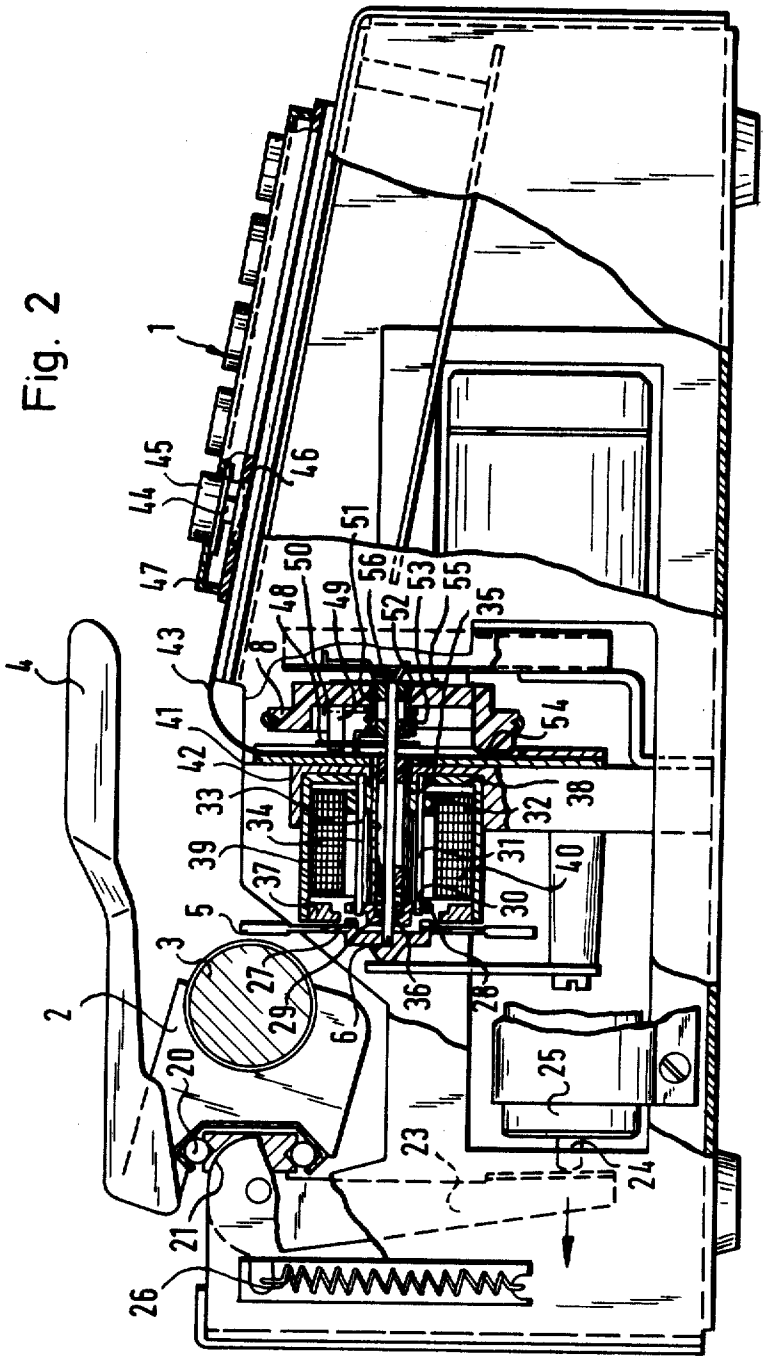
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Fig. 3

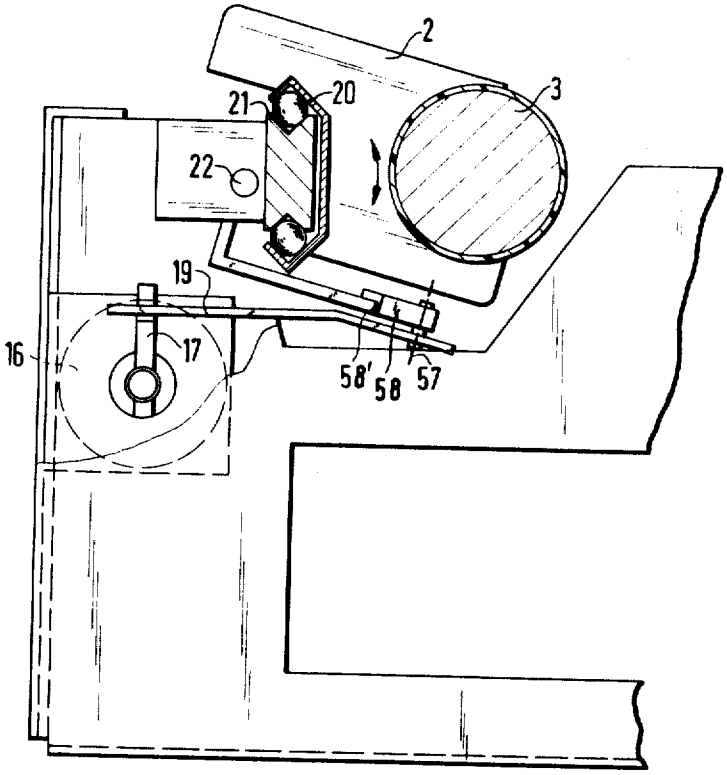


Fig. 4

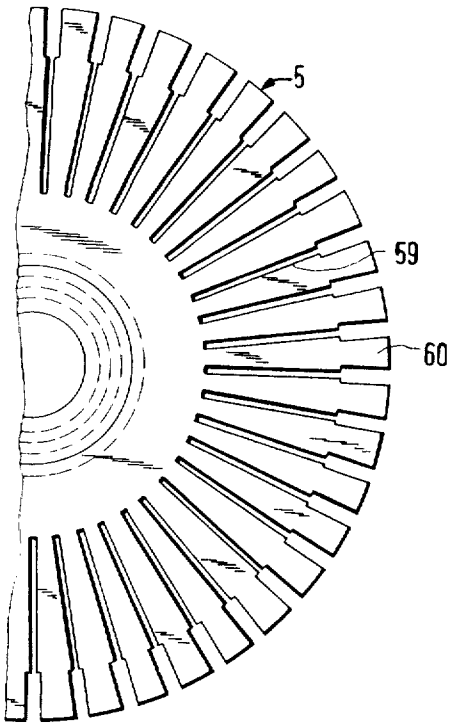
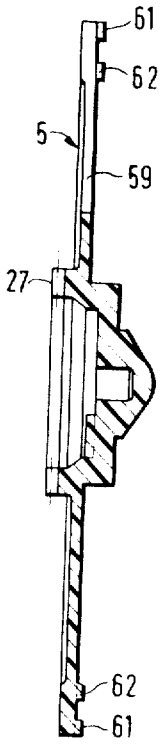


Fig. 5



ELECTRICALLY OPERATED TYPEWRITER

This invention relates to electrically operated typewriters, and particularly to an electrically operated mechanism for impressing type on a suitable supported sheet of writing material.

Most electrically operated typewriters in current use have a multiplicity of type levers mechanically triggered by depressing keys and brought into abutting engagement with paper or other sheet material supported on a cylinder with the aid of an electrically driven rubber roller. These typewriters thus are basically mechanical devices in which the electrical drive merely has an auxiliary function in reducing the amount of manual effort required. They include as many individual elements as any manual typewriter and are accordingly costly and complex.

It is known to equip the read-out of an electronic computer with a printing device in which a continuously rotating disc carries types on circumferentially distributed tongues, and the tongues are struck by a hammer to form an impression on a writing material (U. S. Pat. No. 3,356,199). Because of the relatively long period during which the hammer remains in abutting engagement with the rotating disc, the impressions produced lack the sharp definition expected from good typed material.

The primary object of the invention is the provision of an electrically operated typewriter which employs a rotatably mounted type carrier disc, but produces sharply defined typed impressions.

With this object and others in view, as will presently be apparent, the invention provides a typewriter analogous to the aforedescribed computer read-out with an arresting device which responds to the driving of the hammer into abutting engagement with a tongue of the type carrier disc for arresting the disc, and a deactivating mechanism which simultaneously deactivates the connection between the disc and the electric motor normally effective to rotate the disc.

Other features, additional objects, and many of the attendant advantages of this invention will readily be appreciated as the same becomes better understood by reference to the following detailed description of a preferred embodiment when considered in connection with the appended drawing in which:

FIG. 1 shows an electric typewriter of the invention in top plan view, a portion of the apparatus being broken away to reveal internal structure;

FIG. 2 shows the typewriter of FIG. 1 in side elevation and partly in section on the line II—II;

FIG. 3 illustrates the same typewriter in fragmentary enlarged section on the line III—III in FIG. 2;

FIG. 4 is a fragmentary, front-elevational view of the type carrier disc of the typewriter on a scale larger than that of FIG. 3; and

FIG. 5 shows the disc of FIG. 4 in radial section.

Referring now to the drawing in more detail, and initially to FIG. 1, there is seen a typewriter having a keyboard 1 of conventional appearance, a horizontally movable carriage 2 on which a rubber covered paper cylinder or platen 3 may be indexed angularly by means of a carriage return lever 4, as is conventional.

A type carrier disc 5 is fixedly mounted in front of the cylinder 4 on a horizontal shaft 6. The shaft 6 passes through an electromagnet 7 of an arresting mechanism which will presently be described in more detail. The front end of the shaft 6 carries a rotatably mounted, but axially secured pulley 8. A V-belt 9 is trained over the pulley 8 and over a small drive pulley 10 on the output shaft 11 of an electric motor 12 mounted to the left and below the magnet 7 in the stationary typewriter frame, as viewed in FIG. 1.

To the right and below the magnet 7, there is mounted the solenoid 13 of a hammer operating mechanism. The armature 14 of the solenoid is hinged to the hammer 15 which is a rocker arm pivoted on the shell of the solenoid 13. The path of the hammer 15 is such that it can strike the topmost peripheral portion of the disc 5. Another solenoid 16 is mounted behind the carriage 2. Its armature 17 and a return spring 18 are

secured to an escapement operating lever of a carriage indexing mechanism which will be further described hereinbelow with reference to FIG. 3.

As is seen in FIG. 2, and partly on a larger scale in FIG. 3, the carriage 2 travels on bearing balls 20 set into a guide rail 21, the rail being mounted on the machine frame by means of a horizontal pivot shaft 22. An arm 23 extends downward from the rail 21 and is held in abutting engagement with the armature 24 of a solenoid 25 by a helical tension spring 26 which tends to swing the rail 21 counterclockwise, as viewed in FIG. 2. When the solenoid 25 is energized, the armature 24 moves in the direction of the arrow, and the rail 21 together with the carriage 2 is shifted downward for the typing of capital letters in a manner that will become evident as the disclosure proceeds.

A crown gear 27 is coaxially provided on the type carrier disc 5, and its teeth are directed toward the magnet 7. The disc-shaped armature 29 of the magnet 7 carries a matching crown gear 28 coaxially opposite the gear 27. The armature 29 has two eccentric, axial bores 30 which are slidably engaged by respective end portions of two resilient rods 31 whose other ends are fixedly fastened in the stationary, tubular core 32 of the magnet 7.

The central bore 33 in the core 32 is lined with a bushing 35 having two longitudinally spaced bearing rings 34 in which the shaft 6 of the disc 5 is journaled. A helical compression spring 36 is coiled about the shaft 6 in the bushing 36 between the armature 29 and the bearing ring 34 which is nearer the armature, therefore axially biasing the crown gear 28 toward engagement with the axially secured crown gear 27 on the disc 5. The core 32 is set in a shell consisting of two radial flanges 37, 38 and an outer cylindrical envelope 39, the winding 40 of the magnet 7 being arranged in the annular space between the core 32 and the envelope 39. The entire magnet assembly is mounted on the typewriter frame by means of a bracket 42.

The bracket also carries a contact ring 41 coaxial with the shaft 6 and having a multiplicity of conductive segments which are connected by respective insulated conductor strands of a cable 43 to microswitches 44, only partly shown in FIG. 2. A microswitch 44 is mounted in the housing 47 of the keyboard 1 under each key 45, the keys being secured in respective apertures of the housing 47 by radial flanges 46 at their lower ends.

The terminal front portion of the shaft 6 which projects from the bushing 35 carries a radially projecting abutment arm 48, and an axial, eccentric abutment pin 49 on the pulley 8 engages the arm 48 when the shaft 6 and the pulley 8 turn relative to each other. The pin 49 is set into the bottom of an annular recess 50 of the pulley 8, the recess being bounded in a radially inward direction by a sleeve 51. Two bearing rings 52 axially spaced in the sleeve 51 rotatably engage the shaft 6. A helical spring 53 is loosely wound on the bushing 51 in the recess 50. One of its ends is attached to the pulley 8, and the other end to the arm 48.

The pulley 8 consists of electrically insulating plastic, and its rear face carries a metallic contact finger 54 which sweeps the stationary contact ring 41 during rotation of the pulley. The front face of the pulley 8 carries a slip ring 55 conductively connected to the contact finger 54 and movably engaged by another contact finger 56 attached to the typewriter frame by an insulated mounting. In a manner shown in more detail in our simultaneously filed, commonly owned application "Electric Typewriter", the contact finger 56 is connected to an amplifier whose output signal causes the winding 40 of the magnet 7 and the solenoid 25 to be deenergized.

Reverting now to FIG. 3, the arm 19 is seen to be connected to an escapement 58 pivotally mounted in the machine frame on a pin 57. The escapement 58 cooperates with a rack 58' on the carriage 2 to permit the carriage to be moved on the rail 21 by one step whenever the solenoid 16 is deenergized in synchronization with the magnet 7 and the solenoid 25 or by pressure exerted on the spacer bar in the keyboard 1. It will be understood that a spring tends to pull the carriage toward the left, as viewed in FIG. 1, in a conventional manner.

The type carrier disc 5 is shown in more detail in FIGS. 4 and 5. Its peripheral portion has a multiplicity of equiangularly distributed radial slots 59, the portions of the disc 5 between the slots forming radial tongues 60. The disc is made of nylon or other plastic having a specific gravity not substantially greater than 2 and is thin enough so that the tongues 60 are resilient. The free end portion of each tongue carries integral types 61, 62 which are coated with hard chromium plate to give them adequate hardness and wear resistance. In a manner customary in conventional typewriters, the same tongue carries the capital type and lower case type of the same letter of the alphabet. The smaller lower case type 61 is offset radially outwardly from the larger capital letter 62 so that the portions of the slots 59 radially coextensive with the types 61 may be made wider than the portions coextensive with the types 62. The wide ends of the slots permit the subject matter typed to be viewed by the typist through the rotating disc 5.

The afore-mentioned crown gear 27 is also integral with the plastic disc 5 and chromium plated for hardness and wear resistance. The disc 5 therefore is extremely light in weight and has little inertia, a feature whose importance will readily be appreciated from the following description of the normal mode of operation of the afore-described apparatus.

When the non-illustrated main switch of the typewriter is closed, the winding 40 of the magnet 7 is energized, whereby the armature 29 is attracted against the restraint of the compression spring 36. The teeth of the crown gear 28 are withdrawn from the teeth of the crown gear 27 on the disc 5 so that the disc 5 may turn freely on the shaft 6.

Closing of the main switch starts the electric motor 12. The shaft 6 being coupled to the pulley 8 by the helical spring 53, the type carrier disc 5 is rotated at a constant speed which may be between 10 and 20 revolutions per second. The contact finger 54 on the pulley 8 sweeps the segments of the contact ring 41. The segments and the associated microswitches 44 are arranged in a series circuit with a non-illustrated direct-current source, each circuit being closed through the non-illustrated amplifier when the microswitch is being closed by depressing the corresponding key 45 while the rotating contact finger 54 makes contact with the segment.

When the winding 40 of the magnet 7 is thereby deenergized, the armature is shifted toward the left, as viewed in FIG. 2, by the spring 36, and the teeth of the gears 27, 28 are engaged. The disc 5 is arrested, its momentum being absorbed largely by the resilient rods 31. The pulley 8 continues rotating, whereby the pin 49 is moved away from the abutment arm 48.

In the illustrated embodiment, the weight of the armature 29 is about 4 to 5 g and is under the pressure of the spring 36 having a force of approximately 2 to 4 kg. The energized winding 40 causes the armature to be attracted with a force of about 5 kg. When the magnet 7 is deenergized, the armature is therefore accelerated with a force of about 500 to 1,000 g so that the crown gears 27, 28 are engaged within 1 millisecond. The disc 5 has 45 tongues to accommodate the usual letters, symbols, and auxiliary functions. At a rotary disc speed of 10 revolutions per second, the disc moves in 1 millisecond through less than one half of the width of a tooth in the crown gears 27, 28 so that the disc 5 is arrested in a precisely defined desired position. The disc is not stopped abruptly, but is permitted by the rods 31 to move ahead 8° to 12° after engagement of the crown gears, whereupon it is moved back by the relaxing rods. Additional damping is provided by the tongues 60 of the disc which are resilient not only in an axial direction, but also circumferentially so that they can yield when the disc is arrested.

The solenoid 13 is deenergized simultaneously with the magnet 7, and the hammer 15 is driven by a return spring, not shown but analogous to the springs 18, 26, 36, against the tongue 60 which is topmost in the arrested disc 5. Because of the relatively long path of the hammer, the tongue 60 is struck only after the disc is fully arrested, and the type 61 or 62 is impressed on a paper sheet carried by the cylinder 3 in a conventional manner, not shown, depending on the angular position of the carriage 2 on the pivot shaft 22 which may be selected by means of a shift key, not shown, in the keyboard, acting on the solenoid 25 in a manner obvious from the preceding description.

The non-illustrated amplifier arrangement contains a delay circuit which causes the magnet 7 to be energized again after having been without current for about 20 milliseconds. The crown gears 27, 28 are disengaged, and the shaft 6 with the disc 5 is accelerated by the spring 53 until the shaft 6 catches up with the pulley 8, and synchronization between the contact ring 41 and the disc 5 is restored when the arm 48 again abuts against the pin 49.

The hammer operating solenoid 13 and the carriage indexing solenoid 16 operate in unison with the magnet 7, so that the typewriter is ready for the next impression to be made after the disc 5 resumes its rotation.

While an inked ribbon may be employed in a conventional manner, not shown, for producing visible impressions, it is preferred to ink the types 61, 62 by means of a train of engaged rollers which transfer ink from a well to the disc 5, or by means of a single, porous inking roller saturated with ink. If the last-mentioned roller is hollow and its interior is filled with ink, the ink is driven to the surface of the rapidly rotating roller by centrifugal forces. If so desired, the inking mechanism may be provided with an electromagnet analogous to the magnets and solenoids more fully described above, which lists the inking roller from the disc 5 when the latter is stationary, thereby permitting the roller to rotate continuously.

Obviously, many modifications and variations are possible in the illustrated apparatus described above without departing from the spirit and scope of the invention.

Thus, the crown gear 28 need not be mounted on the armature of a magnet, but may be arranged on a movable magnet coil corresponding to the voice coil of a dynamic speaker without materially affecting the operation of the apparatus. The coupling spring 53 and the abutments 48, 49 may be replaced by a slipping clutch, but the contact finger 54 in such an arrangement is arranged on the shaft 6, not on the pulley 8, and there is never any phase difference between the disc 5 and the contact finger. Also, the disc 5 itself may be made axially movable and directly attached to the armature of the magnet 7 for movement between positions of engagement of suitable projections and recesses on the disc with a first set of mating projections and recesses secured to the stationary machine structure and a second set of similar projections and recesses rotating with the pulley 8.

If it is desired to mount the cylinder or platen 3 in fixed axial position on the machine frame without a moving carriage, the type carrier disc together with its drive mechanism and other necessary elements of the typewriter may be made to move along the cylinder, while the common axis of the contact ring 41, the pulley 8, and the contact finger 54 is fixed on the machine frame. Proper synchronization between the disc 5 and the contact finger 54 is achieved in this event by means of a grooved connecting shaft parallel to the axis of the cylinder 3 and suitable crown and bevel gears.

The type carrier disc may also be driven by means of a timing belt trained over two guide pulleys on a laterally movable, spring loaded slide. The belt is driven by a fixedly mounted electric motor whose output shaft is coaxial with the contact ring 41 and carries the contact finger 54. This arrangement permits the disc 5 to be moved not only axially along the cylinder 3 but also circumferentially relative to the cylinder for shifting between capital and lower case letters without loss of synchronization.

What is claimed is:

1. An electrically operated typewriter comprising, in combination:

a. a rotatably mounted type carrier disc having an axis and a plurality of circumferentially distributed resilient tongue portions;

b. a type on each tongue portion;

c. an electric motor;

d. connecting means for drivingly connecting said electric motor to said disc and for rotating the disc about said axis when said motor is energized;
e. sheet carrier means for carrying a sheet of writing material;
f. a movably mounted hammer member;
g. electromagnetic hammer operating means for driving said hammer member into abutting engagement with one of said tongues and for thereby impressing the type of said tongue on a sheet carried by said sheet carrier means and for withdrawing said hammer member;
h. arresting means for arresting rotation of said disc, said arresting means including
1. two locking members, one of said locking members being connected to said type carrier disc for rotation therewith,
2. limiting means limiting rotation of the other locking member about said axis,
3. electromagnetic engaging means for engaging and disengaging said locking members, said electromagnetic operating means and said electromagnetic engaging means each including
i. a winding for generating a magnetic field when said winding is energized,
ii. a return spring,
iii. an armature connected to said return spring and mounted in said field for movement in one direction against the restraint of said spring when said winding is energized, and for movement in a second direction by the force of said spring when said winding is deenergized,
4. said hammer member being connected to the armature of said hammer operating means and driven against said tongue by the return spring of said operating means,
5. one of said locking members being connected to the armature of said engaging means and engaged with the other locking member by the force of the return spring of said engaging means,
6. the armature of said engaging means being moved in the direction of said axis by the associated return spring and the associated magnetic field,
7. said locking members including respective rows of teeth annular about said axis, said teeth being secured to said disc and to the armature of said engaging means respectively,
8. said limiting means including a normally stationary frame and yieldably resilient means secured to said frame and to said armature of the engaging means for resisting rotation of said armature of the engaging means about said axis, while permitting axial movement of said armature;
i. deactivating means for deactivating said connecting means; and
j. control means for operating said hammer operating means and said deactivating means simultaneously with the arresting of said disc.

2. A typewriter as set forth in claim 1, wherein said disc is formed with a plurality of radial slots circumferentially separating said tongue portions, another type larger than said first-mentioned type offset from said first type on each tongue portion in a radially inward direction, the portion of each slot radially coextensive with said first types of the two tongue portions separated by said slot being circumferentially wider than the portion of each slot radially coextensive with said other types on said two tongue portions.

3. A typewriter as set forth in claim 2, wherein said disc essentially consists of resilient plastic having a specific gravity not greater than 2.

4. A typewriter as set forth in claim 1, further comprising a keyboard including a plurality of switches and a plurality of keys respectively associated with said switches for operating the same, a contact ring including a plurality of segments respectively connected to said switches, a contact finger rotatably mounted for sweeping said segments, coupling means for coupling said contact finger to said disc for simultaneous rotation, said control means including circuit means connecting said contact ring, contact finger, said switches, said engaging means, and said hammer operating means for operating said engaging means and said hammer operating means in response to the operating of said switches by said keys.

5. A typewriter as set forth in claim 4, wherein said contact ring is normally fixed, and said contact finger is mounted for rotation about said axis.

6. A typewriter as set forth in claim 5, further comprising a shaft, said disc being fixedly mounted on one end portion of said shaft, said shaft passing through the winding of said engaging means, and said contact finger being mounted on the other end portion of said shaft.

7. A typewriter as set forth in claim 6, said connecting means including slip clutch means interposed between said motor and said shaft for rotating said shaft when said motor is energized while permitting said shaft to be arrested.

8. A typewriter as set forth in claim 7, wherein said slip clutch means including a pulley member rotatably mounted on said shaft and drivingly connected to said motor, respective abutments spaced from said axis on said shaft and on said pulley member, and yieldably resilient means biasing said abutments toward driving engagement.

9. An electrically operated typewriter comprising, in combination:
a. a rotatably mounted type carrier disc having an axis and a plurality of circumferentially distributed resilient tongue portions;
b. a type on each tongue portion;
c. an electric motor;
d. connecting means for drivingly connecting said electric motor to said disc and for rotating the disc about said axis when said motor is energized;
e. sheet carrier means for carrying a sheet of writing material;
f. a movably mounted hammer member;
g. electromagnetic hammer operating means for driving said hammer member into abutting engagement with one of said tongues and for thereby impressing the type of said tongue on a sheet carried by said sheet carrier means and for withdrawing said hammer member;
h. arresting means for arresting rotation of said disc, said arresting means including
1. two locking members, one of said locking members being connected to said type carrier disc for rotation therewith,
2. limiting means limiting rotation of the other locking member about said axis,
3. electromagnetic engaging means for engaging and disengaging said locking members, said electromagnetic operating means and said electromagnetic engaging means each including
i. a winding for generating a magnetic field when said winding is energized,
ii. a return spring,
iii. an armature connected to said return spring and mounted in said field for movement in one direction against the restraint of said spring when said winding is energized, and for movement in a second direction by the force of said spring when said winding is deenergized,
4. said hammer member being connected to the armature of said hammer operating means and driven against said tongue by the return spring of said operating means,
5. one of said locking members being connected to the armature of said engaging means and engaged with the other locking member by the force of the return spring of said engaging means,

6. said limiting means including two resilient rod members elongated in the direction of said axis and having respective first terminal portions fastened to the winding of said engaging means,

7. the armature of said engaging means being formed with two openings therein, said rod members having respective second terminal portions slidingly received in said openings:

i. deactivating means for deactivating said connecting means; and

j. control means for operating said hammer operating means and said deactivating means simultaneously with the arresting of said disc.

10. A typewriter as set forth in claim 9, wherein said control means include means for arresting said disc before said hammer abuts against said tongue.

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