

Dec. 14, 1965

G. O. HOFFMANN

3,223,322

TRANSFER COUNTER

Filed Aug. 7, 1964

5 Sheets-Sheet 1

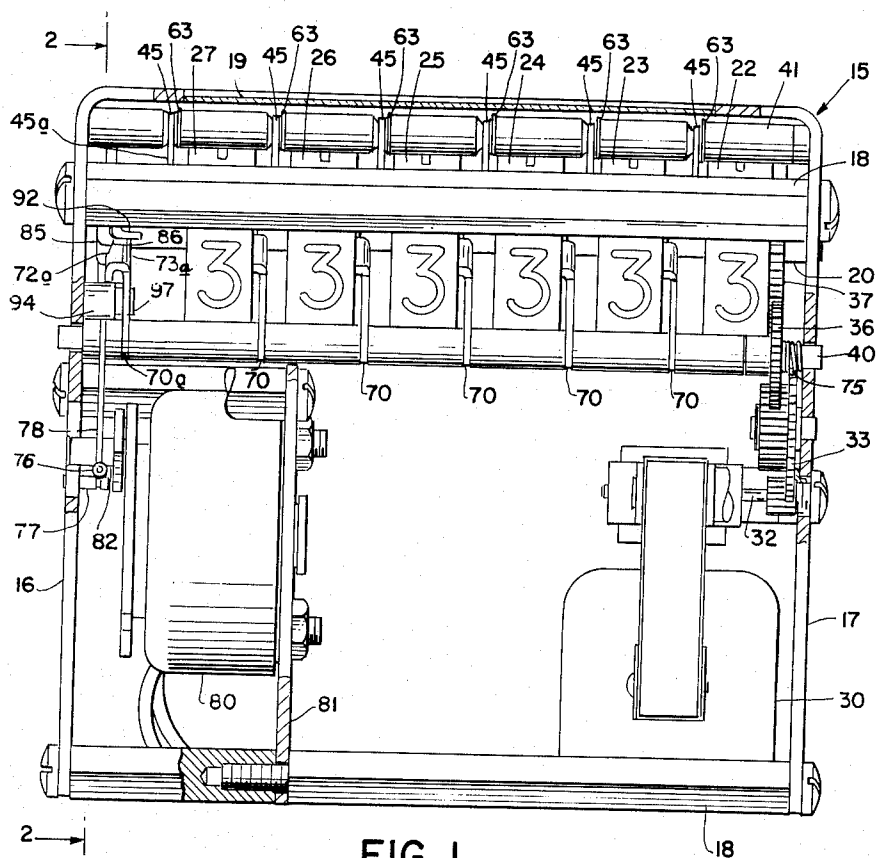


FIG. 1

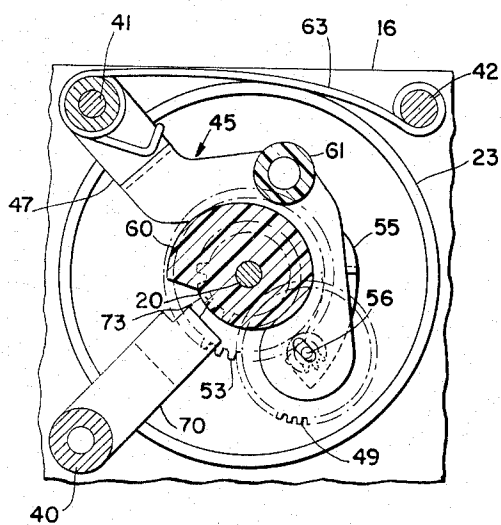


FIG. 7

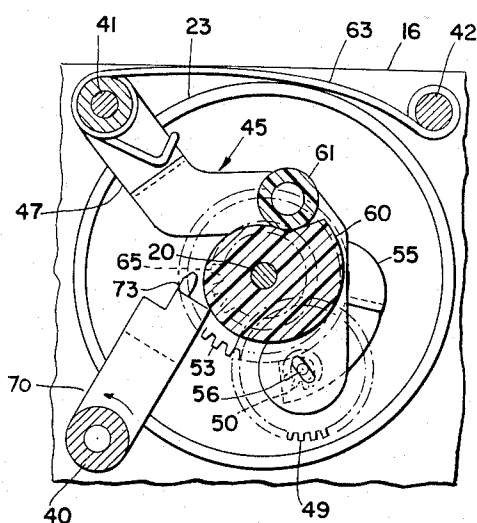


FIG. 8

Dec. 14, 1965

G. O. HOFFMANN
TRANSFER COUNTER

3,223,322

Filed Aug. 7, 1964

5 Sheets-Sheet 2

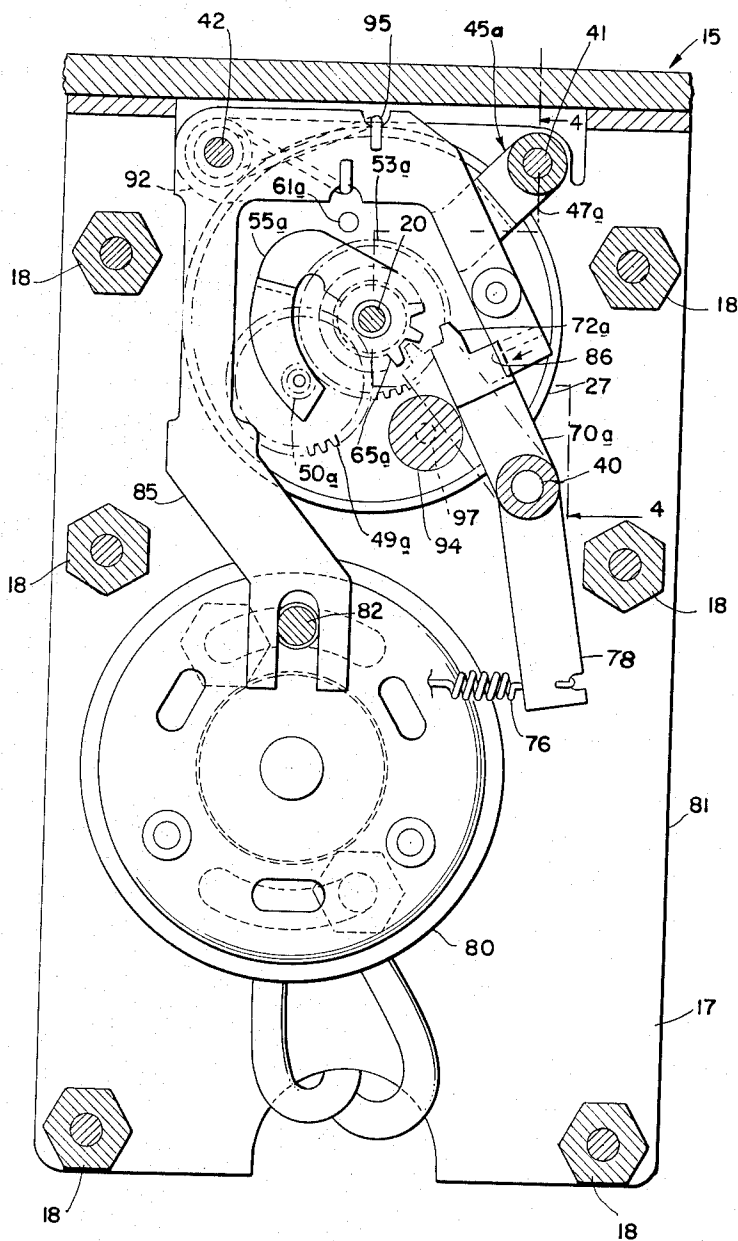


FIG. 2

Dec. 14, 1965

G. O. HOFFMANN
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3,223,322

Filed Aug. 7, 1964

5 Sheets-Sheet 3

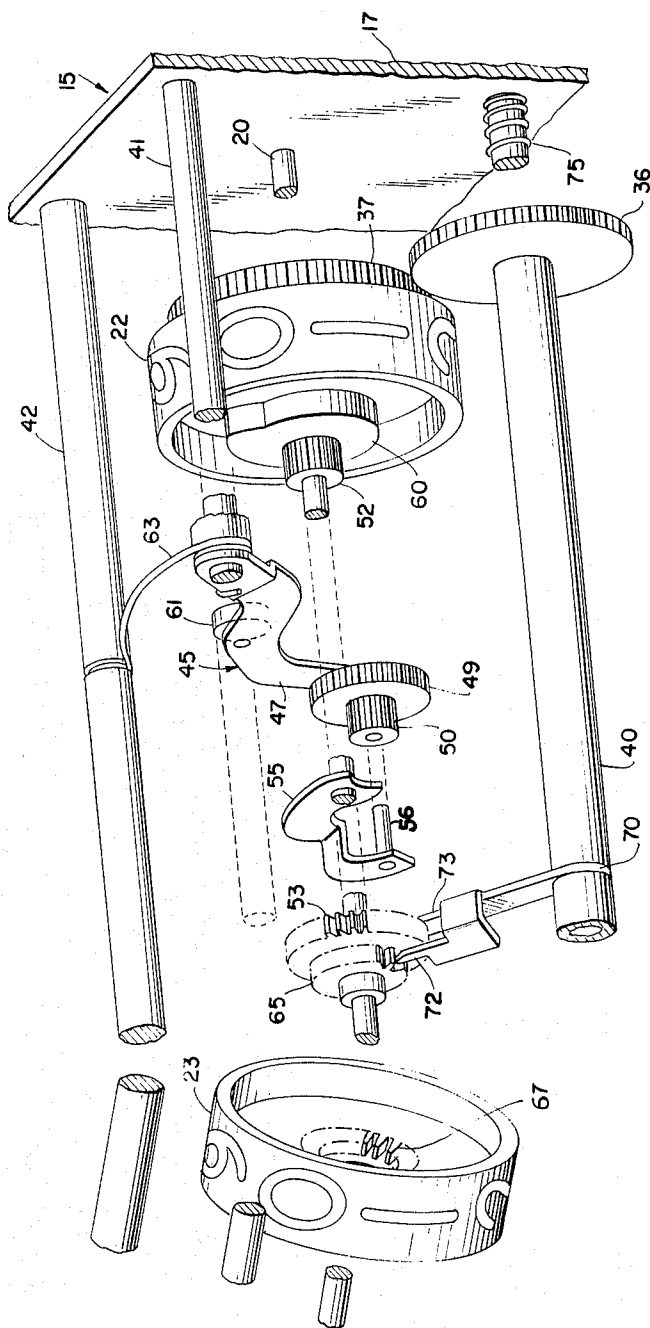


FIG. 3

Dec. 14, 1965

G. O. HOFFMANN
TRANSFER COUNTER

3,223,322

Filed Aug. 7, 1964

5 Sheets-Sheet 4

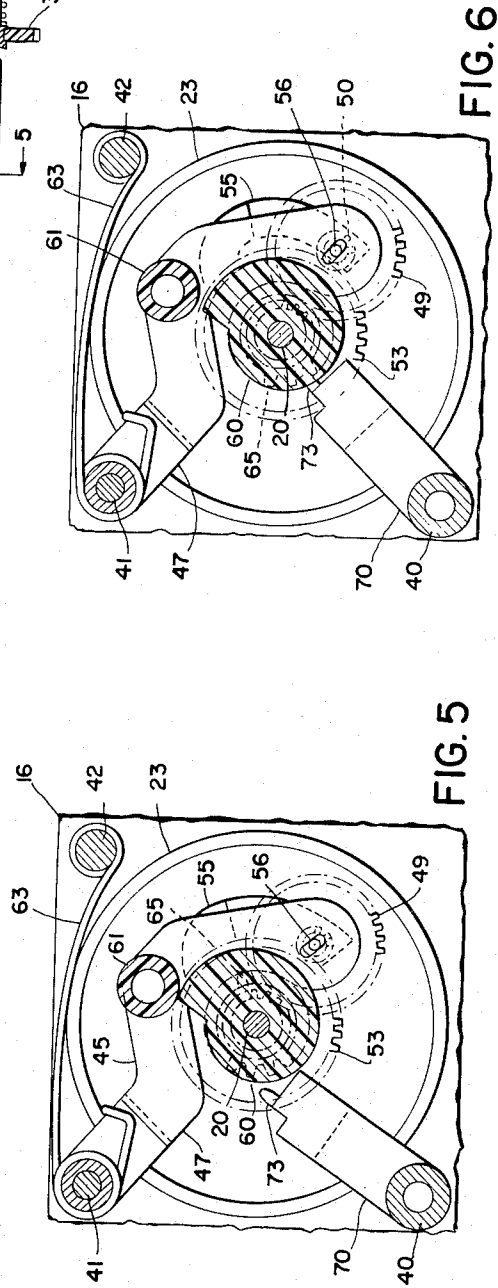
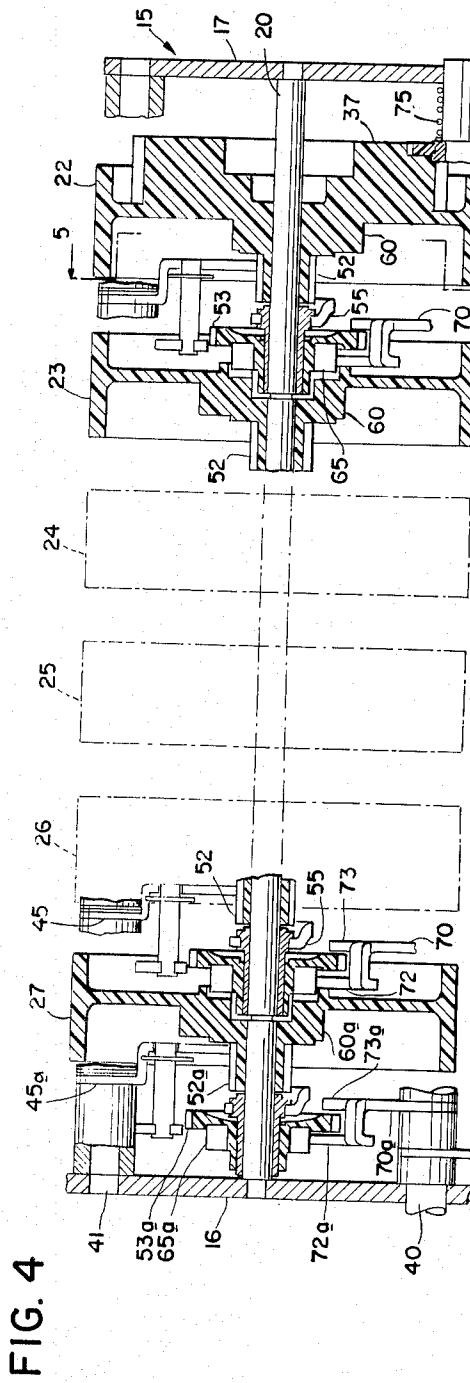
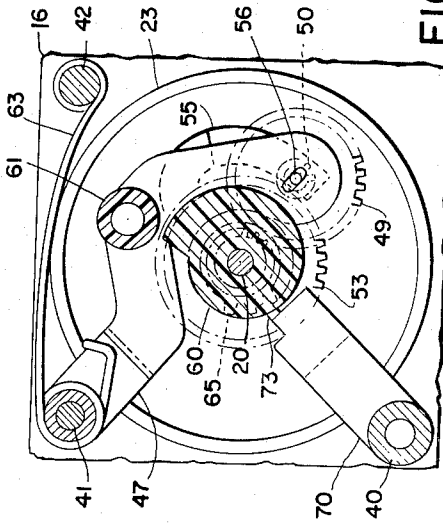


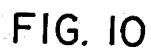
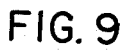
FIG. 6



Filed Aug. 7, 1964

TRANSFER COUNTER

5 Sheets-Sheet 5



3,223,322

TRANSFER COUNTER

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Filed Aug. 7, 1964, Ser. No. 388,074
22 Claims. (Cl. 235-117)

This invention relates to counting devices and more particularly to such devices which are quickly and easily resettable to an initial position.

There has been developed a transfer counter which is extremely rapid in action and highly efficient. One such counter is disclosed, for example, in A. W. Haydon Patent 3,069,083, granted December 18, 1962. Counters of this type utilize a series of indicia bearing counting elements, customarily in the form of register drums, which are rotatably supported about a common axis and are maintained in driving relationship with each other by unique planetary gearing interposed between adjacent drums. Each of the drums includes an integrally formed cam which cooperates with a follower mounted on the supporting arm for the planetary gearing. The particular gear ratios and the surface contour of each cam are such that, as a given drum in a decade counter, for example, rotates from its "zero" position to its "nine" position, the next higher order drum remains stationary. As the given drum is rotated from its "nine" position to its "zero" position, however, the planetary gearing drives the higher order drum through a 36° angle to carry it from "zero" to "one." The support arm for the planetary gearing is provided with a biasing spring which, during the movement of the given drum from "zero" to "nine," gradually builds up the necessary force to drive the higher order drum without imposing any substantial impact forces on the main drive mechanism of the counter.

Heretofore, in the use of transfer counters including those of the foregoing type, difficulties have been encountered in quickly and easily resetting such counters to a zero or null position. In the counter described in the above-noted Haydon patent, for example, the resetting operation has been performed by urging the individual cam followers against their corresponding cams to drive the drums in the reverse direction until they reach their zero position. Because of the frictional resistance between each follower and the surface of its cam, together with the relatively small force vector acting on the cam, such prior resetting often took place at a comparatively slow rate and necessitated the exertion of an unnecessarily large resetting pressure on the follower. In addition, in the resetting of many types of transfer counters previously employed, the driving connection between adjacent drums was interrupted by moving the support arms for the rotating transfer elements in a lateral direction with respect to the drums, thus producing an undesirable side loading on the rotating elements. Furthermore, several of the transfer counters used heretofore employed drums which were not readily releasable to enable the individual setting of the drums to any desired reading and thus provide a predetermined or settable counter. These latter difficulties, while applicable to a wide variety of prior counters, have been of special moment in cases in which attempts were made to provide the counter with a resettable feature.

One general object of this invention, therefore, is to provide a new and improved transfer counter which is quickly and easily resettable to an initial position.

More specifically, it is an object of this invention to provide such a counter in which the available resetting forces are employed with optimum efficiency to perform the resetting operation at high speed.

Another object of this invention is to provide a counter of the character indicated in which any side loading on the various rotating elements is maintained at a minimum.

A further object of this invention is to provide a transfer counter in which the register drums or other indicia bearing counting elements may be easily and individually set to any desired position.

Still another object of this invention is to provide a transfer counter utilizing comparatively simple mechanical and electrical components which is economical to manufacture and thoroughly reliable in operation.

In one illustrative embodiment of this invention, there is provided a transfer counter which comprises a plurality of indicia bearing register drums in coaxial relationship with each other. A cam element is mounted on one side of each drum, and each but the lowest order drum includes a driving gear assembly rigidly but detachably secured to the other side. The drums are maintained in driving relationship with each other through the use of resiliently biased transfer mechanisms which interconnect each lower order drum with the driving gear for the adjacent higher order drum. The arrangement is such that each higher order drum is operated in a given direction by its transfer mechanism only during selected portions of the operation of the lower order drum.

In accordance with one feature of the invention, the counter is provided with unique reset means which cooperates with the individual transfer mechanisms to enable operation of all of the register drums or other indicia bearing elements in a direction to quickly and easily reset the counter to its initial position.

In accordance with another feature of the invention, in certain particularly advantageous embodiments, the reset means is effective to move the followers for the various cams into spaced relationship with the cam surfaces against the resilient bias of the transfer mechanisms. The transfer mechanisms are thereupon effective to rotate the drums in the reverse direction to their initial positions. Substantially entirely throughout this return movement, the followers and cams are maintained in spaced relationship to eliminate frictional losses that might otherwise result because of contact therebetween.

In accordance with a further feature of several advantageous embodiments of the invention, the individual driving gears are arranged for movement in an axial direction with respect to the drums to disconnect each gear from its corresponding drum. The disconnected drums are freely and individually rotatable and may be set to any desired position. The transfer mechanisms, on the other hand, remain in fixed planes with respect to the axis of the drums with the result that no appreciable side loading takes place on the rotating transfer elements.

In accordance with many good arrangements, the movement of each of the cam followers into spaced relationship with its cam is accomplished by operating the reset means to rotate the detached driving gear for the next higher order drum through a small angle. The resulting torque acts through the transfer mechanism between this drum and the adjacent lower order drum against the mechanism's resilient bias. The transfer mechanism thereupon produces a comparatively high force which rapidly drives the lower order drum to its initial position independently of the cam or other motion modifying means.

In certain good embodiments, the reset means is effective to rotate the driving gears with a type of "snap" action. In some cases, this action is supplied through the use of an electrically operated solenoid, while in other situations the reset means is operated manually but is provided with a novel spring and arm construction to produce the snap action. The rapid movement of the

driving gears applies a momentary impulse through the transfer mechanism to each drum to start the drums rotating toward their reset positions at a rapid rate.

The present invention, as well as further objects and features thereof, will be understood more clearly and fully from the following description of certain preferred embodiments, when read in conjunction with the accompanying drawings, in which:

FIGURE 1 is a front elevational view, with certain parts broken away and in section, of a transfer counter having an automatically operated reset mechanism in accordance with one illustrative embodiment of the invention;

FIGURE 2 is a transverse sectional view taken generally along the line 2—2 of FIGURE 1;

FIGURE 3 is an exploded perspective view of the counter shown in FIGURE 1, with certain parts omitted for purposes of clarity;

FIGURE 4 is a sectional view taken generally along the line 4—4 of FIGURE 2, with certain portions shown in elevation;

FIGURE 5 is a transverse sectional view taken along the line 5—5 of FIGURE 4;

FIGURES 6, 7 and 8 are transverse sectional views in general similar to FIGURE 5 but showing portions of the counter in successive positions during the reset operation;

FIGURE 9 is a transverse sectional view in general similar to FIGURE 2 but illustrating a transfer counter having a manually operated reset mechanism in accordance with another illustrative embodiment of the invention; and

FIGURE 10 is a fragmentary perspective view showing portions of a transfer counter having a reset mechanism in accordance with still another illustrative embodiment of the invention.

Referring to FIGURE 1 of the drawings, there is shown a transfer counter comprising a generally U-shaped frame 15 which serves to support the various counter components. The legs 16 and 17 of the frame 15 are suitably spaced apart by a series of posts 18, and the bight of the frame includes an elongated window 19 of transparent material to facilitate the reading of the counter. A stationary shaft 20 extends between the legs 16 and 17 adjacent the window 19 and supports a series of counting elements in the form of register drums 22—27. In the illustrated embodiment, the drums are arranged to provide a decade counter with each drum bearing indicia from "zero" to "nine." The drums are freely rotatable on the shaft 20 and advance one digit each time the drum moves through an angle of 36°.

The counter drums 22—27 are of molded plastic construction and include indicia bearing flanges about their outer peripheries which are spaced from the axis of the shaft 20 by generally disk-shaped web sections. The web sections are arranged substantially midway between the edges of the corresponding flanges to form recesses in both surfaces of the drums. In the interests of compactness, these recesses accommodate substantial portions of the various operating components of the counter. The drums 22—27 are arranged in progressively increasing order on the shaft 20 from the lowest order drum 22 to the highest order drum 27. The lowest order drum 22 is rotated by a drive motor 30. Although a wide variety of drive motors may be employed to operate the drum 22, one particularly advantageous motor for this purpose is disclosed, for example, in the copending Haydon, Herbert and Riggs U.S. Patent application entitled "Electric Rotating Machine." Motors of this type may be employed to rotate the drum 22 continuously and thus perform a timing function, for example, or they may operate as stepper motors to advance the drum 22 in successive digital increments. The output shaft 32 of the motor 30 is connected to a reduction gear train 33 which operates an axially movable pinion 36. In its FIGURE 1 position, the pin-

ion 36 is in meshing engagement with a driving gear 37 on the adjacent side of the drum 22.

As best shown in FIGURE 3, in spaced relationship with the assembly of register drums are three parallel rods 40, 41 and 42 which extend in longitudinal directions between the legs 16 and 17 of the frame 15. The rod 40 is pivotally and axially movable with respect to the frame 15, for purposes that will become more fully apparent hereinafter, while the rods 41 and 42 are maintained in stationary positions. The rod 41 pivotally supports a series of resiliently biased transfer mechanisms 45 (only one of the mechanisms 45 being visible in FIGURE 3) which are interposed between each pair of adjacent register drums and serve to transfer motion from each lower order drum to the next higher order drum. Each of the transfer mechanisms 45 includes a support arm 47 which is pivotally connected at one end to the rod 41 and is provided at its opposite end with a rotary planetary gear assembly comprising a large diameter gear 49 and a comparatively smaller gear 50 integrally formed therewith.

Integrally molded on the side of each of the drums 22—27 adjacent the next higher order drum is a pinion 52. The opposite side of each drum except the lowest order drum 22 is provided with a drive gear 53. The compound planetary gears 49 and 50 on each of the transfer arms 47 are in respective meshing engagement with the pinion 52 on the corresponding drum and the drive gear 53 for the next higher order drum. The various gear ratios are such as to provide a ten-to-one reduction between each pair of adjacent drums, thus rotating each higher order drum one-tenth of a revolution for each revolution of the lower order drum.

The axis of rotation of the planetary gears 49 and 50 is maintained in predetermined spaced relationship with that of the pinion 52 and the drive gear 53 by a radius arm 55. One of the arms 55 is provided for each of the transfer mechanisms 45, and the arms are positioned between each pair of adjacent drums. One end of each arm 55 is pivotally supported on the drum shaft 20, while its opposite end includes a pin 56 about which the gears 49 and 50 rotate. The arm 55 enables movement of the gears 49 and 50 relative to the shaft 20 while retaining the gears in proper position to mesh with the corresponding pinion 52 and drive gear 53.

The counter preferably is designed to limit the effectiveness of each of the transfer mechanisms 45 to transfer motion from a lower order drum to the adjacent higher order drum except during selected portions of the operation cycle. As a given drum moves from its "zero" position to its "nine" position, for example, it is desirable to modify the action of the adjacent transfer mechanism to prevent the transfer of motion to the next higher order drum. As the drum moves between its "nine" and "zero" positions, however, the transfer mechanism is rendered effective to rotate the higher order drum one-tenth of a revolution. For this purpose, each of the drums 22—27 is provided with motion modifying means which comprises an integrally formed compensating cam 60 between the pinion 52 and the adjacent drum surface. The cam 60 cooperates with a roller or follower 61 which is carried intermediate the ends of the corresponding compensating arm 47. A wire spring 63 extends from the longitudinal rod 42 around the rod 41 adjacent each arm 47 and engages the arm to exert a resilient bias on the follower 61 and thereby normally maintain the follower in contact with its cam.

As more fully explained in the aforementioned Haydon patent, during the rotation of the lowest order drum 22, for example, in the direction of increasing count, its pinion 52 acts on the planetary gears 49 and 50 in a direction which tends to produce similar rotation of the adjacent higher order drum 23. However, as the drum 22 rotates from its "zero" position to its "nine" position, the cam 60

acts on its follower 61 to move the follower away from

the drum shaft 20 and thereby pivot the transfer arm 47 and the gears 49 and 50 about the rod 41. The cam 60 is of single lobe construction and is contoured such that this latter movement of the gears 49 and 50 exactly compensates for the tendency of the gears to drive the higher order drum, so that in fact the higher order drum remains stationary.

Upon the movement of the lowest order drum 22 between its "nine" position and its "zero" position, the follower 61 drops off the lobe of the cam 60 under the action of the stored tension in the spring 63 and enables the rapid rotation of the higher order drum through a 36° angle to move this latter drum between its "zero" and "one" positions. The arrangement is such that, at the time motion is transferred to each higher order drum, the energy needed to rotate the drum is derived from the spring 63, rather than from the input to the lowest order drum. As a result, even for counters having a large plurality of drums which are simultaneously transferred from their "nine" positions to their "zero" positions, the imposition of substantial impact forces on the main input drive is eliminated.

The structure described thus far for the most part is illustrative of a conventional combination of transfer counter components. It will readily be apparent that in any such combination situations may arise where it is desirable to reset the individual drums to "zero" or to some other initial position. Heretofore, in counters of the type specifically described above, such resetting has been accomplished by permitting the springs 63 to urge each of the followers 61 firmly against the surface of the corresponding cam 60, thus tending to rotate the cam and its attached drum toward "zero." Primarily because of the frictional resistance between the follower and the cam surface and the comparatively small force vector available to drive the cam in the desired direction, such prior resetting arrangements were comparatively inefficient and often necessitated the exertion of an unnecessarily large pressure on the follower by the spring.

In the illustrated embodiments of the invention, the resetting operation is initiated by first detaching the various driving gears 53 from their corresponding drums and thereafter rotating the driving gears through a small angle in a direction to urge the followers 61 into spaced relationship with the associated cams 60. The transfer mechanisms 45 are thereupon effective to drive the drums toward the reset position through the planetary gears 49 and the pinions 52 with the followers and the cams maintained in their spaced relationship.

The various gears and pinions between each pair of adjacent drums may be considered as forming a three element differential, with the pinion 52 on the lower order drum as the first element, the planetary gears 49 and 50 as the second element and the driving gear 53 for the higher order drum as the third element. During the normal counting operation, the rotation of the first element pinion 52 is transmitted to the second element gear 49 and 50. The rotary movement of these gears is compensated for by the movement of the transfer arm 47 in response to the motion-modifying cam 60 as the pinion rotates through a major portion of a revolution to maintain the third element gear 53 in a stationary position. Thereafter, as the follower 61 drops off the lobe on the cam 60, the third element gear 53 is rotated to drive the higher order drum. The effective gear ratio between the pinion 52 and the drive gear 53 is one-to ten.

During reset, the operation of the differential is reversed, and the effective gear ratio becomes ten-to-one. The third element gear 53 is rapidly rotated through a small angle with a type of snap action, and the gear 53 tends to rotate the second element gears 49 and 50. However, the gears 49 and 50 as well as the first element pinion 52 and its attached drum initially remain substantially stationary primarily because of the inertia of the drum. The initial motion of the gear 53 is absorbed by

the transfer arm 47 which moves against its resilient bias to carry the follower 61 away from the cam 60. As the third element gear 53 continues to rotate, its motion is transmitted through the second element gears 49 and 50 to the first element pinion 52 to start the pinion and its attached drum moving toward the reset position. Thereafter, the gear 53 is held stationary, and the resilient bias of the transfer arm takes over to continue the reset movement of the pinion and drum independently of the cam 60.

Each of the driving gears 53 is maintained in rigid but detachable relationship with its corresponding drum through the use of a toothed wheel or spline 65 which is integral with the gear. The wheel 65 is of somewhat smaller diameter than that of the gear 53 and is provided with ten teeth around its periphery. Each of the assemblies comprising the gear 53 and the wheel 65 is slidably supported on the stationary shaft 20 and is arranged for both axial and rotary movement with respect thereto. The surface of the drum adjacent the wheel 65 is recessed to form an internal gear 67 having ten teeth which mate with the teeth on the wheel to establish a driving connection between the gear 53 and the drum during the normal counting operation.

The rotary and axial reset movement of each of the assemblies comprising the driving gear 53 and the toothed wheel 65 is controlled by a reset arm 70, the number of reset arms corresponding to the number of assemblies. Each of the arms 70 is affixed at one of its ends to the axially movable rod 40, while the other end of each arm is provided with a pair of upstanding fingers 72 and 73. These fingers are positioned on opposite sides of the gear 53 with the finger 72 in position to engage the teeth of the wheel 65.

An additional reset arm 70a (FIGURE 1) is mounted on the rod 40 adjacent the side of the highest order drum 27 facing the leg 16. In a manner similar to that described above, the arm 70a includes two upstanding fingers 72a and 73a which are arranged on opposite sides of a gear 53a. This gear does not perform a driving function during the normal counting operation but is otherwise the same as the gears 53. A toothed wheel 65a is integrally formed with the gear 53a in position to be engaged by the finger 72a.

As best shown in FIGURE 2, the assembly comprising the gear 53a and the wheel 65a cooperates with a transfer mechanism 45a which is substantially the same as the mechanisms 45 described heretofore. The mechanism 45a includes a compensating arm 47a, a large planetary gear 49a cooperating with a pinion 52a on the drum 27, a smaller planetary gear 50a in meshing engagement with the gear 53a, a radius arm 55a and a follower 61a which cooperates with the compensating cam on the adjacent surface of the highest order drum 27.

The axial movement of the reset rod 40 is resiliently opposed by a coil spring 75 (FIGURES 1 and 3). The spring 75 extends around a reduced portion of the rod 40 between the upstanding leg 17 of the frame 15 and the pinion 36. This spring serves to bias the rod toward the left, as viewed in FIGURES 1 and 3, to similarly bias the reset arms 70 and the toothed wheels 65 and thereby maintain the wheels 65 in meshing engagement with the corresponding internal gears 67.

The rotary motion of the rod 40 is opposed by a coil spring 76 (FIGURES 1 and 2). One end of the spring 76 is secured to a longitudinally extending post 77 which protrudes inwardly from the leg 16. The opposite end of the spring is connected to the depending portion of a biasing member 78 which is fixedly carried by the rod 40. The spring 76 biases the rod 40 in a clockwise direction, as viewed in FIGURE 2.

The rotary and axial movement of the individual drive gear assemblies is controlled by an electrically actuated solenoid 80. The solenoid 80 is supported beneath the drums 22-27 by an upstanding plate 81

carried by the lower posts 18. The solenoid includes a protruding pin 82 which is arranged for movement to the left from the position shown in FIGURE 2 upon the application of an energizing current pulse to the solenoid winding.

The actuating pin 82 cooperates with the bifurcated lower end of a reset lever 85. The lever 85 extends upwardly from the pin 82 between the highest order drum 27 and the leg 16 (FIGURE 1) and is pivotally supported on the rod 42. The upper part of the lever 85 is disposed above the stationary shaft 20, and the lever then extends in a generally downward direction with its opposite end in engagement with the reset arm 70a. This latter end of the lever 85 includes a camming surface 86 thereon in contact with the adjacent portion of the reset arm. The configuration of the surface 86 is such that, upon pivotal movement of the lever 85 about the rod 42 in a clockwise direction, as viewed in FIGURE 2, the surface produces axial movement of the rod 40 to the right from the position shown in FIGURE 1 against the biasing force of the spring 75.

The rotary reset movement of the rod 40 takes place in response to movement of an angularly shaped lever 92. One end of the lever 92 is pivotally carried by the rod 42 immediately adjacent the reset lever 85, and the lever 92 extends laterally and downwardly from the rod in substantially coextensive relationship with the lever 85. The lever 92 is slightly shorter than the lever 85, and the lower end of the lever 92 rests on the upper adjacent portion of the reset arm 70a. In the normal, non-reset position of the arm 70a, the arm is interposed between the lever 92 and a boss 94 which protrudes inwardly from the leg 16 of the frame 15, thereby preventing pivotal movement of the arm 70a and hence the rod 40. The levers 85 and 92 are resiliently interconnected by a scissors spring 95. This spring is disposed around the rod 42 and its ends engage the levers 85 and 92 to resiliently hold the levers in fixed relationship with each other.

Upon energization of the solenoid 80 to reset the counter, the actuating pin 82 moves to the left from the position shown in FIGURE 2 to pivot the reset lever 85 in a clockwise direction, as viewed in this figure, about the rod 42. During at least a major portion of this pivotal movement, the lever 92 is held stationary because of its engagement with the reset arm 70a on the boss 94, and the lever 85 moves relative to the lever 92 against the biasing force of the scissors spring 95. The pivotal movement of the lever 85 urges the reset arm 70a to the right from the position shown in FIGURES 1 and 3 by reason of the configuration of the camming surface 86. This movement of the arm 70a produces axial movement of the rod 40 against the resistance of the spring 75 to carry each of the reset arms 70 away from their associated drums. The fingers 72 on the arms 70 engage the adjacent faces of the drive gears 53 and move these gears axially along the stationary shaft 20 to carry the toothed wheels 65 away from the internal gears 67 on the drums 23-27. The individual gears 53 are thereby detached from their corresponding drums to permit the free rotation of each drum to any desired position. The axial movement of the rod 40 also carries the pinion 36 out of mesh with the driving gear 37 for the lowest order drum 22 to free this latter drum.

As the reset arm 70a completes its longitudinal movement, it rides off the boss 94 and is thus free to pivot about the axis of the rod 40. The lever 92 is biased by the scissors spring 95 in a direction to urge the arm 70a counterclockwise, as viewed in FIGURE 2, to its dotted line position, where the movement of the arm is arrested by a pin 97 which protrudes from the boss 94. The rod 40 and the remaining reset arms 70 affixed thereto are similarly pivoted about the rod axis against the resistance of the coil spring 76 on the biasing member 78. During the pivotal movement of each reset arm, the finger 72 thereon moves between adjacent teeth on the corresponding wheel 65 and

rotates the wheel and its attached driving gear 53 through a small angle. The fingers thereafter hold the wheels and driving gears stationary in their rotated positions.

The scissors spring 95 imparts a quick, snap-action rotary movement to each of the driving gears 53 through the lever 92, the reset arm 70a, the rod 40, the reset arms 70, the fingers 72 and the toothed wheels 65. Although the movement of the rod 40 is resisted by the coil spring 76, the tension in this spring is substantially less than the force exerted by the spring 95 during the energization of the solenoid 80. The driving gears 53 are thus rapidly rotated through a small angle in a counterclockwise direction, as viewed in FIGURES 5-8. Because of the inertia of the various drums, during the initial portion of this rotary movement the drums remain stationary. The impact of the individual fingers 72 on the wheels 65 and the gears 53 is received by the transfer mechanisms 45, and the transfer arms 47 pivot slightly in a counterclockwise direction against the biasing force of the springs 63 to carry the followers 61 away from the surfaces of the corresponding cams 60. Each transfer mechanism is thus moved against its resilient bias to avoid frictional engagement between the followers and the cams during reset and to increase the available force in the springs 63 to perform the reset operation. During this portion of the reset cycle, the transfer arms 47 move from the position shown in FIGURE 5 to that shown in FIGURE 6.

The sharp impact of each of the fingers 72 on the toothed wheels 65 produces counterclockwise motion of the driving gears 53, and the gears 53 rotate the planetary gears 49 and 50 in a clockwise direction as soon as the initial inertia is overcome. The clockwise motion of these latter gears produces counterclockwise rotation of the pinions 52 and the attached drums 22-27 to thereby start the drums moving rapidly in the reverse direction toward their reset position.

Thereafter, the scissors spring 95 (FIGURE 2) continues to act on the lever 92 to hold the reset arms in their rotated positions, with the fingers 73 in engagement with the teeth on the various wheels 65. The drive gears 53 are thus affirmatively prevented from further rotational movement. However, the increased biasing force of each of the transfer springs 63 produces pivotal movement of the corresponding transfer arm 47 about the rod 41 in a clockwise direction, as viewed in FIGURES 5-8. The planetary gears 49 and 50 move relative to the stationary driving gears 53 and continue to rotate clockwise to thereby maintain the rapid counterclockwise movement of the drums. Substantially entirely throughout the counterclockwise rotation of the drums to their reset position, the followers 61 are in spaced relationship with the cams 60.

As each of the drums approaches the termination of its reset movement and is carried from the position shown in FIGURE 7 to that shown in FIGURE 8, the transfer mechanism followers 61 engage the lobes on the corresponding cams 60 to arrest further reset movement of the drums. The orientation of the cams with respect to their attached drums is such that the movement of the drums is arrested at the time the drums are in their "zero" or other initial position.

Upon the de-energization of the solenoid 80, the actuating pin 82 returns to the position shown in FIGURE 2 to move the camming surface 86 on the reset lever 85 in an upward direction. Substantially simultaneously, the scissors spring 95 is effective to raise the free end of the lever 92. Upon the upward movement of the free end of the lever 92, the spring 76 acts on the biasing member 78 to pivot the rod 40 clockwise, as viewed in FIGURE 2, and thereby move the reset arm 70a from its dotted line position to its full line position. The fingers 72 on the various reset arms are thus urged away from the teeth on the wheels 65 to their initial positions, and the followers 61 (FIGURE 3) then drop onto the surfaces of the cams 60 through the action of the springs 63. As the camming surface 86 on the lever 85 moves upwardly, the coil spring

75 urges the rod 40 in an axial direction, and the fingers 73 on the reset arms 70 engage the corresponding drive gears 53 to return these gears and the attached wheels 65 to their initial positions. The teeth on the wheels 65 engage the internal gears 67 on the associated drums 23-27 to again connect the drive gears thereto, while the pinion 36 is brought into meshing engagement with the drive gear 37 for the drum 22.

In several advantageous arrangements, rather than providing a lowest order drum which has a configuration different from that of the remaining drums, an alternative drum identical to any of the drums 23-27 is substituted for the lowest order drum 22. The substituted drum is provided with a toothed wheel and driving gear assembly, of a type similar to that described above, which is slidably movable on the stationary shaft 20 in response to an additional reset arm 70 on the rod 40. The driving gear is maintained in meshing engagement with the gear train 33 but may be readily detached from the drum upon the axial reset movement of the rod 40.

In certain good embodiments, it is advantageous to reset the counter manually rather than through the operation of a solenoid or other electrically operated means. In FIGURE 9, for example, there is shown a transfer counter which is reset by the manual actuation of a lever 100. The lever 100 is of generally Y-shaped configuration and includes an upstanding leg 101 which protrudes through a slot 102 in the adjacent portion of the frame 15a. The leg 101 is provided with a button 104 on its protruding end and is resiliently maintained in its unoperated position (the position shown) by a coil spring 105 between the button and the adjacent surface of the frame.

The second leg 107 of the lever 100 is pivotally supported by the elongated rod 42, while the third leg 108 extends downwardly into engagement with the reset arm 70a. The legs 107 and 108 are of substantially the same shape as the corresponding portions of the reset lever 85 (FIGURE 2). The leg 108 is provided with a camming surface 86a thereon which contacts the reset arm 70a to move the reset arms and the rod 40 in an axial direction in the manner described above upon the actuation of the button 104.

To enable the realization of the desired snap action, there is provided an angularly shaped lever 110 which is substantially coextensive with the legs 107 and 108 of the lever 100. The lever 110 is pivotally carried at one end by the rod 42 and is resiliently connected to the lever 100 by a scissors spring 111. The lever 110 and the spring 111 function in a manner similar to the lever 92 and the spring 95 discussed heretofore. As the various reset arms move longitudinally to disengage the drive gears 53 from the corresponding drums, the arm 70a rides off the boss 94, and the spring 111 rapidly pivots the lever 110 about the rod 42 to rotate the drive gears through a small angle.

Upon the release of the button 104, the coil spring 105 returns the lever 100 to its initial position, and the scissors spring 111 similarly returns the lever 110. The drive gears are brought into engagement with their corresponding drums through the action of the spring 75 (FIGURES 1 and 3), while a spring 112 on the rod 40 acts on the arm 70a to pivot the reset arms and thereby carry the fingers 72 away from the wheels 65.

Although the snap action provided by the various reset levers and scissors springs in the above-described embodiments is particularly advantageous, for reasons including those expressed heretofore, in some embodiments these components may be omitted without departing from the spirit or scope of the invention. In these latter arrangements, the reset operation is accomplished by moving the reset rod 40 in an axial direction and then pivoting the rod through a small angle. This axial and pivotal movement may be accomplished manually but preferably under the control of a plunger-type solenoid

or other electrically operated device to preserve the snap action.

In the embodiment shown in FIGURE 10, a ratchet 115 is substituted for each of the toothed wheels 65 (FIGURE 3) on the driving gears 53. The face of the ratchet 115 adjacent the drum 116 therefor is provided with a longitudinally protruding pin 118 which is arranged to engage one of ten apertures 120 in the adjacent drum surface.

As the reset arm 70 is moved in a longitudinal direction in response to the axial movement of the rod 40, the finger 72 engages the adjacent face of the gear 53 to move the gear axially along the stationary shaft 20 and thereby withdraw the pin 118 from the corresponding aperture 120, thus detaching the gear from the drum. Upon the pivotal reset movement of the arm 70, the finger 72 engages one of the teeth of the ratchet 115 to rotate the ratchet and its attached gear through a small angle in the manner described heretofore with respect to the wheel 65. Upon the termination of the reset operation, the return movement of the reset arm again brings the pin 118 into engagement with one of the apertures 120 to connect the gear to the drum.

The terms and expressions which have been employed are used as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed.

What is claimed is:

1. In a transfer counter, in combination, a plurality of indicia bearing counting elements including a lower order element and a higher order element, means for operating said lower order element, resiliently biased transfer means interconnecting said lower order element with said higher order element for operating said higher order element in response to operation of said lower order element and in predetermined relationship therewith, and reset means for moving said transfer means against its resilient bias, said transfer means thereupon acting on said lower order element to reset the same to an initial position.

2. In a transfer counter, in combination, a plurality of counting elements including a lower order element and a higher order element, said higher order element having a driving member rigidly but detachably affixed thereto, means for operating said lower order element, resiliently biased transfer means interconnecting said lower order element with the driving member of said higher order element for operating said higher order element in response to operation of said lower order element and in predetermined relationship therewith, and reset means for detaching said driving member from said higher order element and for moving said driving member against the resilient bias of said transfer means, said transfer means thereupon acting on said lower order element to reset the same to an initial position.

3. In a transfer counter, in combination, a plurality of indicia bearing counting elements including a lower order element and a higher order element, said higher order element having a driving member rigidly but detachably affixed thereto, means for operating said lower order element in a given direction, resiliently biased transfer means interconnecting said lower order element with the driving member of said higher order element for operating said higher order element in said given direction only during selected portions of the operation of said lower order element and in predetermined relationship therewith, reset means for detaching said driving member from said higher order element and for moving said driving member against the resilient bias of said transfer means, said transfer means thereupon acting on said lower order element to drive the same in a direction opposite to said given direction, and means for arresting the movement of

said lower order element in said opposite direction as it reaches a predetermined initial position.

4. In a transfer counter, in combination, a plurality of indicia bearing counting elements including a lower order element and a higher order element, means for operating said lower order element, resiliently biased transfer means interconnecting said lower order element with said higher order element for operating said higher order element in response to operation of said lower order element and in predetermined relationship therewith, motion modifying means connected to said lower order element and cooperating with said transfer means for rendering the same ineffective to transfer motion to said higher order element except during selected portions of the operation of said lower order element, and reset means for moving said transfer means against its resilient bias, said transfer means thereupon acting on said lower order element independently of said motion modifying means to reset the same to an initial position.

5. In a transfer counter, in combination, a plurality of indicia bearing counting elements including a lower order element and a higher order element, said higher order element having a driving member rigidly but detachably affixed thereto, means for operating said lower order element, resiliently biased transfer means interconnecting said lower order element with the driving member of said higher order element for operating said higher order element in response to operation of said lower order element and in predetermined relationship therewith, motion modifying means connected to said lower order element and cooperating with said transfer means for rendering the same ineffective to transfer motion to said higher order element except during selected portions of the operation of said lower order element, and reset means for detaching said driving member from said higher order element and for moving said driving member against the resilient bias of said transfer means, said transfer means thereupon acting on said lower order element independently of said motion modifying means to reset the same to an initial position.

6. In a transfer counter, in combination, a plurality of indicia bearing register drums including a lower order drum and a higher order drum in coaxial relationship with each other said higher order drum having a rotary driving assembly rigidly but detachably affixed thereto, means for operating said lower order drum, resiliently biased transfer means interconnecting said lower order drum with the driving assembly of said higher order drum for operating said higher order drum in response to operation of said lower order drum and in predetermined relationship therewith, and reset means for moving said rotary driving assembly in an axial direction with respect to said drums, to detach said assembly from said higher order drum, and for thereafter rotating said assembly through a small angle, to move said transfer means against its resilient bias, said transfer means thereupon acting on said lower order drum to reset the same to an initial position.

7. In a transfer counter of the character set forth in claim 6, said rotary driving assembly comprising a gear in engagement with said resiliently biased transfer means, and position locating means connected to said gear for maintaining the same in one of a series of preselected positions with respect to said higher order drum when said assembly is affixed thereto, said position locating means cooperating with said reset means to rotate said gear through said small angle when said assembly is detached from said higher order drum.

8. In a transfer counter of the character set forth in claim 7, said higher order drum including a series of apertures in the portion thereof adjacent said rotary driving assembly, said position locating means comprising a ratchet member having a protruding element arranged for insertion in one of said apertures.

9. In a transfer counter, in combination, a plurality of register drums including a lower order drum and a higher order drum in coaxial relationship with each other, said higher order drum having a rotary driving assembly rigidly but detachably affixed thereto, means for operating said lower order drum, resiliently biased transfer means interconnecting said lower order drum with the driving assembly of said higher order drum for operating said higher order drum in response to operation of said lower order drum and in predetermined relationship therewith, motion modifying means carried by said lower order drum and cooperating with said transfer means for rendering the same ineffective to transfer motion to said higher order drum except during selected portions of the operation of said lower order drum, and reset means for moving said rotary driving assembly in an axial direction with respect to said drums, to detach said assembly from said higher order drum, and for thereafter rotating said assembly through a small angle, to move said transfer means against its resilient bias, said transfer means thereupon acting on said lower order drum independently of said motion modifying means to reset the same to an initial position.

10. In a transfer counter, in combination, a plurality of indicia bearing counting elements including a lower order element and a higher order element, means for operating said lower order element, resiliently biased transfer means interconnecting said lower order element with said higher order element for operating said higher order element in response to operation of said lower order element and in predetermined relationship therewith, motion modifying means including a compensating cam connected to said lower order element, said transfer means having a cam follower cooperating with said cam to render said transfer means ineffective to transfer motion to said higher order element except during selected portions of the operation of said lower order element, and reset means for moving said transfer means in a direction to carry said cam follower into spaced relationship with said compensating cam, said transfer means thereupon acting on said lower order element to reset the same to an initial position with said follower and said cam in said spaced relationship during at least a major portion of the reset movement.

11. In a transfer counter, in combination, a plurality of counting elements including a lower order element and a higher order element, said higher order element having a driving member rigidly but detachably affixed thereto, means for operating said lower order element, resiliently biased transfer means interconnecting said lower order element with the driving member of said higher order element for operating said higher order element in response to operation of said lower order element and in predetermined relationship therewith, motion modifying means including a compensating cam connected to said lower order element, said transfer means having a cam follower cooperating with said cam to render said transfer means ineffective to transfer motion to said higher order element except during selected portions of the operation of said lower order element, and reset means for detaching said driving member from said higher order element and for operating said driving member to move said transfer means against its resilient bias in a direction to carry said cam follower into spaced relationship with said compensating cam, said transfer means thereupon acting on said lower order element to reset the same to an initial position with said follower and said cam in said spaced relationship during at least a major portion of the reset movement.

12. In a transfer counter, in combination, a plurality of indicia bearing register drums including a lower order drum and a higher order drum in coaxial relationship with each other, said higher order drum having a rotary driving assembly rigidly but detachably affixed thereto, means for operating said lower order drum, transfer means interconnecting said lower order drum with said

higher order drum for operating said higher order drum in response to operation of said lower order drum and in predetermined relationship therewith, motion modifying means including a compensating cam connected to said lower order drum, said transfer means having a cam follower cooperating with said cam to render said transfer means ineffective to transfer motion to said higher order drum except during selected portions of the operation of said lower order drum, and reset means for moving said rotary driving assembly in an axial direction with respect to said drums, to detach said assembly from said higher order drum, and for thereafter rotating said assembly through a small angle, to move said transfer means in a direction to carry said cam follower into spaced relationship with said compensating cam, said transfer means thereupon acting on said lower order drum to reset the same to an initial position.

13. In a transfer counter, in combination, a plurality of indicia bearing register drums including a lower order drum and a higher order drum in coaxial relationship with each other, said higher order drum having a rotary driving assembly rigidly but detachably affixed thereto, means for operating said lower order drum, resiliently biased transfer means interconnecting said lower order drum with the driving assembly of said higher order drum for operating said higher order drum in response to operation of said lower order drum and in predetermined relationship therewith, motion modifying means including a compensating cam connected to said lower order drum, said transfer means having a cam follower cooperating with said cam to render said transfer means ineffective to transfer motion to said higher order drum except during selected portions of the operation of said lower order drum, and reset means for detaching said driving assembly from said higher order drum and for operating said driving assembly to move said transfer means against its resilient bias in a direction to carry said cam follower into spaced relationship with said compensating cam, said transfer means thereupon acting on said lower order drum independently of said motion modifying means to reset the same to an initial position with said follower and said cam in said spaced relationship during at least a major portion of the reset movement.

14. A transfer counter comprising, in combination, a plurality of indicia bearing register drums including a lower order drum and a higher order drum, cam means secured to each of said drums, means for rotating said lower order drum in a given direction, transfer means interconnecting said lower order drum with said higher order drum for operating the same in said given direction, said transfer means including a follower cooperating with the cam means on said lower order drum to enable operation of said higher order drum only during selected portions of the operation of said lower order drum, reset means operatively associated with said transfer means for moving said follower into spaced relationship with said cam means, said transfer means thereupon acting on said lower order drum independently of said cam means to drive said lower order drum in a direction opposite to said given direction with said follower and said cam means in said spaced relationship, the movement of said lower order drum in said opposite direction being arrested as it reaches a predetermined initial position, and means for controlling said reset means to initiate the resetting operation.

15. A transfer counter comprising, in combination, a plurality of indicia bearing register drums including a lower order drum and a higher order drum in coaxial relationship with each other, a rotary driving assembly rigidly but detachably affixed to said lower order drum, means for rotating said lower order drum in a given direction, transfer means interconnecting said lower order drum with the driving assembly of said higher order drum for operating the same in said given direction, motion modifying means cooperating with said

transfer means for rendering said transfer means ineffective to transfer motion to said higher order drum except during selected portions of the operation of said lower order drum, reset means for detaching said rotary driving assembly from said higher order drum and for rotating said assembly through a small angle, the rotary reset movement of said driving assembly acting through said transfer means to move said lower order drum in a direction opposite to said given direction, means for arresting the movement of said lower order drum in said opposite direction as it reaches a predetermined initial position, and means for controlling the movement of said reset means to impart snap-type rotary motion to said driving assembly and thereby initiate the resetting operation.

16. A transfer counter of the character set forth in claim 15, in which the means for controlling the movement of said reset means comprises a manually operable lever arranged for pivotal movement to initiate said resetting operation, a camming member responsive to said pivotal movement for moving said driving assembly in an axial direction with respect to said drums, to thereby detach said assembly from said higher order drum, and means including a snap-action spring for thereafter rotating said assembly through said small angle.

17. A transfer counter comprising, in combination, a plurality of indicia bearing register drums including a lower order drum and a higher order drum in coaxial relationship with each other, a rotary driving assembly rigidly but detachably affixed to said lower order drum, means for rotating said lower order drum in a given direction, resiliently biased transfer means interconnecting said lower order drum with the driving assembly of said higher order drum for operating the same in said given direction, motion modifying means cooperating with said transfer means for rendering said transfer means ineffective to transfer motion to said higher order drum except during selected portions of the operation of said lower order drum, reset means for detaching said rotary driving assembly from said higher order drum and for thereafter rotating said assembly through a small angle, the rotary reset movement of said driving assembly acting on said transfer means to move the same against its resilient bias, said transfer means thereupon acting on said lower order drum to drive the same in a direction opposite to said given direction, means for arresting the movement of said lower order drum in said opposite direction as it reaches a predetermined initial position, and solenoid means for controlling the movement of said reset means to impart snap-type rotary motion to said driving assembly and thereby initiate the resetting operation.

18. A transfer counter comprising, in combination, a plurality of indicia bearing register drums arranged in progressively increasing order in coaxial relationship with each other, a compensating cam secured to one side of each of said drums, driving means carried by the other side of each of said drums, means for rotating the driving means of the lowest order drum in a given direction, transfer means interconnecting each lower order drum with the driving means of an adjacent higher order drum for operating the same in said given direction, each of said transfer means including a follower cooperating with the compensating cam on said lower order drum to enable operation of said higher order drum only during selected portions of the operation of said lower order drum, additional transfer means including an additional follower cooperating with the compensating cam on the highest order drum, reset means operatively associated with said transfer means for moving each of said followers into spaced relationship with their corresponding cams, each of said transfer means thereupon acting on the associated lower order drum to drive said drums in a direction opposite to said given direction with said followers and said cams maintained

15

in said spaced relationship, means for arresting the movement of said drums in said opposite direction as the drums reach a predetermined initial position, and means for controlling said reset means to impart snap-type motion to each of said drums and thereby initiate the resetting operation.

19. A transfer counter comprising, in combination, a plurality of indicia bearing register drums arranged in progressively increasing order in coaxial relationship with each other, a compensating cam secured to one side of each of said drums, driving means carried by the other side of each of said drums, means for rotating the driving means of the lowest order drum in a given direction, resiliently biased transfer means interconnecting each lower order drum with the driving means of an adjacent higher order drum for operating the same in said given direction, each of said transfer means including a follower cooperating with the compensating cam on said lower order drum to enable operation of said higher order drum only during selected portions of the operation of said lower order drum, additional resiliently biased transfer means including an additional follower cooperating with the compensating cam on the highest order drum, reset means for rotating said driving means through a small angle, the rotary reset movement of said driving means acting through said transfer means to move each of said followers into spaced relationship with their corresponding cams against the resilient bias of said transfer means, each of said transfer means thereupon acting on the associated lower order drum to drive said drums in a direction opposite to said given direction with said followers and said cams maintained in said spaced relationship, means for arresting the movement of said drums in said opposite direction as the drums reach a predetermined initial position, and means for controlling said reset means to impart snap-type rotary motion to each of said drums and thereby initiate the resetting operation.

20. A transfer counter comprising, in combination, a plurality of indicia bearing register drums arranged in progressively increasing order in coaxial relationship with each other, a compensating cam secured to one side of each of said drums, a driving gear assembly rigidly but detachably affixed to the other side of each of the higher order drums, means for rotating the lowest

16

order drum in a given direction, resiliently biased transfer means interconnecting each lower order drum with the driving gear assembly of an adjacent higher order drum for operating the same in said given direction, each of said transfer means including a follower cooperating with the compensating cam on said lower order drum to enable operation of said higher order drum only during selected portions of the operation of said lower order drum, additional resiliently biased transfer means including an additional follower cooperating with the compensating cam on the highest order drum, reset means for detaching each of said driving gear assemblies from their corresponding drums and for rotating said assemblies through a small angle, the rotary reset movement of said assemblies acting through said transfer means to move each of said followers into spaced relationship with their corresponding cams against the resilient bias of said transfer means, each of said transfer means thereupon acting on the associated lower order drum to drive the same in a direction opposite to said given direction with said followers and said cams maintained in said spaced relationship, said cams arresting the movement of the corresponding drums in said opposite direction as the drums reach a predetermined initial position, and solenoid means for controlling the movements of said reset means to impart snap-type rotary motion to each of said driving gear assemblies and thereby initiate the resetting operation.

21. A transfer counter of the character set forth in claim 20, in which each of said driving gear assemblies comprises a first toothed wheel in motion-transferring relationship with the corresponding transfer means and a second toothed wheel cooperating with said reset means.

22. A transfer counter of the character set forth in claim 21, in which said other side of each of said higher order drums is recessed to form an internal gear, said second toothed wheel being removably positioned within said internal gear.

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