July 9, 1957 R. W. BOYER 2,798,670

DIGITAL COUNTER ASSEMBLY

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Fig 1

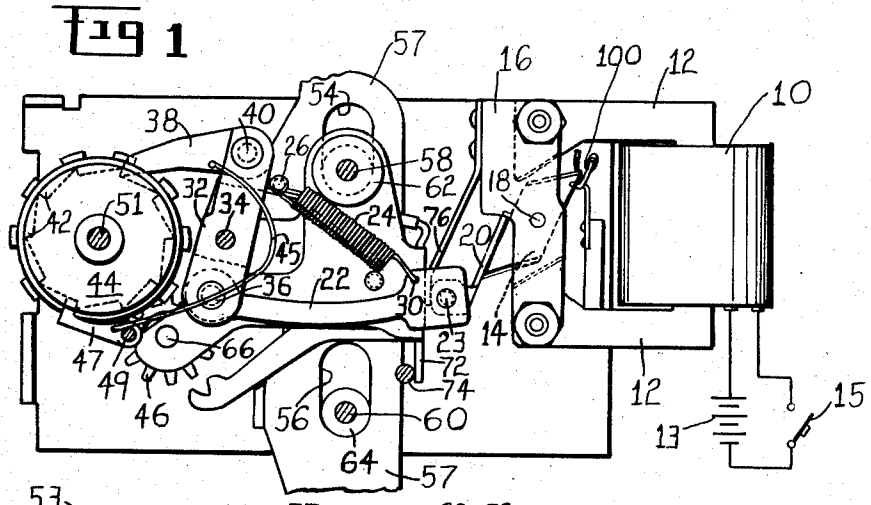


Fig 2

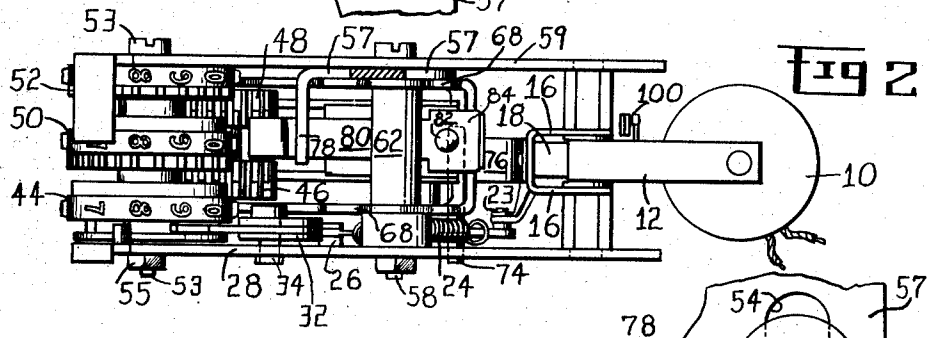


Fig 3

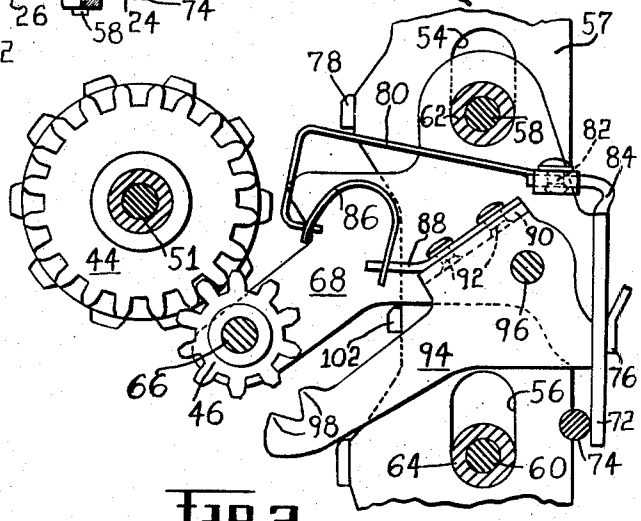
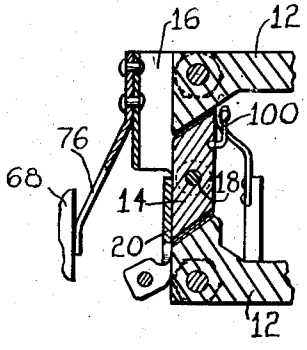


Fig 4



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Fig 5

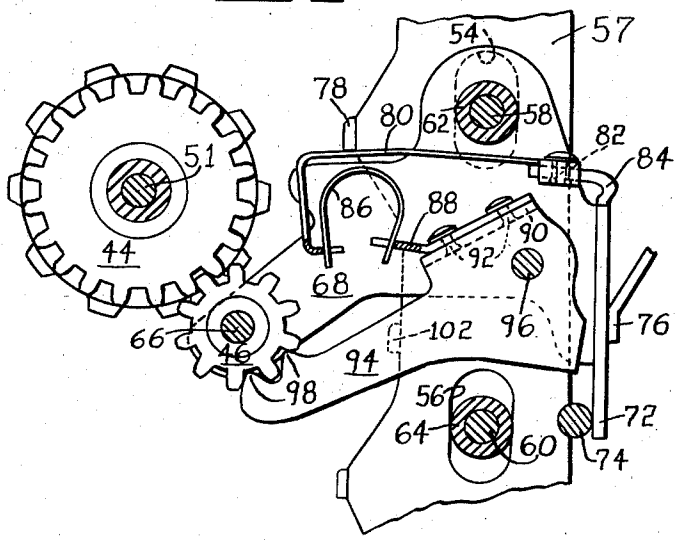


Fig 6

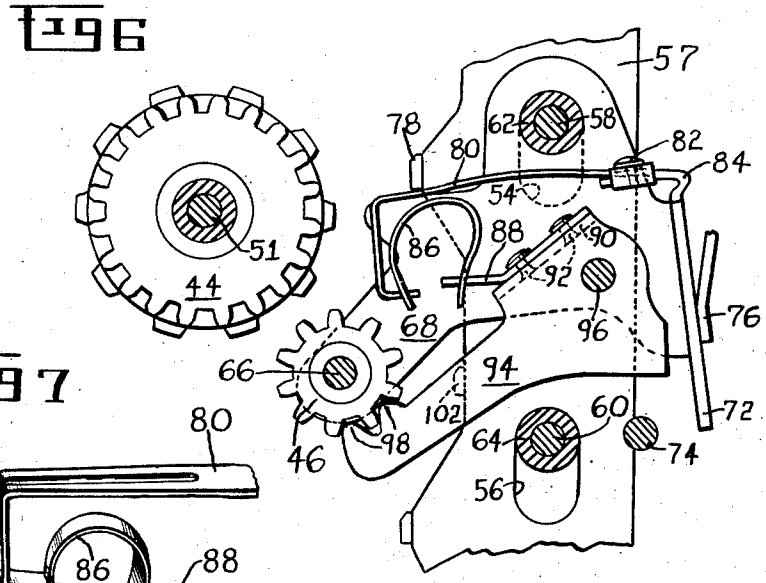


Fig 7

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DIGITAL COUNTER ASSEMBLY

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Application December 5, 1952, Serial No. 324,319

10 Claims. (Cl. 235—92)

This invention relates to a digital counter assembly. The invention pertains more particularly to a counter device which has a reset mechanism. However, the invention is not so limited.

Several counter assemblies now in use employ the mutilated transfer pinion principle. This is the type of pinion having some of the pinion teeth of full length and the remainder of the pinion teeth or half length. Digital counters using this mutilated transfer pinion principle are probably the most reliable among the various types of counters. This is particularly true of mechanisms in which the assembly is subjected to hard usage and vibration. However, when this type of pinion is used in conjunction with mechanisms to reset the counter to zero indication, it has been found that a problem exists in retaining the normal radial position of the transfer pinions during the period in which the pinions are disengaged to allow restoration of the indicating wheels to zero. Known devices for aligning the transfer pinions with the wheels after a reset operation are not completely effective. These known devices allow the pinions freedom of rotation during the time the pinions are free of the aligner mechanism. If proper radial alignment is not maintained while the transfer pinions are disengaged from the digit wheels, the digit wheels will not register correctly after the reset procedure.

An object of this invention is to provide a counter assembly having a reset mechanism which always returns the transfer pinions to the proper location in the proper relationship to the indicating wheels or drums.

Another object of this invention is to provide a solenoid operated actuating mechanism which is capable of high frequency operation.

A further object of this invention is to provide a solenoid operated actuating mechanism which is small in physical size and is capable of doing a comparatively large amount of work.

Another object of this invention is to provide a counter assembly which will function properly when used in a high speed aircraft in which forces are experienced which are several times the force of gravity.

Other objects and advantages reside in the construction of parts, the combination thereof and the mode of operation, as will become more apparent from the following description.

Referring to the drawings,

Figure 1 is a side view of the counter assembly with a side cover frame member removed.

Figure 2 is a top plan view of the counter assembly.

Figure 3 is a fragmentary sectional view showing the reset mechanism with the transfer pinions in engagement with the counter wheels.

Figure 4 is a fragmentary sectional view of the core with the armature of the actuating mechanism in solenoid energized position.

Figure 5 is a fragmentary sectional view showing the aligning fingers in engagement with the transfer pinions. This figure shows a step in the reset operation.

Figure 6 is a fragmentary sectional view showing a further step in the reset operation in which the transfer pinions are out of engagement with the counter wheels.

Figure 7 is a fragmentary perspective view showing the trigger and spring assembly of the reset mechanism.

Referring to the drawings in detail, a solenoid **10** having a core **12** may be energized in any suitable manner, such as by battery **13** and switch **15**. As the solenoid is energized, the core **12** is magnetized, resulting in rotation of an armature **14**. It may be noted that the ends of the armature **14** are formed at angles substantially 45 degrees with respect to the longitudinal axis of the armature **14**. The portions of the core **12** which are adapted to seat the armature **14**, are, also, formed at angles of substantially 45 degrees. The armature **14** is rotatably retained in a guide member **16** by a pintle **18**.

As the solenoid **10** is energized, the core **12** is magnetized to cause rotation of the armature **14**. The armature rotates about the pintle **18** until the ends of the armature **14** contact and seat themselves in the ends of the core **12**, as shown in Figure 4. The 45° angle construction of the ends of the armature **14** and the ends of the core **12** makes possible a higher ratio of torque per unit volume of the magnetic steel in the core **12** and the armature **14**. This construction gives a small initial air gap at the closest points between the ends of the armature **14** and the core **12**, as shown in Figure 1. This construction, also, provides a mechanism which will operate within a very small space.

Rotation of the armature **14** causes movement of an arm **20** which is rigidly attached to the armature **14** and pivotally connected to a linkage **22** by a pin **23**. As the armature **14** rotates, the arm **20** moves arcuately toward the guide member **16** until the arm **20** contacts the guide member **16**. The arm **20** contacts the guide member **16** simultaneously with the seating of the armature **14** against the ends of the core **12**.

The linkage **22** is moved substantially horizontally toward the guide member **16** by the arm **20**. As this occurs, it causes a spring **24** to be elongated. The spring **24** is connected between a pin **26** of a side frame plate **28** and an orifice **30** in the linkage **22**. The movement of the linkage **22** toward the guide member **16** rotates an arm **32** which is rotatably mounted on the side frame plate **28** by means of a pin **34**. The arm **32** is pivotally connected to the linkage **22** by means of a pin **36**. The arm **32** is, also, connected to a pawl **38** by means of a pin **40**. The pointed end of the pawl **38** engages one of a plurality of notches of the units wheel **44**. Each time the solenoid **10** is energized, movement through the arms **20** and **32** and the linkage **22** causes the pawl **38** to revolve the units wheel **44** from one of the notches **42** to the next adjacent notch **42**.

A spring **45** resiliently connects the pawl **38** and a latch **47**. The latch **47** is pivotally mounted on the side frame plate **28** by means of a pin **49**. The latch **47** prevents reversal of rotation of the units wheel **44**.

This counter assembly employs a conventional system of connection among the digit wheels. This connection is through the conventional mutilated transfer pinions. In this counter assembly, transfer pinion **46** is connectively interposed between digit wheels **44** and **50** and transfer pinion **48** is connectively interposed between digit wheels **50** and **52**, as best shown in Figure 2. The digit wheels **44**, **50** and **52** are rotatably supported between the side frame plates **28** and **59** by a bolt **51** having a head **53** and a nut **55**.

At the completion of each full revolution of the units wheel, the transfer pinion **46** causes the tens wheel **50** to rotate to the next higher digit. Accordingly, at the completion of each full revolution of the tens wheel **50**, the transfer pinion **48** causes the hundreds wheel **52** to

rotate to the next higher digit. It may be understood that this counter assembly is not limited to three digit wheels but many more digit wheels may be added as required by a particular application.

The transfer pinions have alternate full leaves and half leaves. In other words, each transfer pinion has a leaf or tooth extending entirely across the width of the pinion followed by a leaf or tooth extending only half of the distance across the pinion. Each digit wheel has a notch which is adapted to allow the wheel to engage with a full leaf of a transfer pinion. Due to the fact that there is but one notch in each wheel, the transfer pinion will be engaged only once each revolution to rotate or step up the next digit wheel. These transfer pinions are of the type referred to in the art as mutilated transfer pinions.

After a completed count is registered on the digit wheels, it is usually desired to reset the wheels to register zero. In order to accomplish the reset process, the transfer pinions of all counters of this type must be disengaged from the counter wheels. In the reset mechanism of this invention, the transfer pinions are retained in proper normal radial position during the period of disengagement. If the proper normal radial position is not retained, the transfer pinions upon re-engagement with the digit wheels would cause the digit wheels to assume improper alignment. Therefore, the holding of proper normal radial position of the transfer pinions makes possible proper resetting of the digit wheels to zero or to any other indication. The reset mechanism in its normal position is disclosed in detail in Figure 3. Figure 3 discloses the position assumed by the reset mechanism during operation of the counter wheels.

A shift lever **57** is provided with elongate slots **54** and **56** slidably attaching the shift lever **57** to the side frame plates **28** and **59** by means of bolts **58** and **60**. Sleeve spacers **62** and **64** aid in positioning the members of the reset mechanism between the side frame plates **28** and **59**.

The transfer pinions **46** and **48** are rotatably supported by a pintle **66** upon a rocker bracket **68**. The rocker bracket **68**, irregular in shape, is rotatably supported upon the bolt **58**. The rocker bracket **68** has a rigid extension **72**. This extension **72** is held firmly against a pin **74** by a leaf spring **76**. Thus, the rocker bracket **68** is retained in its normal position and thus the transfer pinions **46** and **48** are firmly engaged with the digit wheels **44**, **50** and **52**. The pin **74** is mounted in the side frame plate **28** and extends only a portion of the distance between the side frame plates **28** and **59**, as best shown in Figure 2.

If it is desired to reset the digit wheels, the shift lever **57** may be moved by any suitable means. The movement of the shift lever **57** is guided by the bolts **58** and **60** in the slots **54** and **56**. The shift lever **57** is provided with a finger **78** extending from the edge of the shift lever **57** normal to the surface of the shift lever **57**. As the shift lever **57** is moved, the finger **78** contacts a trigger **80** which is a resilient member attached to the rocker bracket **68** by means of a rivet **82** in a mounting bracket **84**. As the finger **78** contacts the trigger **80**, the trigger **80** begins to bend. The bend increases as the shift lever **57** carries the finger **78** farther from its normal position. The bending movement of the trigger **80** causes an arcuate spring **86** to bend. The arcuate spring **86** is loosely retained between the trigger **80** and a projection **88** by means of a slot in each end of the arcuate spring, as clearly shown in Figure 7. The projection **88** is mounted on a base **90** by means of rivets **92**.

Upon the base **90** are mounted a plurality of arms **94**, one arm for each of the transfer pinions. These arms **94** are rotatably attached to the rocker bracket **68** by means of a pin **96**.

As the trigger **80** causes the arcuate spring **86** to bend, bringing the ends of the arcuate spring closer together,

the arcuate spring causes a snap action rotation of the arms **94** toward the transfer pinions **46** and **48**. The arms **94** are provided with aligning fingers **98** which straddle one leaf and engage a leaf on either side of the straddled leaf. The position of the members of the reset mechanism with the aligning fingers **98** engaging the leaves of the transfer pinions **46** and **48** is disclosed in Figure 5. The arms **94** and the fingers **98** thus locate the radial position of the transfer pinions **46** and **48** before the transfer pinions **46** and **48** are disengaged from the digit wheels.

The disengaging process is as follows. The shift lever **57** is caused to move farther along the guide bolts **58** and **60**. The finger **78** will contact the rocker bracket **68**. Further movement forces the rocker bracket **68** to rotate about the bolt **58**. This rotation of the rocker bracket **68** carries the aligned transfer pinions **46** and **48** away from the digit wheels. The reset mechanism with the transfer pinions **46** and **48** fully disengaged is clearly shown in Figure 6. The rocker bracket **68** during its rotation to the position shown in Figure 6 has caused deflection of the leaf spring **76** and the rocker bracket **68** is firmly held in the position as shown in Figure 6 by the leaf spring **76**.

It may be understood that the transfer pinions **46** and **48** are not permitted to rotate as they are carried by the rocker bracket **68** away from the digit wheels **44**, **50** and **52**. This allows free rotation of the digit wheels **44**, **50** and **52** for resetting. The transfer pinions **46** and **48** are, of course, held in proper radial position by the aligning fingers **98** during the time the digit wheels **44**, **50** and **52** are reset. The resetting of the digit wheels may be done by any suitable means. The aligning fingers **98** firmly hold the transfer pinions from radial movement until the shift lever **57** returns to its normal position, allowing the leaf spring **76** to move the rocker bracket **68** clockwise. As the rocker bracket **68** rotates clockwise to its normal position, it carries with it the transfer pinions **46** and **48** which remain firmly engaged by the fingers **98** until after the leaves of the transfer pinions **46** and **48** are again fully nested in the digit wheels. Only after the complete and correct return of the transfer pinions **46** and **48** into engagement with the digit wheels do the arms **94** move to their normal position as shown in Figure 3.

So it may be understood that the reset mechanism engages the transfer pinions and holds them in proper radial position during the complete cycle of fully disengaging the transfer pinions to returning the transfer pinions to the proper radial positions with respect to the digit wheels. The three major steps in the reset cycle are clearly disclosed in Figures 3, 5 and 6.

To provide a means for inserting resistors in the solenoid circuit after energization of the armature **14**, a switch **100** has been positioned near the armature **14** and is operated by the movement of the armature **14**. This switch can be used to short out the resistors until the armature is in the energized position.

So that the reset mechanism cannot operate except by movement of the shift lever **57**, a boss **102** has been provided on one edge of the shift lever **57**. The boss **102** abuts the rocker bracket **68** and is provided in view of the fact that this counter assembly is used in aircraft. Instruments in high speed aircraft are subjected to high gravitational forces. It is necessary to provide means to prohibit interference by these forces of the proper operation of the counters.

The entire counter assembly has been so invented that it can withstand external forces of many types to insure proper operation. The counter assembly may be assembled in any suitable type of instrument for operation in any suitable type of application.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the

combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

Having thus described my invention, I claim:

1. In a counter assembly, the combination including a frame, a plurality of rotatably mounted digit wheels and transfer pinions mounted within the frame, a transfer pinion disengaging mechanism including a rocker bracket rotatably supporting the transfer pinions, a plurality of arms, the rocker bracket also rotatably supporting said arms, each arm having a plurality of aligning fingers, a trigger and spring assembly mounted upon the rocker bracket and connected to the arms, and a shift lever slidably attached to the frame, an operating finger formed on said shift lever operatively contacting the trigger and spring assembly so that operation of the shift lever actuates engagement of the aligning fingers with the transfer pinions, followed by engagement of the operating finger with the rocker bracket causing disengagement of the transfer pinions from the digit wheels by rotation of the rocker-bracket while the transfer pinions are secured by the aligning fingers, thus permitting retention of the transfer pinions in proper radial position during resetting of the digit wheels, the aligning fingers maintaining engagement with the transfer pinions until re-engagement of the transfer pinions with the digit wheels.

2. In an aircraft instrument of the digital counter type, of the type provided with a solenoid operated actuating mechanism having a core, an armature rotatively engaging the core, a plurality of digit wheels adjacent each other, a linkage and arm operatively connecting the armature to one of the digit wheels, a plurality of transfer pinions, there being one transfer pinion transposed between adjacent digit wheels, each transfer pinion operatively connecting said adjacent digit wheels, a common shaft supporting said transfer pinions rotatably mounted thereon, the combination comprising a disengaging mechanism providing a mounting support for said common shaft, a plurality of arms having fingers, said disengaging mechanism rotatably supporting said plurality of arms, a trigger and spring assembly supported upon the disengaging mechanism and connected to the arms, and a shift lever engageable with the trigger and spring assembly and engageable with the disengaging mechanism to actuate grasping of the fingers upon the transfer pinions and to actuate disengagement of the transfer pinions from the digit wheels, providing freedom of rotation of the digit wheels for resetting of the wheels and providing means of retaining proper radial position of the transfer pinions during disengagement of the transfer pinions from the digit wheels.

3. In a disengaging mechanism for a counter assembly of the type having a plurality of digit wheels and having transfer pinions connectively interposed among the digit wheels, the disengaging mechanism including a rocker assembly rotatably supporting the transfer pinions, each transfer pinion having a plurality of leaves, a plurality of arms having aligning fingers, the arms rotatably supported upon the rocker assembly, a trigger and spring assembly supported upon the rocker assembly and connected to the arms, and a shift lever slidably connected to the rocker assembly, the shift lever being provided with abutment means engageable with the trigger and spring assembly to cause rotation of the arms thereby engaging the fingers of the arms with a plurality of leaves of the transfer pinions, the abutment means of the shift lever further engageably operating the rocker assembly to disengage the transfer pinions while the leaves of the transfer pinions are engaged by the fingers, the fingers retaining the leaves of the transfer pinions in proper radial position so that the digit wheels may be reset and properly re-engaged with the transfer pinions.

4. In a counter reset mechanism, the combination including a plurality of rotatively mounted digit wheels, transfer pinions engaging the digit wheels, a rocker bracket rotatably supporting the transfer pinions, the rocker bracket being operative to move the transfer pinions from the digit wheels, a plurality of arms having fingers, the arms being rotatably supported upon the rocker bracket, the arms being operable to engage the fingers with the transfer pinions to secure the radial position of the transfer pinions as the transfer pinions are moved from the digit wheels and to secure the radial position of the transfer pinions while the transfer pinions are out of engagement with the digit wheels, lever means operable to actuate movement of said arms and said rocker bracket, and means included upon said lever means prohibiting operation of said arms and said rocker bracket except by operation of said lever means.

5. In a disengaging mechanism for digital counters of the type having a plurality of transfer pinions engaging the digit wheels, and side plate frame members, the combination comprising a shift lever slidably attached to one of said side plate frame members, a finger rigidly attached to the shift lever, a rocker bracket pivotally attached to one of the side plate frame members, said transfer pinions being rotatably supported upon said rocker bracket, an arm having a finger rotatably supported upon the rocker bracket, a substantially right angle spring attached to the rocker bracket, and an arcuate spring attached to the right angle spring and to the arm, the finger attached to the shift lever being adapted to abut the right angle spring to cause bending of said right angle spring and said arcuate spring causing pivotal movement of the arm to engage the finger of the arm with a transfer pinion, the finger attached to the shift lever also being adapted to abut the rocker bracket causing pivotal movement of said rocker bracket.

6. In a counter assembly of the type provided with a frame, a plurality of rotatably mounted digit wheels and transfer pinions mounted within the frame, the combination comprising a transfer pinion disengaging mechanism including a rocker bracket rotatably supporting said transfer pinions, a pin attached to the frame and pivotally supporting the rocker bracket, a shift lever slidably attached to said pin, a plurality of arms pivotally supported upon said rocker bracket, each arm having a plurality of aligning fingers, a trigger and spring assembly mounted upon the rocker bracket and connected to the arms and an operating finger attached to said shift lever and operable to contact said trigger so that operation of the shift lever causes engagement of the aligning fingers by pivotal movement of the arms, the operating finger attached to the shift lever also being operable to engage the rocker bracket causing rotation of said rocker bracket.

7. In a counter assembly of the type provided with a frame, a plurality of rotatably mounted digit wheels and transfer pinions mounted within the frame, the combination comprising a transfer pinion disengaging mechanism including a rocker bracket rotatably supporting said transfer pinions, a pin attached to the frame and pivotally supporting the rocker bracket, a shift lever slidably attached to said pin, a plurality of arms pivotally supported upon said rocker bracket, each arm having a plurality of aligning fingers, a trigger and spring assembly mounted upon the rocker bracket and connected to the arms, and means attached to said shift lever contacting said trigger to cause pivotal movement of said arms, said means also contacting said rocker bracket causing pivotal movement of said rocker bracket.

8. In a disengaging mechanism for digital counters of the type having a plurality of rotatably mounted digit wheels, a plurality of transfer pinions engaging the digit wheels, and side plate frame members, the disengaging mechanism including a shift lever slidably attached to one of said side plate frame members, a rocker bracket rotatably supporting the transfer pinions, a shaft engaging one of said side plate frame members, the rocker bracket being rotatably mounted upon said shaft, a spring

member abutting the rocker bracket insuring normal engagement of the transfer pinions with the digit wheels, a plurality of rotatably mounted arms attached to the rocker bracket and provided with fingers for engagement with the transfer pinions, a trigger and spring assembly connected to the rocker bracket and to the arms, abutment means carried by the shift lever and engageable with the trigger and spring assembly for actuation thereof, the abutment means also being engageable with the rocker bracket for rotation thereof, the combination being so constructed that operation of the shift lever causes engagement of the abutment means with the trigger and spring assembly actuating rotation of the arms moving the fingers into firm engagement with the transfer pinions, further operation of the shift lever causing rotation of the rocker bracket while the fingers engage the transfer pinions, said rotation of the rocker bracket causing disengagement of the transfer pinions from the digit wheels, the fingers engaging the transfer pinions maintaining the transfer pinions in proper radial position during the period of disengagement of the transfer pinions from the digit wheels.

9. In a counter assembly of the type provided with support structure, a plurality of rotatably mounted digit wheels and transfer pinions carried by the support structure, the combination comprising a transfer pinion disengaging mechanism including a rocker bracket rotatably supporting said transfer pinions, a pin attached to the support structure and pivotally supporting the rocker bracket, a shift lever slidably supported by the support

structure, a plurality of arms pivotally supported upon said rocker bracket, there being one arm for each of said transfer pinions, a trigger member carried by said rocker bracket and operably connected to the arms, and abutment means attached to said shift lever and engageable with the rocker bracket for forcing pivotal movement of said rocker bracket.

10. In a counter assembly provided with a solenoid, a core and an armature, the combination comprising a support structure, a plurality of rotatably mounted digit wheels carried by the support structure, a transfer pinion interposed between adjacent digit wheels, an arm operatively connecting the armature to one of said digit wheels, the support structure being provided with a pin member adjacent the digit wheels, a shift lever slidably guided by the pin member, a rocker bracket rotatably supported by the pin member, a transfer pinion rotatably carried by the rocker bracket, an arm rotatably supported by the rocker bracket and engageable with the transfer pinion, abutment means carried by the shift lever and engageable with the rocker bracket for rotation thereof.

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