April 4, 1939. T. E. TORKELSON 2,153,215

PERCENTAGE COUNTER

Filed Sept. 26, 1936 3 Sheets-Sheet 1

FIG.1.

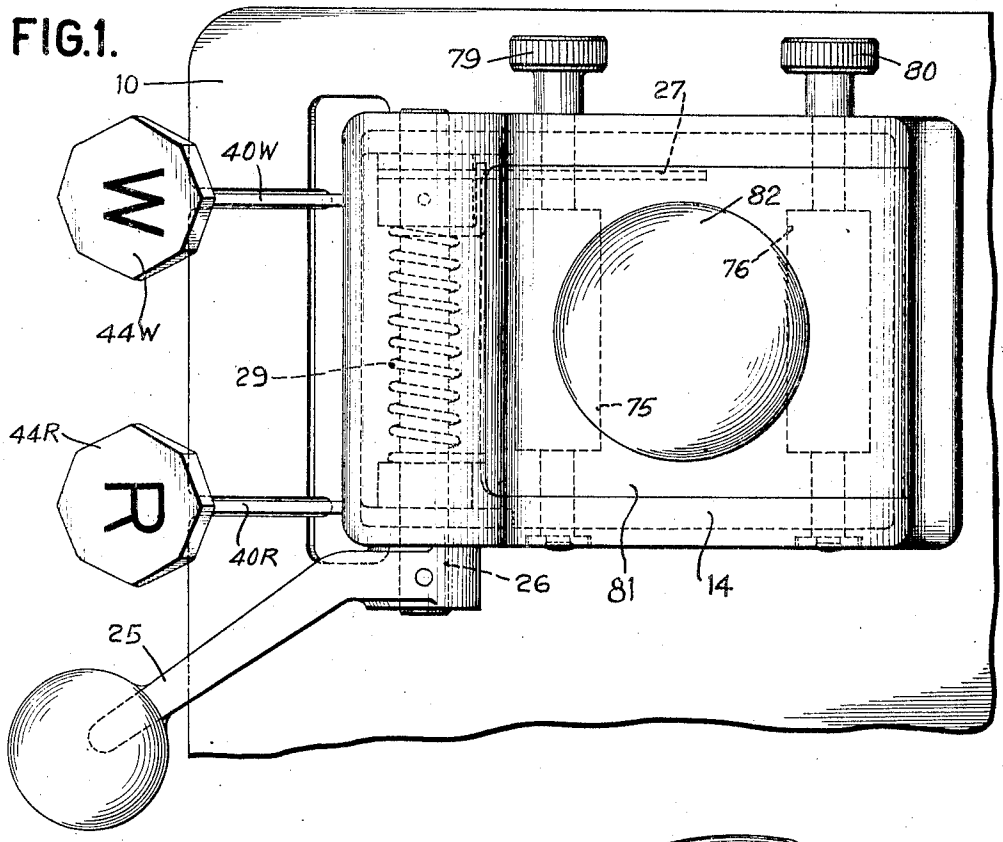
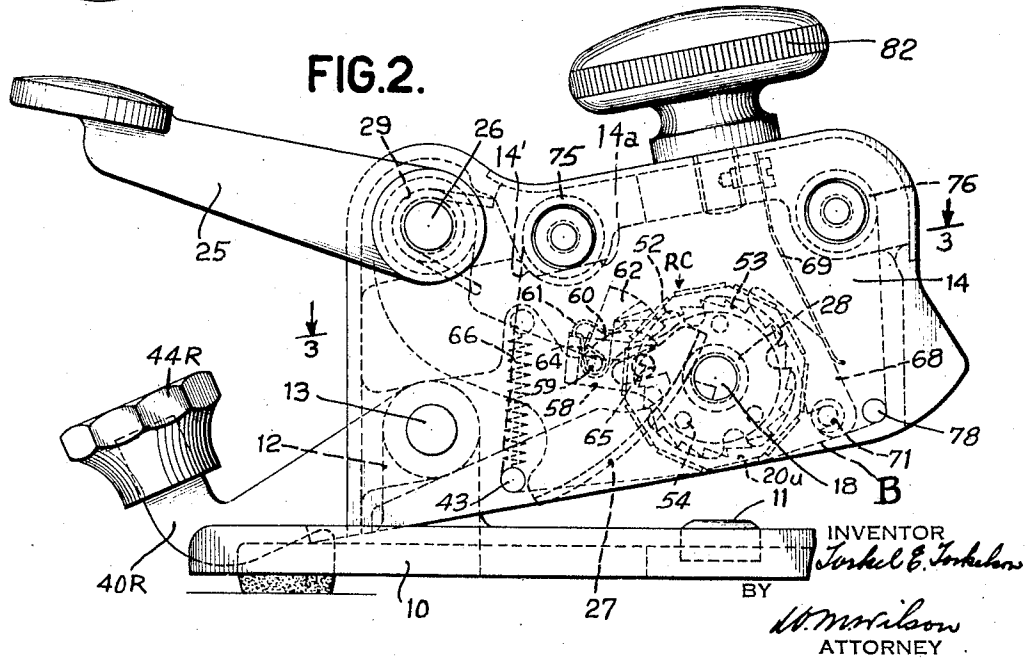


FIG.2.



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PERCENTAGE COUNTER

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FIG. 3.

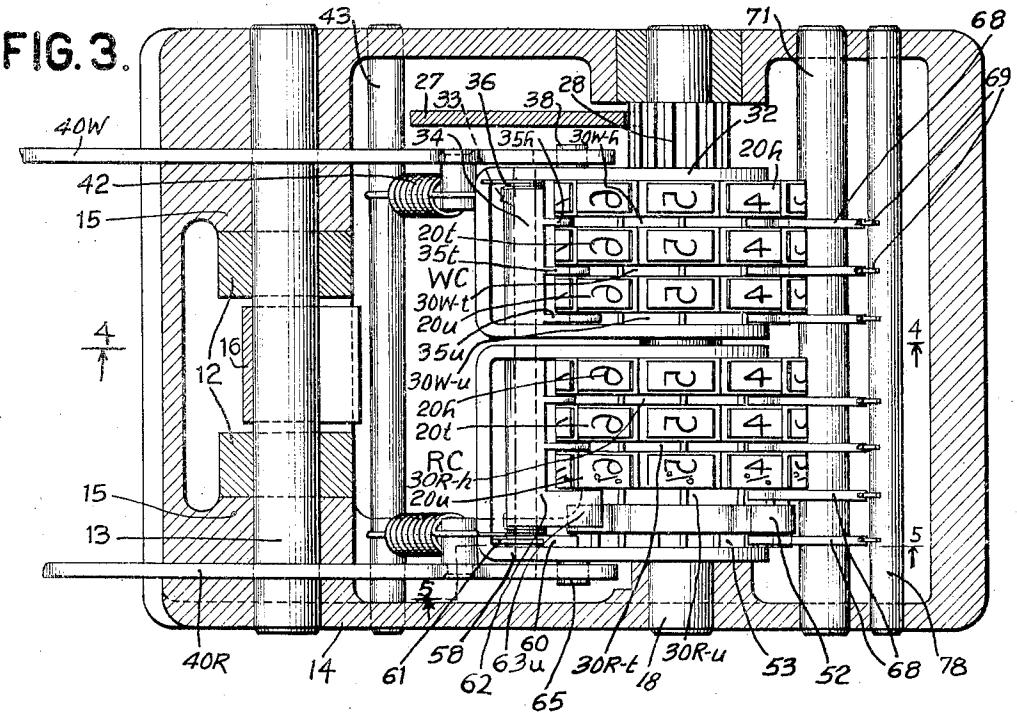
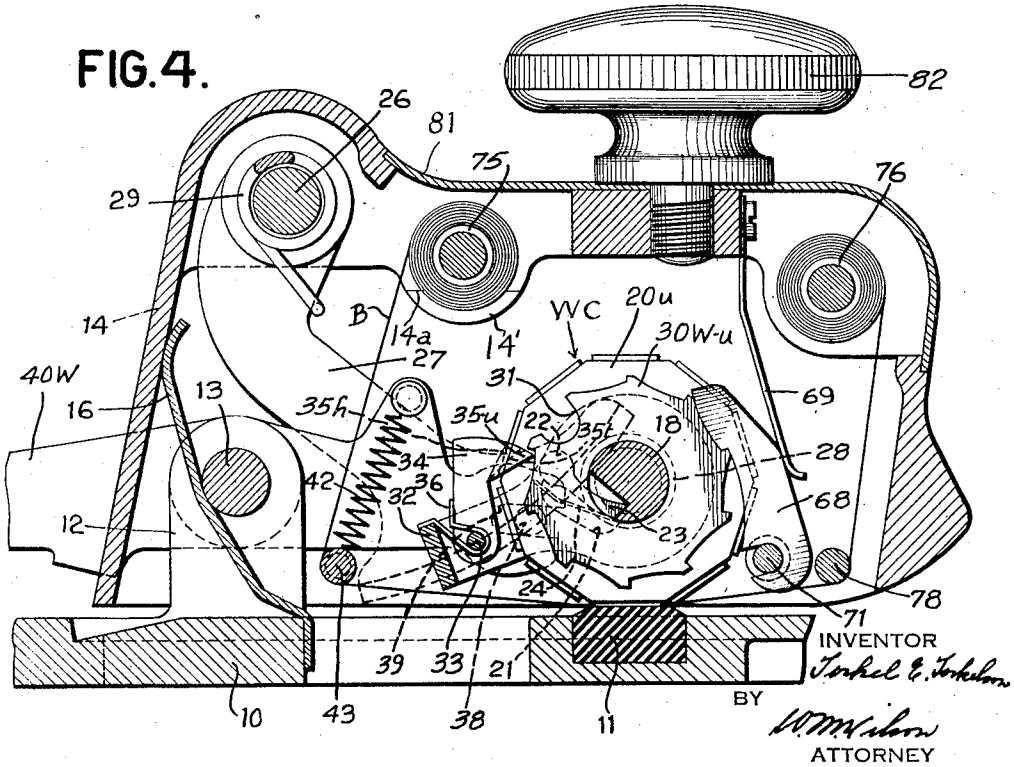


FIG. 4.



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PERCENTAGE COUNTER

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FIG.5.

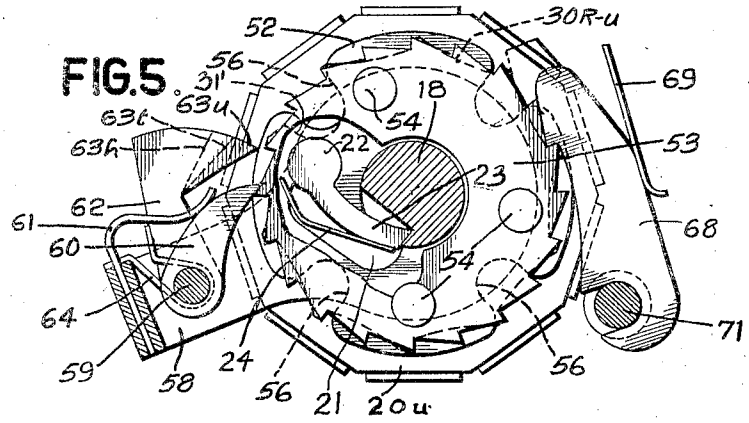


FIG.6.

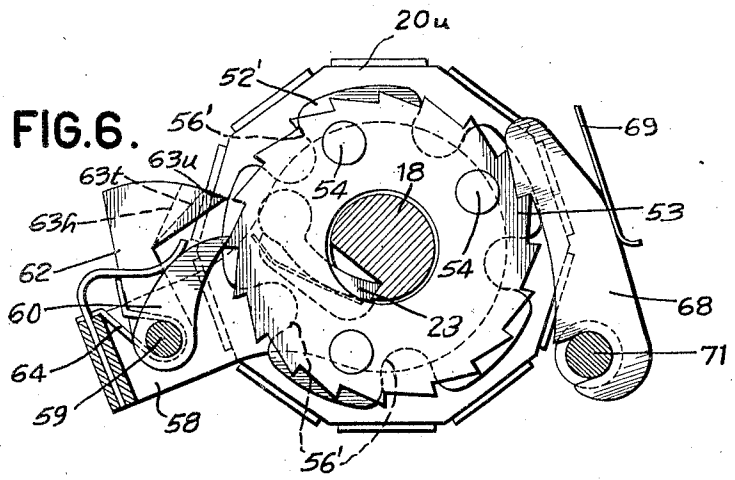
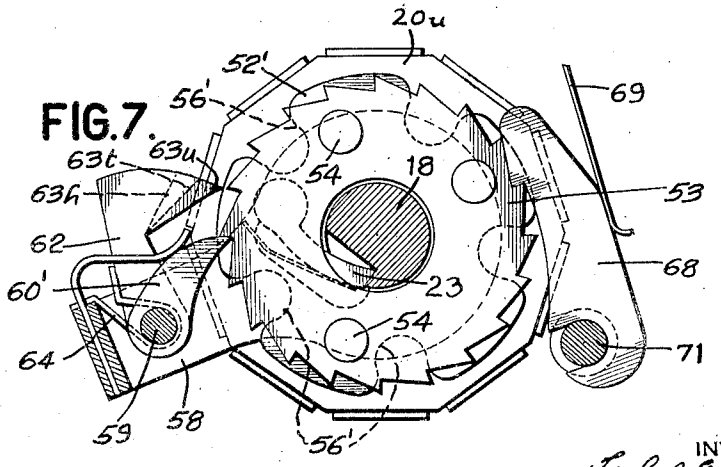


FIG.7.



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PERCENTAGE COUNTER

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Application September 26, 1936, Serial No. 102,652

1 Claim. (Cl. 235—91)

This case relates to an examination evaluating device, particularly to a printing counter for scoring answers on an examination paper and printing the result of the evaluation.

In examinations of the "Yes" and "No" or selection or multiple choice type, a great number of questions are given, and it is desirable to provide a device for conveniently and rapidly evaluating the answers and printing the result of the evaluation.

An object of the invention is to provide means for evaluating a set of answers in terms of percentages of the total number of questions.

Thus, if the total number of questions is 400 and 100 answers are correct, then the percentage of correct answers is 25%, and the object is to evaluate the set of answers directly as percentages without requiring additional calculation extraneous to the calculation made by the scoring or evaluating device.

The object, more broadly, is to provide means for converting a count into percentages of a predetermined total possible count.

Another object is to provide novel means to render only a predetermined ratio of operations of a recurrently operating member effective to be counted by a counting device.

Other objects will appear from the following parts of the specification and from the drawings, in which:

Fig. 1 is a plan view of the machine.

Fig. 2 is a side view showing the printing head in open, non-printing position and a counter operating lever in actuated position.

Fig. 3 is a section along lines 3—3 of Fig. 2.

Fig. 4 is a section along lines 4—4 of Fig. 3, showing the printing head after depression to effect printing.

Fig. 5 is a detail section along lines 5—5 of Fig. 3 showing one example of the invention.

Fig. 6 is a view similar to Fig. 5 showing another illustration of the invention, and

Fig. 7 is a view similar to Fig. 5 of still another example of the invention.

The machine has a base 10 in which is set a rubber block 11 to serve as a platen. Integral with base 10 are upright ears 12 carrying a pivot rod 13. The entire printing head is journaled on rod 13 and comprises a cast housing or casing 14 formed with bosses 15 rotatably surrounding pivot rod 13. A leaf spring 16 (Figs. 3 and 4) is fast at its lower end to base 10 and at its upper end abuts the front wall of head casing 14, tending to maintain the printing head at its counterclockwise limit indicated in Fig. 2. This is the non-printing or lifted position of the printing head.

Rotatably carried by and between the side walls of head casing 14 is a shaft 18 for rotatably mounting two banks of counters WC and RC, the former for giving a direct count of wrong answers and the latter for giving a percentage evaluation of right answers. Each bank comprises a units order type wheel 20*u*, a tens order type wheel 20*t*, and a hundreds order type wheel 20*h*. Each type wheel is provided with an internal recess 21 (see particularly Fig. 5) formed with a round bearing seat for pivotally seating the round head 22 of a reset pawl 23. A leaf spring 24 located inside recess 21 is fixed at one end to the wheel 20 and at the other end bears on the pawl 23 to urge the nose of the latter towards shaft 18. Shaft 18 is notched so that during a clockwise revolution thereof, the rear notch wall will meet all the reset pawls 23 and acting through the latter will turn wheels 20 ahead to their zero positions.

The resetting revolution of shaft 18 is effected by depression of a handle 25 fixed to one end of a rock shaft 26 journaled by the side walls of head casing 14. Shaft 26 rigidly carries a rack sector 27 meshed with teeth 28 formed in the periphery of reset shaft 18. A spring 29 coiled around rock shaft 26 and abutting a part of casting 14 at one end and at the other end abutting rack sector 27 tends to maintain handle 25 elevated. Upon depression of handle 25 against resistance of spring 29, rack sector 27 rotates shaft 18 clockwise, causing its notch to engage reset pawls 23 to reset all the type wheels 20 to zero positions. During the return of shaft 18, its notch freely ratchets past pawls 23. To limit the stroke of handle 25 and rack sector 27 to one for imparting exactly one revolution to shaft 18, the top edge of sector 27 engages a flat 14*a* on a boss 14' of head casing 14 at the end of the up stroke of sector 27.

Each type wheel 20 has ten type lugs 0 to 9. Fastened to one side of each type wheel for rotation therewith is a ten tooth ratchet wheel 30. Thus, each of banks WC and RC has three type wheels to each of which is individually fixed a ratchet wheel. The ratchet elements of bank WC may hereafter be distinguished by suffixing the common reference character 30 by the letter W, and the elements of bank RC by suffixing the common reference character by the letter R. The denominational order of any of the elements of the counter banks may be indicated by the appended characters *u*, *t*, and *h*, respectively representing units, tens, and hundreds.

Considering bank WC which gives a direct count of the wrong answers, the unit ratchet wheel 30W—*u*, as seen in Fig. 4, has a deep notch 31 between the "9" and "0" positions. A similar notch (not shown) is provided between the "9" and "0" positions of the tens ratchet wheel 30W—*t*. Rotatably carried by shaft 18 is a yoke 32 straddling the counter bank WC. Pivoted on a pin 33 carried between the sides of yoke 32 is a multiple pawl member 34 having three integral pawl noses 35*u*, 35*t*, and 35*h*, respectively in the planes of the units, tens, and hundreds ratchet wheels 30. A spring 36 between yoke 32 and pawl member 34 urges the pawl noses into engagement with their respective ratchet wheels. Unit pawl nose 35*u* is the longest, tens pawl nose 35*t* is shorter, and hundreds pawl nose 35*h* is still shorter. When pawl nose 35*u* is engaged with any of teeth 0 to 8, it prevents pawl member 34 from rocking sufficiently clockwise to permit pawl noses 35*t* and *h* to engage any of the teeth on their respective ratchet wheels.

Yoke 32 is provided at one side with a stud 38 passing through a slot 39 formed in the right hand end of a key lever 40W (see Figs. 3 and 4). Lever 40W is journaled for rocking movement on pivot rod 13. A spring 42 between lever 40W and a pin 43 carried by the sides of head casing 14 urges lever 40W in a clockwise direction. The left hand arm of lever 40W extends outside casing 14 and its free end is provided with a key or button 44W bearing the letter W, representing the word "wrong."

Now, whenever a wrong answer is found, the operator depresses button 44W, rocking lever 40W counterclockwise. As lever 40W rocks counterclockwise, it acts through slot 39 and stud 38 to rock yoke 32 clockwise, causing pawl nose 35*u* to engage a tooth of wheel 30W—*u* and advance the latter and its connected type wheel 20*u* one step. When the unit type wheel has been advanced nine times from zero position, to its "9" position, then notch 31 of the units ratchet wheel reaches pawl 35*u*, permitting spring 36 to rock the pawl member 34 until pawl nose 35*t* engages its ratchet wheel 30W—*t*. Now, upon the next actuation of lever 40W, pawls 35*u* and *t* will engage their respective ratchet wheels to advance them one step each. In this manner, as the units order passes from "9" to "0", a transfer is effected to the tens order. When lever 40W has been depressed ninety-nine times, then both wheels 30W—*u* and 30W—*t* will have their notches 31 opposite pawl noses 35*u* and *t*, permitting spring 36 to rock pawl member 34 still further clockwise until pawl nose 35*h* engages the periphery of its ratchet wheel 30W—*h*. The hundredth depression of lever 40W then effects a step advance of each of the ratchet wheels. In this manner, a transfer is effected to the hundreds order as the lower order wheels pass from "99" to "00".

Counter bank WC is thus operated to provide a direct count of the number of wrong answers.

The percentage printing counter RC for printing the percentage of right answers will now be explained.

Counter RC includes means for converting numerical counts into percentage evaluations. The percentage evaluation differs with the denominator. Three different examples of converting means based on three different denominators have been illustrated. Fig. 2 shows the assembly with means for converting counts into percentages on a base of 400, and Fig. 5 shows the converting means of Fig. 2 in detail. This example of the invention shown in Figs. 2 and 5 will now be explained.

The type wheels 20*u*, *t*, and *h* and ratchet wheels 30R—*u*, *t*, and *h* of counter bank RC are similar to the corresponding elements of counter bank WC. In addition, bank RC has adjacent units order ratchet wheel 30R—*u*, a cam and ratchet assembly comprising a cam 52 and a ratchet wheel 53 removably carried by the cam for rotation therewith. To carry the ratchet wheel 53, cam 52 has pins 54 projecting from its side and wheel 53 has holes receiving the pins. Cam 52 also has a reset pawl 23, such as described before, so that the cam and its ratchet wheel will be reset by shaft 18 together with the type wheels and their ratchets.

Cam 52 is formed with notches 56 equally spaced around the periphery of the cam. For a percentage evaluation on a base of 400, four notches 56 are provided.

A yoke 58 similar to yoke 32 is rotatably mounted on reset shaft 18 and straddles the counter bank RC, including cam 52 and ratchet 53. A pivot pin 59 carried by the sides of yoke 58 pivotally carries pawl 60 for engaging the teeth of ratchet 53 under the influence of a spring 61. Also pivoted on pin 59 is a multiple pawl member 62 having three pawl noses 63*u*, *t*, and *h* for respectively engaging ratchets 30R—*u*, *t*, and *h*. A spring 64 urges pawl noses 63 towards their respective ratchet wheels. Pawl nose 63*u* is wide enough to extend across the peripheries of cam disk 52 and ratchet 30R—*u*. The arcuate part of disk 52, between successive notches 56 is formed at a greater radius than the crests of the teeth of ratchet wheels 30. Thus, when pawl 63*u* rides on the arcuate portion of disk 52, its nose is held out of engagement with the ratchet wheel 30R—*u*.

Ratchet wheel 53 has twenty teeth, twice as many as the ratchet wheels 30. Since there are four notches 56 in cam disk 52, there are five teeth of wheel 53 between successive notches 56.

Yoke 58 has a pin 65 (see Fig. 2), passing through a slot in the right hand end of a lever 40R, the left end of which extends outside head casing 14 and is provided with a finger button or key 44R bearing the legend R, representing the word "right." Each time a right answer is found, the operator depresses key 44R to the position shown in Fig. 2, rocking lever 40R against resistance of a spring 66, causing clockwise rocking of yoke 58. As yoke 58 rocks, pawl 60 rides up along a tooth of ratchet wheel 53 until it abuts the radial side of the next tooth and by engagement therewith actuates the ratchet wheel. The stroke of yoke 58, when rocked by lever 40R, is such as to cause pawl 60 to move through a distance covering two teeth of ratchet 53. The pawl member 62 moves through the same distance but covers only one tooth of ratchet wheels 30, since the latter have half as many teeth as wheel 53, each tooth of a wheel 30 being twice as wide as a tooth of wheel 53. Thus, when lever 40R is rocked, it moves pawl 60 through a distance covering two teeth of ratchet 53. However, initially the pawl is on top of a tooth of ratchet 53 and nearly a tooth distance away from the side of the next tooth. Hence, pawl 60 will move nearly a tooth distance before starting to actuate ratchet 53. The pawl then moves the ratchet through slightly more than a tooth distance and then returns. Engaging the teeth of all the ratchet wheels 30 and 53 are individual holding pawls 68, the one engaging ratchet 53 having a

shorter head to fit the smaller teeth of the latter ratchet. The holding pawls are urged by springs 69 to rock about their pivot rod 71 towards the ratchets and coact with the ratchet teeth to aline the ratchets in an exact tooth position. Thus, when ratchet 53 is moved slightly more than a tooth step, as pawl 60 retreats, the holding pawl of this ratchet returns the ratchet to an exact step position, thereby restoring the ratchet wheel the amount of its overthrow.

Starting from the zero position shown in Fig. 5, three steps of advance of ratchet 53 and cam 52 are required to bring the first notch 56 of the cam to the tip of pawl nose 63—*u*. Before reaching the notch, the pawl nose 63—*u* rides on the arc of disk 52 located between a pair of notches 56 and is thereby held disengaged from ratchet wheel 30R—*u*. Likewise, pawl noses 63*t* and *h* are held above and free of their ratchet wheels 30R—*t* and *h*. Thus, it requires three depressions of key 44R, causing three steps of advance of ratchet wheel 53 before pawl nose 63—*u* drops into a notch 56. After three depressions of key 44R, the pawl nose 63*u* is permitted to drop into a notch 56 and as a result to engage a tooth of its ratchet wheel 30R—*u*. In this position of pawl nose 63*u*, it is engaged with the leading or upper wall of a notch 56, while pawl 60 is in its normal position, nearly a tooth distance from the same wall of the notch. Consequently, upon the fourth depression of key 44R, pawl nose 63*u* immediately starts moving cam 52 and ratchet 53 as well as its own ratchet 30R—*u*. The latter, which is a ten tooth ratchet wheel, is moved through one tooth distance or one step while twenty-tooth ratchet wheel 53 is moved by pawl nose 63*u* through a distance spanning two of the teeth of ratchet 53 or twice as far as when moved by pawl 60.

At the completion of this movement and upon the return stroke of pawl nose 63*u*, the latter is again resting on the circular part of disk 52 located between two notches 56. Thus, every step of advance of unit ratchet 30R—*u* requires three steps of advance of ratchet 53 corresponding to three teeth of the latter ratchet and a fourth step of advance corresponding to two teeth of the latter ratchet. The total number of teeth through which ratchet 53 moves for each step of ratchet 30R—*u* is thus five teeth. Hence, each five teeth of ratchet 53 correspond to four operations of lever 40R and one step of unit ratchet 30R—*u*. Since ratchet 53 has twenty teeth, a full revolution of the latter ratchet corresponds to sixteen operations of lever 40R and four steps of ratchet 30R—*u*. Thus, for sixteen correct answers, counter bank RC will register 4, which is the percentage of sixteen on a base of four hundred.

It is clear now that the cam 52 and ratchet 53 are constructed and arranged to convert the number of correct answers of a maximum of four hundred into a percentage evaluation.

The transfer of "1" to tens ratchet wheel 30R—*t* and type wheel 20R—*t* for each ten steps of type wheel 20R—*u* and the transfer of "1" to hundreds wheel 20R—*h* for each hundred steps of advance of the unit wheel are effected in the same manner as described in connection with counter bank WC. Thus, after nine steps of advance of ratchet wheel 30R—*u*, the notch 31' of the latter (see Fig. 5) will be opposite pawl nose 63*u* but the latter will be unable to drop into a notch because of its engagement with the arcuate periphery of cam disk 52. After three actuations of lever 40R causing three steps of advance of disk 52, a notch 56 of the latter will aline with notch 31', permitting pawl 63*u* to drop into the alined notches, and pawl 63*t* to engage ratchet 30R—*t*. Upon the fourth operation of lever 40R, pawl 63*u* will engage the front wall of notch 31' to move ratchet 30R—*u* one step and disk 52 and ratchet 53 two steps (each one-half of a step of ratchet 30R—*u*) while pawl 63*t* will engage a tooth of ratchet 30R—*t* to move the latter one step.

Fig. 6 shows a construction and arrangement for providing percentage evaluations on a base of 300. In this case, a cam disk 52' with five notches 56' is used in place of the disk 52 with four notches 56 of the previous example. The remaining parts are exactly the same.

Now, upon the first operation of lever 40R, pawl 60 will advance ratchet 53 and disk 52' one step. Upon the second operation of lever 40R, the disk 52' will be advanced a second step, bringing a notch 56' to pawl nose 63*u*. The latter drops into this notch and thereby is permitted to engage ratchet 30R—*u*. Upon the third operation of lever 40R, pawl 63*u* will advance its ratchet 30R—*u* one step and will act on the front wall of disk 52' to advance the latter and ratchet 53 through two teeth of ratchet 53. Thus, ratchet wheel 30R—*u* and type wheel 20*u* of bank RC are moved one step for every three operations of lever 40R while ratchet 53 and disk 52' are moved through four teeth of the ratchet 53. The latter ratchet has twenty teeth, so that fifteen operations of lever 40R are required to cause ratchet 53 and its cam 52' to make one revolution. During this revolution, ratchet 30R—*u* and its type wheel 20*u* will move five steps. Counter bank RC will thus add 5% for every 15 operations of lever 40R which is a percentage evaluation on a base of 300.

Fig. 7 shows a construction and arrangement for converting counts into a percentage evaluation on a base of 200. In this case, the cam disk 52' with five notches 56' is exactly as in Fig. 6. The ratchet wheel 53 and pawls 63*u*, *t*, and *h* remain the same for all three examples. The only change from Fig. 6 is in the actuating pawl 60' of ratchet 53 which is made shorter than the pawl 60 of the preceding examples. Thus, pawl 60' is short enough to initially engage the end of a tooth of ratchet 53. Consequently, upon an operation of lever 40R, pawl 60' will immediately start moving ratchet 53 and disk 52, and being effective throughout its forward stroke will advance the latter two elements through two teeth of ratchet wheel 53.

Now, upon the first operation of lever 40R, pawl 60' will advance ratchet 53 two teeth, bringing the first notch 56' of disk 52' in line with pawl 63*u* which will drop into the notch and also engage its ratchet wheel 30R—*u*. Upon the second operation of lever 40R, pawl 63*u* will advance its ratchet wheel and type wheel one tooth step and at the same time advance ratchet 53 two teeth. Thus, two operations of lever 40R result in adding "1" to counter bank RC and in moving ratchet 53 four teeth. Since the latter has twenty teeth, and for every step of type wheel 20*u*, the wheel 53 moves four teeth, there will be five steps of wheel 20*u* to a revolution of wheel 53. Each operation of lever 40R moves wheel 53 two teeth, or a full revolution of wheel 53 requires ten operations of lever 40R. Thus, ten operations of lever 40R add "5" to counter bank RC which a percentage evaluation on a base of 200.

In order to change counter bank RC from the form shown in Fig. 5 to that in Fig. 6, it is merely

necessary to force shaft 18 out of the head casing 14, thereby releasing the assembly of cam 52 and ratchet 53. The ratchet is then forced off pins 54 and assembled to disk 52'. The assembly of cam 52' and ratchet 53 is then re-mounted on shaft 18.

To change from the form shown in Fig. 5 to the form shown in Fig. 7, it is necessary to do the same thing outlined above and in addition to force pivot pin 59 sufficiently out of the side of yoke 58 to permit replacement of pawl 60 by the shorter pawl 60'.

A pair of ribbon spools 75 and 76 is carried between the sides of head frame or casing 14. From spool 75, the inking ribbon B extends downwardly, then around pin 43, horizontally beneath the banks WC and RC, then around a pin 78 and upwardly to spool 76. Pins 43 and 78 are so located as to cause the ribbon extending between them to engage with the type wheels 20. The pressure of the inking ribbon against the type wheels is utilized to frictionally retard free turning of the type wheels upon their actuation by lever 40R or W, thus preventing overthrow of the type wheels. The shafts of spools 75 and 76 extend outside the head casing 14 and are provided with knurled handles 79 and 80 by which the spools may be rotated to feed the inking ribbon at will. A cover 81 for casing 14 is provided and retained on the casing by a hand knob 82 screwed to the top of the casing. To obtain a record of the standings of counters RC and WC the operator presses on knob 82, depressing the printing head from the position shown in Fig. 2 to that in Fig. 4 to effect a pressure print by type wheels 20 of both banks WC and RC on a sheet placed on platen 11.

The interior of the device may be exposed by unscrewing hand knob 82 and removing cover 81.

While the invention has been disclosed in connection with an examination scoring device, it is understood that it may be used for other statistical purposes.

Further, while the invention has been disclosed in the several forms herein illustrated and explained, it is understood that variations, departures, and changes may be made within the scope of mechanical skill without departing from the spirit or bounds of the invention. I, therefore, wish to be limited only in accordance with the following claim.

What is claimed is:

Numbering apparatus comprising number wheels, a ratchet wheel fixed to the units order number wheel, a member given recurrent operations, a pawl for engaging said ratchet wheel, a movable carrier for said pawl given a single oscillation by said member upon each single operation of said member, said oscillation of the carrier causing the pawl, when the latter is engaged with its ratchet wheel, to advance the ratchet wheel one step and adding one to the units order wheel, a cam disk mounted coaxially with the number wheels and having a plurality of notches around its periphery for receiving the pawl to enable the latter to engage its ratchet wheel and having between said notches arcuate dwell portions engageable with the pawl to hold the latter disengaged from the ratchet wheel, a ratchet disk fixed to the cam disk, and a dog carried by said carrier for engaging the ratchet disk to advance the latter and the cam disk one step upon an operation of the member to thereby after successive operations of the member periodically place a notch of said disk in coaction with the pawl to render the latter effective upon the next operation of said member to advance the units order wheel one step, said pawl when received in a notch engaging the front wall of the latter so as to advance the cam disk and ratchet disk a plurality of steps of the latter when advancing its own ratchet wheel.

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