

Feb. 7, 1967

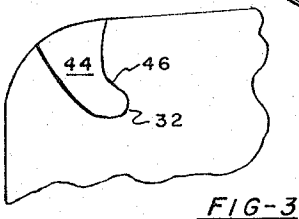
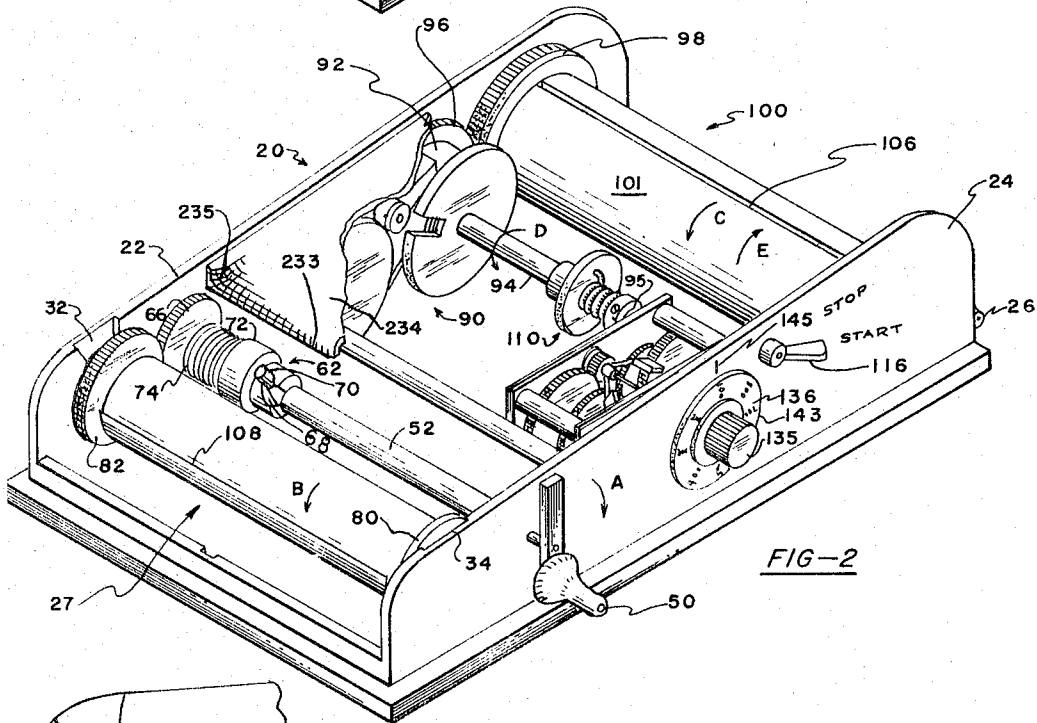
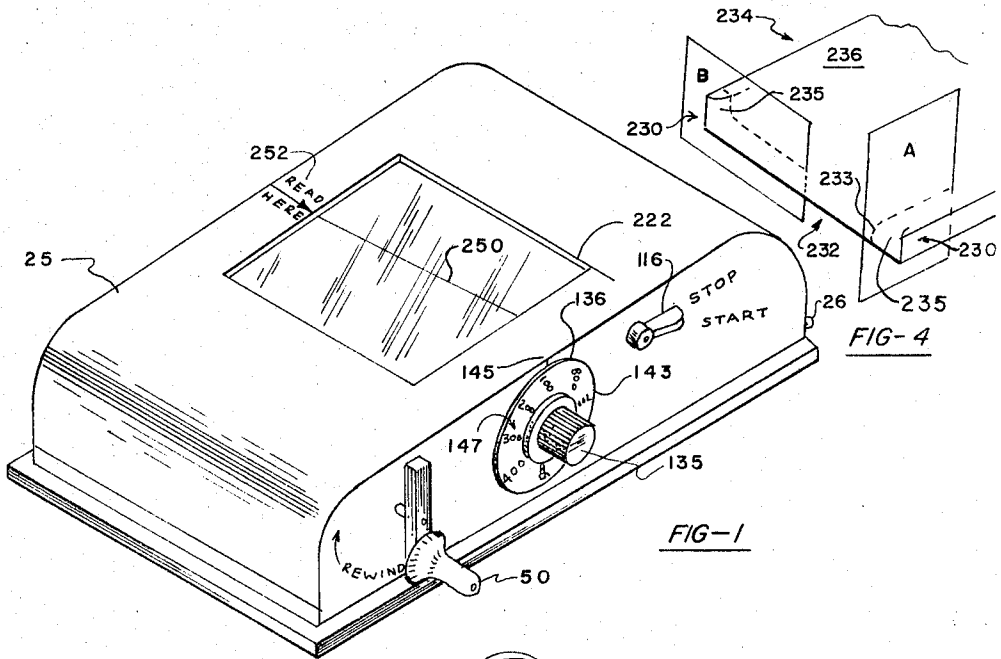
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3,302,309

READING PACER

Filed Dec. 18, 1963

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

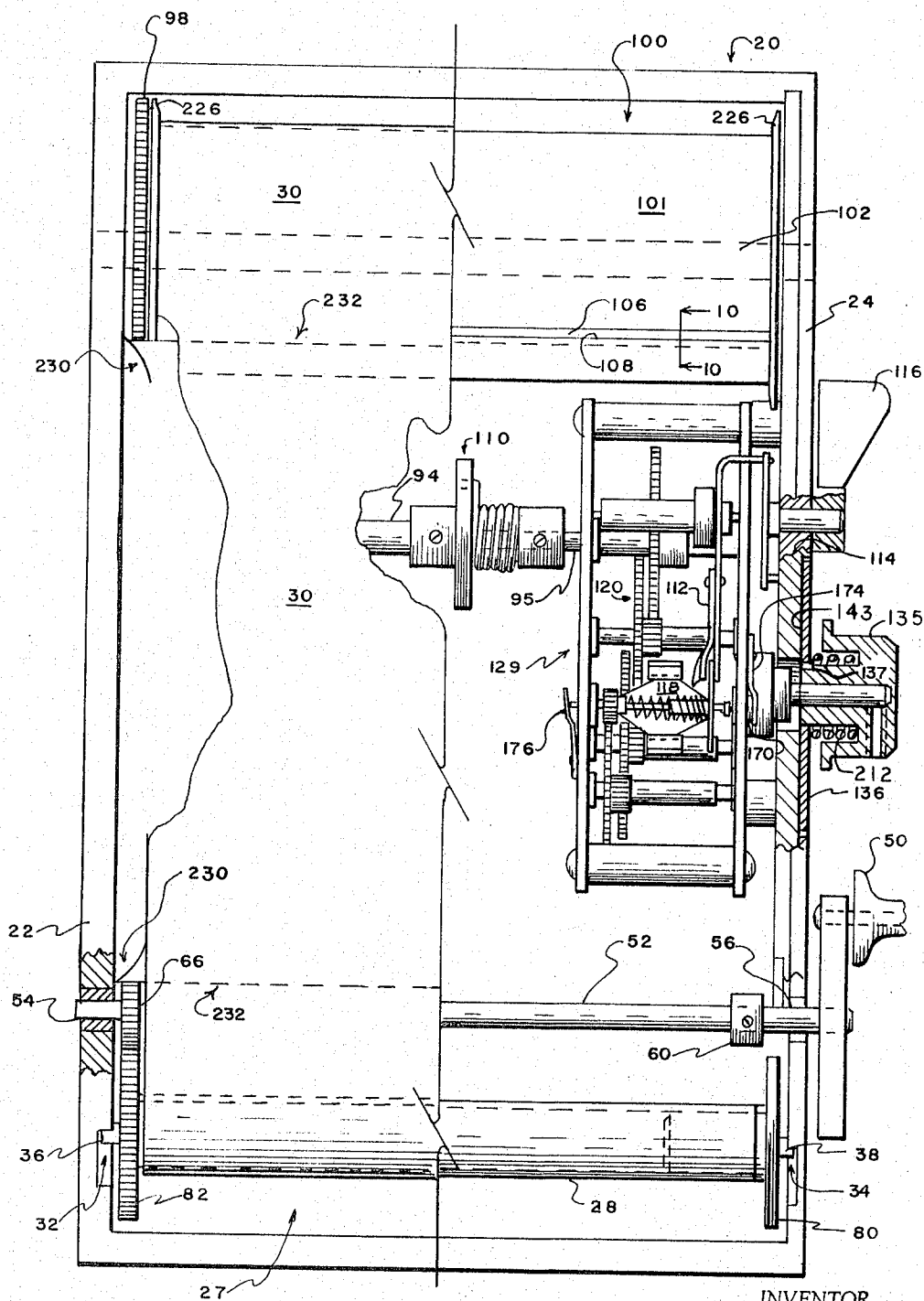


FIG-5

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3,302,309

READING PACER

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12 Claims. (Cl. 35—35)

This invention relates to readers or reading pacers, and more particularly to devices designed to aid in teaching or helping a person to improve reading speed. Essentially, the device comprises a mechanism to run a web of printed material past a particular position, at controlled speeds, so that a person using the device may begin at a slow speed and work his way up to higher speeds to improve his reading speed.

It is an object of this invention to provide a reader in which the mechanism for transporting the web is spring wound, and in which the spring is rewound by the same manual operation required to reroll the web of material, thus eliminating a separate operation for rewinding the spring and rerolling the web.

It is also an object of this invention to provide a positive stop and start device which respectively stops and starts the web immediately.

It is a further object of this invention to provide a speed control comprising an indicator dial and control knob which operate in the direction of the increasing and decreasing speed.

It is another object of this invention to provide an observation station or window with a guide line medially located to aid the reader in maintaining his line of vision at a particular position while the web moves past.

Another object of this invention is to provide such a reading guide line at a fixed angle which will serve as a proper guide for all speeds at which the reader is run.

It is also an object of this invention to provide guides and other means in the mechanism to assure proper alignment of the web.

It is also an object of this invention to provide a web having program material arranged in such a manner that it will compensate for the increasing speed of the web due to the increasing size of the advance roll by reason of the increasing thickness of the web as it is rolled thereon.

Other objects and advantages will appear from the specification hereinbelow, and these objects and advantages are achieved with the device illustrated in the accompanying drawings in which:

FIG. 1 is a perspective view of the invention;

FIG. 2 is a perspective view of the invention with the cover removed and parts cut away to show the mechanism;

FIG. 3 is an elevational detail of a portion of a bearing wall of the invention;

FIG. 4 is a diagrammatic perspective view of the platen of the invention having imaginary planes intersecting the same to show the curvature of the edges of the said platen;

FIG. 5 is an enlarged top plan view of the device with the cover removed and parts cut away, parts in section and parts in phantom;

FIG. 6 is a detail in section of a portion of the drum cylinder of the advance roll of the invention;

FIG. 7 is a stretchout, partially in plan, partially in section and partially in phantom, of the speed control means of the invention;

FIG. 8 is a sectional view along the line 8—8 in FIG. 7;

FIG. 9 is a detail, partly in section and partly broken away, of the start and stop brake unit, the governor, partly broken away, and associated parts of the invention with the brake portion rotated into the plane of the drawing sheet for purposes of clarity, and showing the start-stop broke in first or running position;

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FIG. 10 is a view similar to FIG. 9 (except that the governor portion has not been partly cut away) showing the brake in an intermediate position between the first or running position and the second or stop position;

FIG. 11 is a view similar to FIG. 9 showing the start-stop brake in second or stop position;

FIG. 12 is a sectional view along the lines 12—12 in FIG. 9;

FIG. 13 is a top view detail, partly in section, of the rewind clutch means;

FIG. 14 is the end of a cutting tool which is used to form the edges of the platen; and

FIG. 15 is an end elevation of the tool of FIG. 14 as seen from arrow 15 in FIG. 14.

Similar numerals refer to similar parts throughout the several views.

The reader mechanism consists of a spring motor, a speed control unit, a supply roll containing the web of paper upon which the program is printed, and the advance roll which transports the web past an observation station, or window. The controls, which are located on the side of the reader case, are the start-stop lever, the speed setting knob and dial, and the rewind handle.

The spring motor is equipped with stops to protect the mechanism and is connected to the speed control unit through a one-way over-running clutch. The purpose of the over-running clutch is to disconnect the speed control unit during rewind so that the operator may be able to remind the web and the spring motor rapidly with a minimum of torque. The act of rewinding the program web onto the supply roll automatically rewinds the spring motor. This is accomplished because the advance roll is reversed when the web is rewound from it to the supply roll; and since the advance roll is permanently geared to the spring motor, the spring motor is rewound by the reverse motion of the advance roll.

The case and the web transporting means

The invention is provided with frame means such as the frame, case, or housing 20 which comprises mechanism bearing means such as the bearing walls 22 and 24. The case 20 comprises a cover 25 mounted on hinges 26. The frame or housing and the cover may be made of any suitable material such as metal or plastic.

A supply roll 27 having a spindle 28 on which the web 30 is rolled, is fitted into supply roll bearings 32 and 34, and rests on its hubs 36 and 38 within the bearings 32 and 34. Bearings 32 and 34 are constructed in opposing relationship in the bearing walls 22 and 24 respectively, and comprise angled entry passages as designated by reference numeral 44 in FIG. 3 of the drawings. The purpose of the angled entry passages is to provide upper bearing points 46 to prevent the rolls 27 from being dislodged from the bearings 32 and 34 by varying the resultant forces of the mechanism and gravity in rolling and unrolling the web 30. Gravity pulls down, but the web is under tension from the operation of the device, and this tension provides an upward component of force. The upper bearing points 46 will keep the rolls 27 in position against the resultant force.

The device also comprises a winding crank 50 which comprises a shaft 52 appropriately mounted on bearings 54 and 56 in the bearing walls 22 and 24 respectively. The shaft or rod 52, which has a crank handle 50 fixed to an end thereof, is both rotatably mounted and permitted to slide axially to provide for a clutch mechanism. There is a collar 60 which prevents the shaft 52 from being dislodged. Freely mounted at one end of the shaft 52 is a rewind clutch means in the form of a cammed coupling 62. The cammed coupling 62 has a central through bore 64 and a pinion 66 at one end, and engaging slots 68 at the other end which are adapted to co-

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operate with an engaging pin 70 which is mounted transversely through the shaft 52.

There is a sleeve 72 mounted on the coupling 62 and a spring 74 seated against the pinion 66 and the sleeve 72 exerting pressure against the sleeve which pushes the sleeve against the engaging pin 70, and normally urges the engaging pin 70 away from the coupling 62. The engaging slots 68 are provided with recesses 76. The sides of the recesses 76 have a camming angle so that they may be disengaged from the engaging pin 70 by action of sleeve 72 and the spring 74. When manual pressure is removed from the winding crank 50, this disengages the crank shaft 52 from the coupling 62. This comprises the clutch means.

It is to be understood that when a person winds the crank 50 in the direction of the arrow A in FIG. 2 of the drawings, he must first push the crank axially, inwardly, to engage the recesses 76 with the engaging pin 70, and so long as the crank 50 is being wound, the recesses 76 will serve to hold the engaging pin 70 for a positive connection. When finger pressure is removed, the engaging pin 70 will be pushed away to break the connection.

The supply roll 27 may have a plain flange 80 at one end, and a gear wheel flange 82 at the other end. The gear wheel flange 82 is designed to mesh with the pinion 66 so that when the supply roll 27 is properly fitted into its bearings 32 and 34, winding the crank 50 will rotate supply roll 27 in the direction of the arrow B shown in FIG. 2 of the drawings. This will serve to rewind or reroll the web 30 onto the supply roll 27, and will also serve to rewind the spring mechanism of the device as will be more fully explained hereinbelow.

The spring mechanism and driving means

The device is driven by a potential energy motor 90 comprising a spiral spring 92 well known in the art, having stops to prevent it from being wound or unwound too much, which are also well known in the art. The spring mechanism is appropriately mounted on one of the bearing walls, such as wall 22, or in any other suitable position in the frame 20, and also comprises a drive shaft 94 and a driving gear 96 which meshes into a driven gear 98 of the advance roll 100.

Advance roll 100 is in the form of a drum 101 which turns on a shaft 102 mounted on the walls 22 and 24. The drum 101 and the driven gear 98 are meshed to rotate together to advance or transport the web 30 past the observation station or window 222. The spring 92 is initially wound up with the palm of the hand by rotating advance roll 100 in a reverse direction such as that indicated by arrow C in FIG. 2 of the drawings, and when spring 92 unwinds, it causes drive shaft 94 and drive gear 96 to move in the direction of arrow D in FIG. 2 of the drawings, and causes drum 101 to rotate in the advance direction of arrow E. Drum 101 has one or more appropriate slotted means 106 within which to place leading edge 108 of web 30. The spring 92 is initially wound by hand. After that, it is rewound by the crank 50 while rerolling the web 30.

Speed control means

The speed control means 129, which is connected to the motor 90 through drive shaft 94, an overrunning clutch 110 and driven shaft 95, comprises a governor 118, a step-up gear train 120, a speed control disc 130, a speed control arm 132, a speed setting member such as a shaft 134, and a speed control knob 135 and speed setting dial 136. The speed setting dial 136 is keyed at reference numeral 137 to the speed control knob 135 which in turn is fastened to the speed setting shaft 134 which has a mounting means such as the matched threads of the shaft in a threaded mounting 138 in a frame element 144 of sub-assembly frame 140.

The speed setting dial 136 is circular, and is fitted into a circular recess 143 in one of the bearing walls such as

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bearing wall 24 of the frame or housing 20. Also, on bearing wall 24, around recess 143, there is a reference mark 145 which is used in conjunction with speed indicating means such as a speed setting scale 147 which is located on the dial 136.

The governor 118, which is a centrifugal flyweight type governor, is geared up by the gear stepup train 120 to run at a speed approximately 1200 times that of the potential energy, or spring, motor 90. There are two flyweights 150 mounted on flyweight springs 152. The governor 118 has a governor shaft 154 having journals 156 and 158, the outer ends of which form pivot means 160 and 162. The flyweight springs 152 are attached at one end to the governor shaft 154, either directly or through a pinion or gear such as gear 164 attached to the shaft. Gear 164 is the connecting means between the governor and the step-up gear train 120. The flyweight springs 152 may be attached to the governor shaft 154 by any other means. The other ends of the flyweight springs 152 are attached to the speed control disc 130 which has a central opening 166 which is positioned around the said governor shaft 154 for axial movement along the said governor shaft. For purposes of clarity, we shall define journal 156 and pivot means 160 as the disc end journal 156 and the disc end pivot means 160. Journal 158 and pivot means 162 will be defined as the gear end journal 158 and the gear end pivot means 162. It is to be understood that the terms "disc end" and "gear end" as used in connection with the journals and pivot means are for purposes of definition of location only since in another form of construction, the gear, which may be attached to the governor shaft, may be located in some other position than at the end of the shaft. This would be considered to be an equivalent construction however.

The journals 156 and 158 are mounted in radial bearings in the frame 140 of the speed control means 129. Outside of the radial bearings 170 and 172, flat springs 174 and 176 are mounted. The governor shaft 154 should be longer than the distance between the outsides of bearings 170 and 172. In other words, pivot means 160 and 162 should be further apart than the outsides of the bearings, and as a result, if disc end pivot means 160 is maintained in the same plane as the outside opening of bearing 170 by means of flat spring 174 seating against both the pivot 160 and bearing 170, then gear end pivot means 162 will protrude outside of bearing 172. The spring 174 at the disc end of the governor is relatively the strongest of the two, and will normally rest relatively the stronger of the two, and will normally rest against the outside of the radial bearing 170 with a more positive force than spring 176 which bears at the gear end of the governor, and said spring 176 will normally be pushed away from the outer face of radial bearing 172 of frame element 142 because gear end pivot means 162 will protrude by reason of the more positive force of spring 174 at the other end. This insures that the governor shaft 154 will be located with pivot means 160 held in contact with spring 174 which remains seated against the outer face of bearing 170 at all times except when the brake 112 is initially applied. This will be more fully described hereinbelow. The two flat springs 174 and 176 will, therefore, form pivot bearings together with the pivot means 162 and 160 of the shaft 154, and spring 174 will be known as the normally fixed spring, and spring 176 may be called the normally floating spring.

The centrifugal governor 118 controls the rate of feed of the web of paper 30 while the reader is in operation, and the purpose of the two flat springs is to fix the position of the governor shaft 154 axially. During normal operation, pivot means 160 at the disc end of the governor shaft will continue to bear against the normally fixed flat spring 174 without lost motion. When the reader is started, the torque of the spring motor 90 causes the governor 118 to accelerate. As the speed of the governor 118 increases, centrifugal force causes the flyweight

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spring combination to expand and causes the disc 130 to move along the governor shaft 154, toward the gear end. The governor 118 will continue to accelerate and the disc 130 will continue to move along the governor shaft 154 until it engages a contact means or point, such as speed control friction contact 180, at the end of the speed control arm 132. Upon engaging the friction contact 180, the governor 118 will accelerate slightly further until a speed is achieved where centrifugal force on the weights 150 will cause the disc 130 to bear on the friction contact 180 and cause a frictional braking torque on the governor 118 which is equal to the useful torque of the spring motor 90 exerted on the governor 118. At this point, the mechanism will cease to accelerate and will run at constant speed. Thus, the speed of the device is controlled by the position of speed control friction contact 180.

The speed control governor is a precision device. The change in axial position of the governor disc 130 for a speed difference of 500 words per minute is approximately .050 of an inch. It is thus apparent that a small error in the position of the governor disc 130 or in the friction contact 180 at the end of the control arm 132 would result in an appreciable error in the web speed in words per minute. It would be impractical to make the parts with a sufficient degree of accuracy to achieve the desired precision as the instrument is assembled by mass production methods. For this reason, a calibration method is provided, as follows:

The control arm 132 is provided with the speed control friction contact 180 at one end, as described, made of a brake material for engaging the governor disc 130. The engagement is normally at the gear end side 182 of the disc 130. The other side of the disc 130 may be called the disc journal side 184. At the other end of the speed control arm 132 are two raised points 190 which bear upon the head of a calibrating screw 192. Near the friction contact 180 end, there is a circular hole 194 which engages the spherical end 196 of the speed setting shaft 134 upon which the speed setting knob 135 and the speed setting dial 136 are mounted. Between this hole 194 and the calibration points 190, there is another hole 198 in the control arm 132. Through this hole 198 there extends a post 200 which is riveted to, or fastened to, or a part of the frame element 144 of the speed control sub-assembly frame 140, and this post 200 is provided with a head 202 and a spring 204 which holds the control arm 132 in place in the speed control assembly 140.

The control arm 132 is thus provided with a three point mounting consisting of the spherical end 196 of the speed setting shaft 134 and the two points 190 which rest upon the head of the calibrating screw 192. The friction contact point 180, the center of the spherical surface 196 on the end of speed setting shaft 134, and the points 190 resting upon the calibration screwhead 192 are all located in the same plane. It is thus apparent that the linear motion of the speed control friction contact 180 in the axial direction of the governor is proportional to the angular motion of the speed setting dial 136. The spring 204 on the post 200 which locates and holds the arm 132 against the three point suspension system removes all lost motion in the speed setting part of the speed control means 129. Thus, after assembly at the factory, an adjustment of the friction contact point 180, with relation to the governor disc 130, may be made by turning screwhead 192, to insure that the web 30 speed will correspond to the scale 147 of the dial 136.

The two flat pivot springs 174 and 176 eliminate all lost motion in the governor 118. The effect of this relationship is that the speed control friction contact 180 will accurately repeat its position over and over for any given speed setting of the dial, and the disc 130 of the governor 118 will repeat its position exactly over and over for any given speed of its rotation. The combination of these

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qualities together with the calibrating screw 192 assures very accurate speed setting of the speed control unit.

In a flyweight governor 118, as described so far, the motion of the disc 130 will not be proportional to the speed of the governor. For example, assume that the flyweights 150 are spaced one-half of an inch apart and the angle of their supporting springs 152 with respect to the governor shaft is approximately 45°. Now, if an accelerating torque is applied to the governor 118 through the gear system 120, the governor 118 will pick up speed and the centrifugal force caused by the tendency of the weights 150 to fly outward will be proportional to the square of their linear velocity divided by the radial distance between the weights and the center of the governor shaft. Since the spring angles are approximately 45° to the governor shaft 154, and since the increase in radial distance due to the outward motion of the weights is proportionately small compared to the large increase in the speed of the governor, it follows that the axial motion of the disc 130 starting at its zero speed relaxed position will be roughly proportional to the square of the speed of the governor. Since, as stated before, the motion of the friction contact point 180 is proportional to the rotation of the speed setting knob 135 and dial 136, it follows that the speed control for a simple governor 118, as just described, would require a non-linear speed setting dial 136 with a rapidly expanding scale. For instance, let us assume that the dial was graduated from zero to 500 words per minute, which would be equivalent to a governor speed varying from zero to 2,500 r.p.m. For this condition, the distance between the 400 and the 500 graduations might be nine times as great as the distance between the zero and the 100 graduations. This is undesirable because such a large proportion of the speed setting dial 136 is used up in the upper speed range that it is not possible to make accurate speed adjustments at the lower end of the speed range. To remedy this situation, a helical spring 210 is placed on the governor shaft between the governor drive gear 164 and the disc 130. This helical spring 210 is fitted so that when the governor 118 is relaxed in the zero speed position, the helical spring 210 is also relaxed and, therefore, is not under pressure. The helical spring is wound with a non-linear pitch. The coils are wound very closely at one end, but not quite touching, and the distance between the coils gradually increase, as shown in the illustration FIG. 7. The action of his helical spring 210 is as follows:

When the governor 118 is relaxed, the coils are all active since none touches the other adjacent to it. When the governor accelerates in speed, the disc moves along the shaft of the governor and closes up the coils of the helical spring one by one until, at maximum operating speed, only a fraction of the coils are still active. As the helical spring 210 is compressed, its reactive force is not proportional to the distance it is compressed. Due to its non-linear pitch, the reactive force builds up at an increasing rate as the spring is compressed. In the speed control unit described, the inventor has developed a combination of flyweight governor 118 and helical spring 210, which has caused the governor disc 130 to move from its relaxed position a distance which is closely proportional to the speed throughout the speed range as used in the reader. This has allowed the use of a speed setting dial 136 which is uniformly graduated throughout the usable speed range with negligible errors in speed indication. An expansion spring 212 is seated between the speed dial 136 and the manual speed setting knob 135. This will take up lost motion in this part of the system.

After a reading lesson on a web 30 is run through the machine, it is necessary to rewind it onto the supply roll before removing same and inserting the next lesson. Since, in many cases, the rewinding will be done by children, it is desirable to have the rewind torque on the rewind handle 50 as low as practical. There is thus a practical limitation on the torque required to wind the

potential energy, or spring motor, since the spring motor 90 is rewound at the same time that the paper web 30 is rewound onto the supply roll. Since the spring motor torque must be kept small in order that it may be rewound by a child, it follows that the bearing friction and the moment of inertia of the governor 118 about its axis, as well as the friction of the connecting gearing, must be kept as low as practical in order that the spring motor 90 will be able to accelerate the machine up to the set speed within a few seconds after the start lever 116 is pushed. To this end, the governor 118 has journal bearings and radial bearings of a very small diameter, and the ends 160 and 162 of the shaft 154 are rounded to form pivot bearings against the hardened steel flat springs referred to before as the normally fixed pivot spring 174 and the normally floating pivot spring 176. The normally fixed pivot spring 174 constitutes a thrust bearing which is capable of withstanding the thrust caused by the pressure of the governor disc 130 against the speed control friction contact 180. Except for a small component of gravity, this is the only force working against this bearing (components 160 and 174) during the normal running of the machine.

The starting and stopping of the device is actuated by the start-stop lever 116 connected to a brake 112, through means such as brake shaft 114. It is most desirable to stop the machine in a fraction of a second, and a special braking means has been provided in the brake 112 for this purpose as follows:

The stopping action is caused by the disc 130 being engaged and held by the stop brake 112. This is illustrated in FIGS. 9, 10 and 11 of the drawings. Stop brake 112 has a rigid finger 218 and a springy finger 220. While the machine is running, the stop brake 112 is in a first position away from the said disc 130. The rigid finger and the springy finger form a V shape with the outer ends of the fingers of the V shape at least as great a distance apart as the axial distance travelled by disc 130 along governor shaft 154 throughout the speed range of the device. Thus, when the stop brake 112 is moved from a first or running position to a second or stop position, the disc 130 will be grasped between the fingers 218 and 220, and will be prevented from rotating. This will stop the governor and the device will stop instantly. The first or running position is illustrated in FIG. 9 of the drawings. The second or stop position is illustrated in FIG. 11 of the drawings. It will be seen that when the device is in the second or stop position, the disc journal side 184 of the disc 130 will lie against the rigid finger 218 and be held against the said rigid finger 218 by the springy finger 220.

The stopping action, as described, causes a thrust on the normally fixed pivot spring 174 some ten times as great as the normal thrust of the speed control friction contact 180. It is necessary to protect this pivot bearing (components 160 and 174) against this abnormal thrust to prevent it from prematurely wearing out.

There is a stop means such as a collar, or shoulder 216, on the governor shaft 154 which is normally spaced a few thousandths of an inch away from the inner face of the radial bearings 170 when the machine is running. The shoulder 216 is maintained in this position by the normally fixed pivot spring 174 which rests with a positive force against the outer face of the radial bearing 170. This positive force of the spring 174 against the outer face of radial bearing 170 is of an order of magnitude of two to three times the normal force exercised by the speed control friction contact 180 against the governor disc 130. So, during the normal running operation of the machine, the governor 118 is maintained very accurately in position, and the shoulder 216 of the governor shaft remains spaced slightly away from the inner face of the radial bearing 170. The normally floating pivot spring 176 at the other end of the governor, being

weaker than the normally fixed pivot spring 174, maintains this relationship without lost motion.

When the start-stop lever 116 is raised, the stop brake 112 goes to second position to be applied to the governor disc 130, and the thrust on the governor shaft 154 now becomes many times as great as the positive force of the normally fixed pivot spring 174 against the bearing 160. This action thrusts the whole governor shaft 154 toward spring 174 as illustrated in FIG. 10 of the drawings. The pivot spring 174 is, therefore, deflected until the shoulder 216 on the governor shaft 154 comes in contact with the inner face of the radial bearing 170. This is a contact of large area compared to that of the pivot bearing 160 against spring 174, and is able to carry the load due to stopping the machine without damage to either the governor 118 or its bearings. While this stop action is going on, the normally floating pivot spring 172 follows up the axial motion of the governor shaft 154. When the stopping action is finished, the axial load on the governor 118 is reduced and the normally fixed pivot spring 174 returns to its position in contact with the outer face of radial bearing 170, and the shoulder 216 on the governor shaft moves out of contact with the inner face of the said radial bearing. The fingers 218 and 220 will then hold the governor disc 130 in a position where it is not touching the speed control friction contact 180 and where the governor shaft shoulder 216 is not in contact with the inner face of the radial bearing 170. It is, therefore, in a position for easy starting when the start-stop lever is depressed to the start position. As a matter of fact, when the brake 112 is moved from second, or stop position, to first, or running position, the movement of the fingers away from the disc serve to give the disc 130 an initial rotational push to aid in starting.

Loading and running the device

To load the reader, a roll 27 containing the reading lesson is dropped into the slots 32 and 34 at the receiving end of the machine. The free end 108 of the paper web 30 is then threaded manually into a slot 106 in the drum 101 of the advance roll 100, after checking to make sure that the spring motor 90 is fully wound. This check is made by turning the advance roll 100 backward with the palm of the hand until it causes the spring 92 to strike against a limit stop on the motor 90.

The reader is started by pressing down on the start-stop lever 116. The speed is set by turning the speed control knob 135 until the speed setting dial 136 reads the proper number of words per minute desired against the index mark on the case. The spring motor 90 will now drive the advance roll 100 through connecting gearing and cause the paper 30 containing the reading lesson to be transported from the supply roll 27 to the advance roll 100, passing all the while under the observation window 222 in the cover. After the lesson is completed, and it is desired to rewind the web 30 back onto the supply roll 27, the student presses in the crank handle 50 in order to engage the crank through a clutch and connecting gearing to the supply roll 27 so that when the handle is turned, the supply roll 27 will turn backwards and, thereby, rewind the paper web on the supply roll 27. This rewind action causes the advance roll 100 to turn backwards as the web 30 is pulled from it. The action of the advance roll 100 turning backwards rewinds the spring motor 90.

It will be understood that the supply roll 27 is removable and replaceable with other supply rolls 27 having webs 30 with other program material. In addition to having replaceable rolls 27, it may sometimes be desirable for a particular roll to be rerun at a particular point. For example, at some point on the roll, there may be an instruction to wind it back to a previous point so that the program material can be reread. Thus, the mechanism of the device is synchronized in the sense that winding the roll 27 back a given length will partially rewind the

spring 92 providing it with sufficient force to rerun the roll 27 for the length that it has been rewound.

Another feature of the device is that the overrunning clutch 110 permits the roll 27 to be rewound even when the device is running without applying brake 112. The overrunning clutch 110 will maintain a positive drive relationship with shaft 94 when shaft 94 rotates in the direction of arrow D as shown in FIG. 2 of the drawings, as when the device is running and the web 30 is being advanced on the advance roll 100. On the other hand, when the advance roll 100 is being rotated in a direction to wind the spring 92, the shaft 94 will rotate in a direction opposite to arrow D, and the overrunning clutch will permit shaft 94 to slip freely. This feature is provided to insure that the spring 92 can be rewound easily and quickly without being obstructed by the speed control mechanism.

Web guide and alignment means

The paper web 30 is under considerable tension during the rewinding process so, in order to reduce the torque on the rewind handle, the rewind handle shaft 52 is geared down to the supply roll 27 by a two to one ratio. (Gears 82 and 66). Paper webs 30 cut into strips twelve or fifteen feet long and five inches wide, which are preferably used with the device, are never straight. Paper webs 30 of this kind are always curved to a greater or less degree, sometimes as much as one-eighth of an inch to the foot or more. Sometimes the curvature runs in one direction for a few feet and then reverses to a curvature in the other direction. When a curved web is rewound onto the supply roll 27 under tension, as is the case in this reader, it tends to weave from side to side and wind unevenly. If it was under any considerable tension while being advanced to the advance roll during the next reading lesson, it would tend to wind unevenly even to a greater degree on the advance roll. The effect is cumulative and a repetition of this advance and rewind cycle several times under tension would cause the paper to wind so unevenly as to tear at the edges and destroy its usefulness. This is a serious problem in paper winding devices of this kind because the paper cannot be controlled by edge pressure if there is any considerable tension in the paper. Tension causes friction against the supporting surface which prevents the paper from being pushed sideways without tearing the edges. This problem is solved in the present reader as follows:

The web is caused to advance onto the advance roll under practically no tension. This is accomplished by mounting the supply roll in free bearings 32 and 34 and by allowing the rewind handle 50 to be disengaged by spring 74 during the advancing part of the cycle. The advance roll 100 has flanges 226 at its ends which are about $\frac{3}{16}$ larger in radius than the cylindrical part or drum 101 of the advance roll 100. That part of each flange extending away from the roll for the first eighth of an inch is perpendicular to the axis of the roll. From thereout the flanges have a slight taper by being rounded, flared or bevelled away from center. The paper is cut to a close tolerance in width, and is caused to fit closely between the flanges on the advance roll, allowing only enough tolerance to cover manufacturing errors.

Since the web 30 is advanced under practically no tension, it easily complies with the edge control exercised by the flanges on the advance roll 100, and is caused to wind on the advance roll 100 in an even manner. The total thickness of the roll of paper on the advance roll is approximately an eighth of an inch for about a fifteen foot length of paper. The rewind roll has a gear 82 at one end and a flange 80 at the other end. These both act as flanges but not guides since the distance between them is about an eighth of an inch greater than the width of the paper. This situation allows room for the paper to wind unevenly on the rewind supply roll when it is under tension, as described above, and, therefore, cannot be guided by edge control.

When the same program, or supply roll 27, is used again and the paper web 30 is advanced during a reading lesson to the advance roll 100, it will be again under practically no tension and, therefore, can be guided by the flanges 226 on the advance roll to wind evenly on the advance roll 100. It is thus apparent that this cycle of advance and rewind can be repeated indefinitely without damage to the paper so long as the paper is wound accurately and evenly during the advancing part of the cycle, and so long as there is plenty of clearance for the roll to wind unevenly while under tension during the rewind part of the cycle. In other words, it tends to run wild during the rewind, but is corrected each time when wound on the advance roll during the reading lesson.

In order that the paper may not run too wild during the rewind, it is kept under partial control by means of rounding edges 232 downwardly and flaring the ends 230 of the edges 232 outwardly, at the advance end and at the rewind end of the platen 234.

The edges 232 of the platen are rounded by providing an arcuate shape along each edge 232 having downward roundings 233 except that the extreme ends 230 where there are outward flares 235. The flares 235 and the roundings 233 comprise true arcs of circles taken in proper vertical planes perpendicular to the face surface 236 of the platen 234. For the downward roundings 233, the vertical plane should be as illustrated in A in FIG. 4 of the drawings, that is, perpendicular to both the face and edge 232 of the platen. For the outward flares 235, the vertical plane should be parallel to the edge 232 and perpendicular to the face 236 as shown in B in FIG. 4 of the drawings. These flares and roundings are fabricated into the edges 232 of the platen 234 by means of a special rotary cutting tool 240 having a shape similar to a truncated cone, except that the sloping cutting edges 242 of the tool 240 are not straight lines, as would be the case with a truncated cone, but are arcs of a circle as illustrated in FIGS. 14 and 15 of the drawings.

During the rewind process when the paper web 30 is under tension and tends to weave left or right, it tends to climb up on the outward flares 235 thereby stretching its climbing edge, making it longer. For instance, if the right edge of the paper is shorter than the left, the web 30 will curve toward the right as viewed in the direction of rewind motion, and will tend to "steer" to the right when moving. As the web steers to the right, it will "climb" the flared portions 235 of the platen and, being under tension, the right edge of the web will stretch in order to follow the longer path. The right edge will continue to climb and stretch until it becomes long enough to cause the web to "steer" or weave in the other direction; e.g., to the left. Thus, the web weaves to a certain extent while being rewound under tension, but the errors are kept within plus or minus one-sixteenth of an inch so long as the web is corrected and wound evenly each time it is advanced under practically no tension, as described above.

Speed ratio compensation means for length of web

It will be understood that as a 15 foot web reels onto the advance roll 100, the diameter of the roll becomes thicker, and as a consequence, the web will be pulled faster. This increase in speed can be compensated for either by diminishing the length of each line of the web, or groups of lines, from the beginning to the end of the program material on the web, or by increasing the distance apart of the said lines from the beginning to the end of the said program material on the web 30. Thus, as the web 30 goes faster as it advances, by either diminishing the length of succeeding lines or increasing the distance between them, this increase in speed will be compensated for. In the preferred form of the invention, speed compensation is provided by diminishing the length of succeeding lines.

The guide line of the device

The device is provided with a guide line 250 which is next to an indicator such as the words "Read Here" together with an arrow 252. Inasmuch as the eye travels on the guide line 250 from left to right in reading English, by the time the eye has completed this travel along one line of the program material of a web 30, it will have advanced somewhat in the direction of the motion of the web 30, relative to the window 222. A guide line 250 has been provided for this device which will act to compensate for this advance of the web 30 as the eye travels along the line. The compensation is accomplished in a guide line 250 which may be located at a medial position in the observation station 222. The guide line 250 should form an acute angle when viewed with relation to any single line of printed material on the web 30 when an end of such line of printed material is superimposed by a portion of the said guide line 250 when viewing the web 30 through the observation window 222. The acute angle thus formed would have its apex toward the left when viewing the observation window 222 of the device. I have found that an angle in which the tangent of the angle is between 0.6 and 1.0 time the distance between the centers of the lines on the said printed program material on the said web 30, divided by the length of a line of the said printed material, will provide a satisfactory acute angle for the guide line, depending upon the aptitude of the one who is reading. The preferred angle is one in which the tangent of the angle is 0.8 time the distance between the centers of the lines on the said printed program material on the said web 30, divided by the length of a line of the said printed material.

While I have described my invention in its preferred forms, there are many forms which it may take as equivalent structures without departing from the spirit and scope of the invention, and I, therefore, desire to be protected for all forms coming within the claims hereinbelow.

Wherefore I claim:

1. An apparatus for reeling a web comprising a main frame having an observation station, a potential energy motor, a supply roll including a web comprising program material, and an advance roll for rolling and advancing the said web past said observation station in which

- (a) the said advance roll is connected to the said potential energy motor by conducting means,
- (b) the said supply roll is connected to a
- (c) manually operable rewinding means with
- (d) the said web forming a drive transmission between the said advance roll and the said supply roll, and there is
- (e) means, mounted in the frame, for steering the said web with relation to the said supply roll, during rewinding, comprising platen means comprising a surface upon which the said web is transported, and at least one end portion substantially at right angles to the direction of transportation of said web, rounded away from the said web with relation to said surface,
- (f) said end portion having outward flares at its ends.

2. An apparatus for reeling a web comprising a main frame having an observation station, a potential energy motor, a supply roll including a web comprising program material, and an advance roll for rolling and advancing the said web past said observation station in which

- (a) the said advance roll is connected to the said potential energy motor by connecting means,
- (b) the said supply roll is connected to a
- (c) manually operable rewinding means with
- (d) the said web forming a drive transmission between the said advance roll and the said supply roll, and there is
- (e) means, mounted in the frame, for steering the said web with relation to the said supply roll, during rewinding, comprising a platen including a flat surface over which the said web is transported, and a pair of

edges substantially at right angles to the direction of transportation of said web, rounded away from the said web with relation to said flat surface of the platen,

- (f) said edges having outward flares at their ends.

3. The device as defined in claim 2, in which the said supply roll is

- (g) removably mounted on bearings in the said frame, and the
- (h) said connection between the said supply roll and the said manually operable winding means comprises gear transmission means.

4. An apparatus for reeling a web of program material comprising a frame having

- (a) an observation station, and
- (b) a web containing program material disposed to be transported past said observation station,
- (c) means for reeling said web on a roller, said means turning said roller at a constant angular velocity, such that the radius of the web increases as it is reeled,
- (d) said web including printed program material arranged in lines of diminishing length extending from the beginning to the end of said program material, said diminishing length of lines being a function of said increasing radius of the web.

5. An apparatus for reeling a web of program material comprising a frame having

- (a) an observation station, and
- (b) a web containing program material disposed to be transported past said observation station,
- (c) means for reeling said web on a roller said means turning said roller at a constant angular velocity, such that the radius of the web increases as it is reeled,
- (d) said web including printed program material arranged in lines spaced an increasing distance apart extending from the beginning to the end of said program material, said increasing distance apart of the lines being a function of said increasing radius of the web.

6. An apparatus for reeling a web of program material comprising a frame having

- (a) an observation station, and
- (b) a web containing program material disposed to be transported past said observation station,
- (c) means for reeling said web on a roller, said means turning said roller at a constant angular velocity, such that the radius of the web increases as it is reeled,
- (d) said web including program material arranged in groups of lines, each succeeding group having shorter lines than the preceding group, said shorter lines of the succeeding group having a predetermined relationship to the said increase in web radius.

7. An apparatus for reeling a web of program material comprising a frame having

- (a) an observation station, and
- (b) a web containing program material disposed to be transported past said observation station,
- (c) means for reeling said web on a roller, said means turning said roller at a constant angular velocity, such that the radius of the web increases as it is reeled,
- (d) said web including program material arranged in groups of lines, each succeeding group having its lines a greater distance apart than the preceding group, said distance between the said lines of each group having a predetermined relationship to said increase in web radius.

8. The apparatus for reeling a web as defined in claim 2, in which said manually operable rewinding means includes clutch means comprising

- (g) a crank shaft having a crank end and a gear end,

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- (h) at least one engaging element fixed to said crank shaft,
- (i) a slideable sleeve comprising gear means surrounding the shaft,
- (j) a slideable collar around the said slideable sleeve,
- (k) said sleeve having at least one engaging element in an end thereof adapted to face the said crank end and to accommodate the said engaging element of the said shaft, and
- (l) spring means between the said collar and the said gear means to coerce the said collar toward the said engaging element of the said shaft.
9. The web reeling apparatus as described in claim 2, in which
- (g) the said pair of edges substantially at right angles to the direction of transportation of said web are rounded away from said web with downward curves which, formed by the intersection of planes perpendicular to the said flat surface of the platen and parallel to the direction of transportation of said web, are substantially arcs of circles, and
- (h) the said outward flares at the ends of said pair of edges are rounded away from the web with outward curves which, formed by the intersections of planes perpendicular to the plane of said flat surface of the platen and at right angles to the direction of transportation of said web, are substantially arcs of circles.
10. An apparatus for reeling a web comprising a main frame including an observation station, a potential energy motor, a removable supply roll including a web comprising program material, an advance roll for advancing the web past said observation station, said advance roll having cylindrical means on which to roll said web, guiding means for aligning said web on said advance roll; and means to permit uneven rewinding of said web on said supply roll, in which
- (a) said advance roll is connected to said potential energy motor by connecting means,
- (b) said supply roll is engaged by
- (c) manually operable rewinding means with
- (d) said web forming a drive transmission between said advance roll and said supply roll,
- (e) said guiding means for aligning said web on the advance roll comprise flanged end portions having larger diameter than said cylindrical means of the advance roll, said flanged ends having inner surfaces spaced in close tolerance with the edges of a web when centrally located on said cylindrical web rolling means to permit contacting relationship with the edges of the web, and outward flares at the circumferences of said flanged end portions at a point beyond the maximum web roll diameter,
- (f) said means to permit uneven rewinding of said web

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- on said supply roll comprising a space at each end of the supply roll laterally beyond the space occupied by the web on said supply roll.
11. The apparatus for reeling a web as defined in claim 10, in which there is coercing means to limit the lateral unevenness in rewinding said web on said supply roll comprising
- (g) a platen, including: a flat surface over which said web is transported, and a pair of edges substantially at right angles to the direction of transportation of said web, with at least one of said edges being rounded away from said web with relation to said flat surface of the platen, and said edge having outward flares at its ends.
12. The apparatus for reeling a web as defined in claim 11, in which
- (h) the said edge substantially at right angles to the direction of transportation of said web is rounded away from said web with downward curves which, formed by the intersection of planes perpendicular to the said flat surface of the platen and parallel to the direction of transportation of said web, are substantially arcs of circles, and
- (i) the said outward flares at the ends of said edge are rounded away from the web with outward curves which, formed by the intersections of planes perpendicular to the plane of said flat surface of the platen and at right angles to the direction of transportation of said web, are substantially arcs of circles.

References Cited by the Examiner

UNITED STATES PATENTS

354,929	12/1886	Pierce	40—87
461,320	10/1891	Claudel	351—37
627,355	6/1899	Romans	40—86
754,190	3/1904	Bechtold	351—32 X
769,805	9/1904	Rosenbaum	351—32 X
1,473,752	11/1923	Wood	40—89
1,806,273	5/1931	Williams	283—62
2,139,763	12/1938	Martin	188—184
2,367,254	1/1945	Abbot	188—184
2,383,637	8/1945	Yates et al.	283—62
2,398,226	4/1946	Holland	40—31
2,407,955	9/1946	Halliday et al.	192—20
2,412,061	12/1946	Quidas	35—35.3 X
2,487,242	11/1949	Holland	40—31
2,674,153	4/1954	Alexander	351—36
2,684,737	7/1954	Johansson	192—20
2,745,199	5/1956	Kreinberg.	40—86

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,302,309

February 7, 1967

James Keith Macomber

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 11, line 45, "by conducting means" should read -- by connecting means --.

Signed and sealed this 17th day of February 1970.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents