Jan. 5, 1960 J. A. SIMPSON ET AL 2,919,500

READING-TRAINING DEVICES

Filed Aug. 21, 1956 5 Sheets-Sheet 1

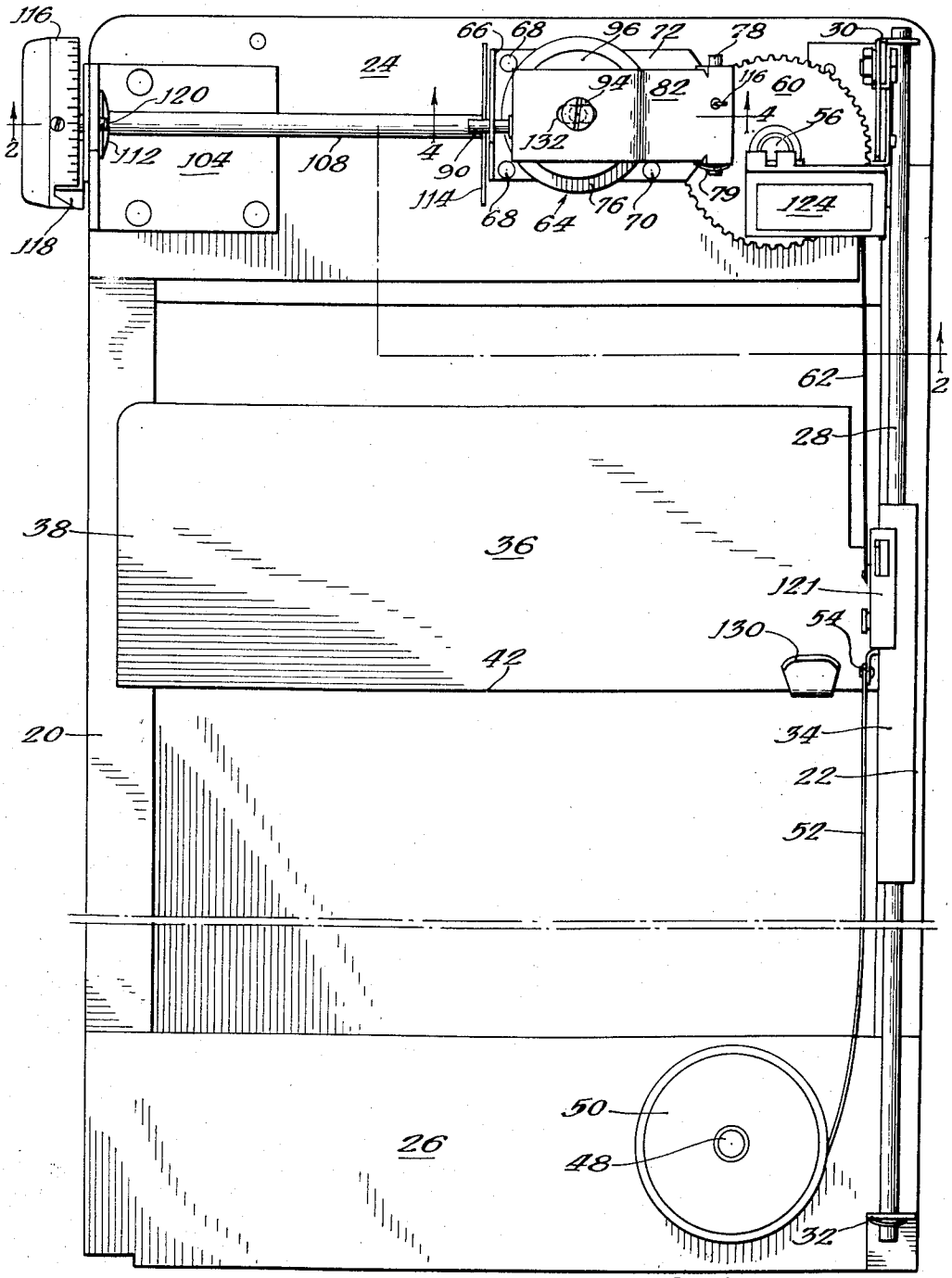


FIG. 1

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READING-TRAINING DEVICES

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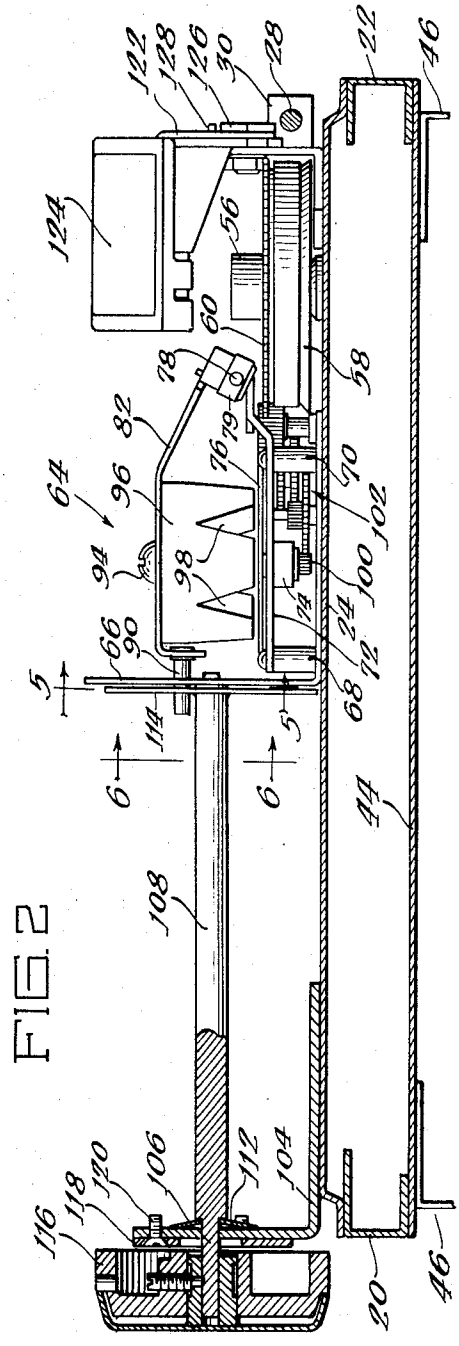


FIG. 2

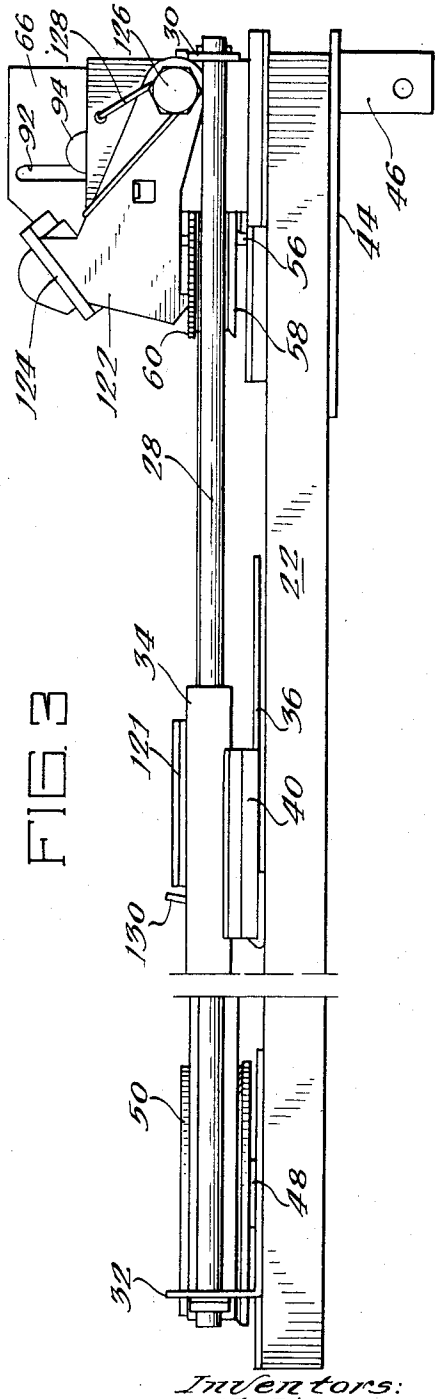


FIG. 3

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READING-TRAINING DEVICES

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FIG. 4

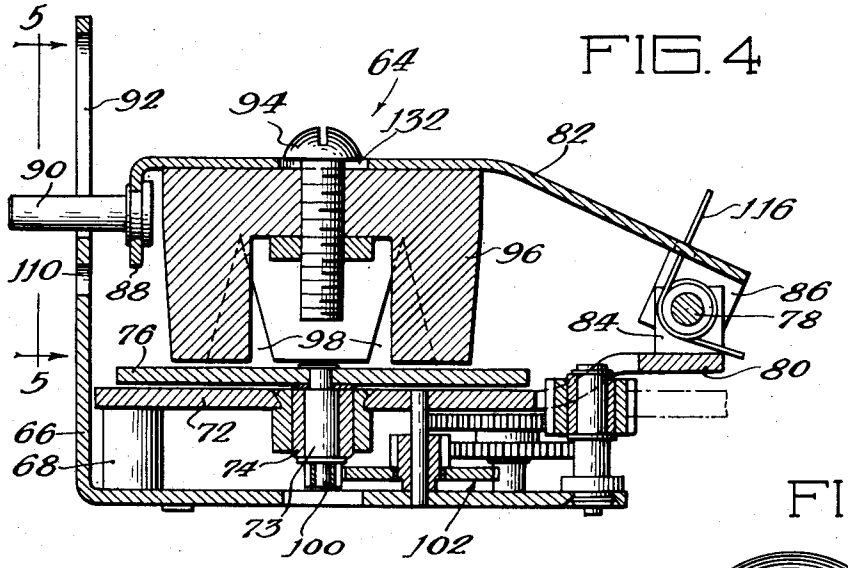


FIG. 5

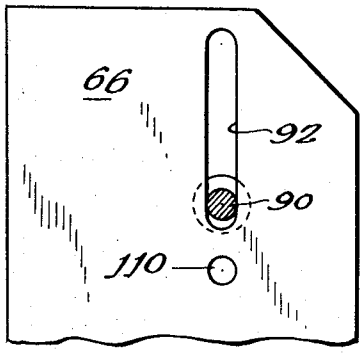


FIG. 6

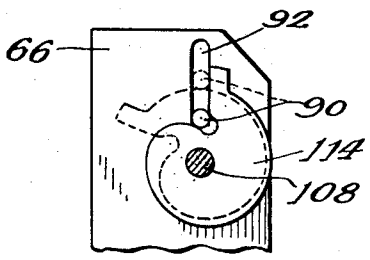


FIG. 7

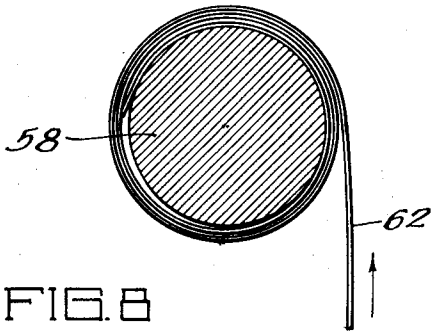
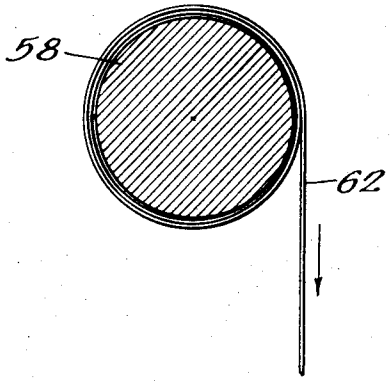


FIG. 8



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READING-TRAINING DEVICES

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FIG. 9

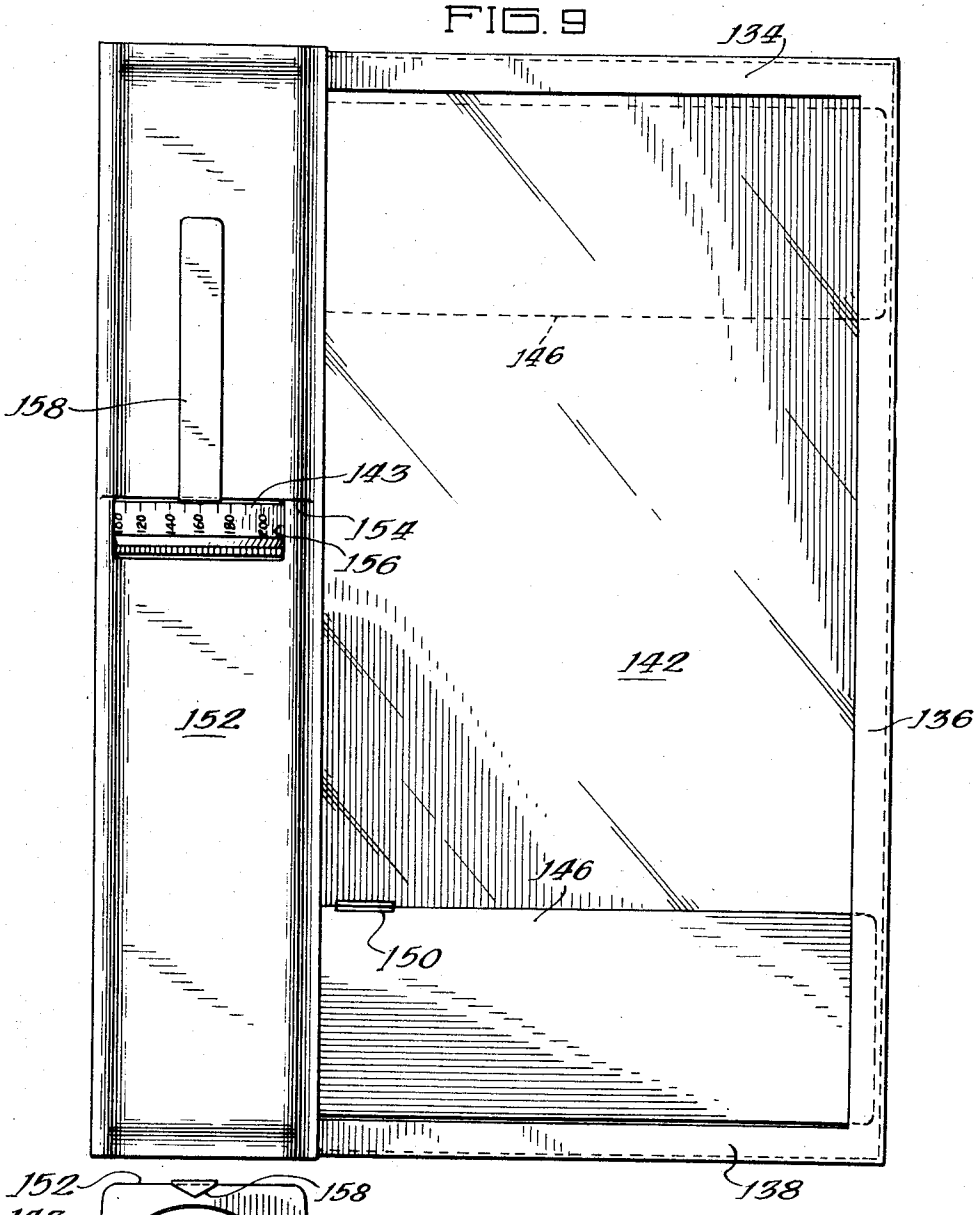
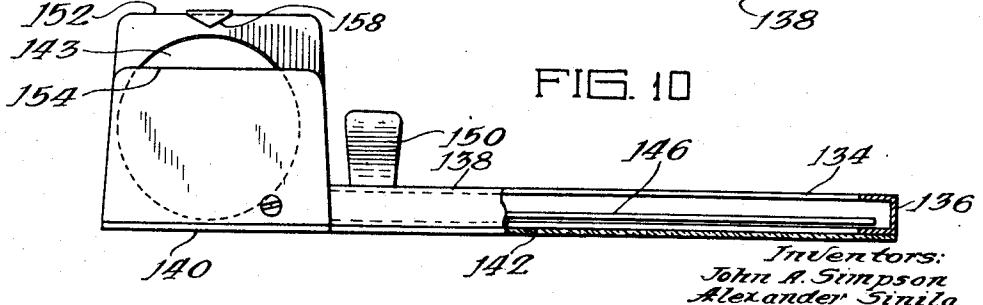


FIG. 10



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READING-TRAINING DEVICES

Filed Aug. 21, 1956 5 Sheets-Sheet 5

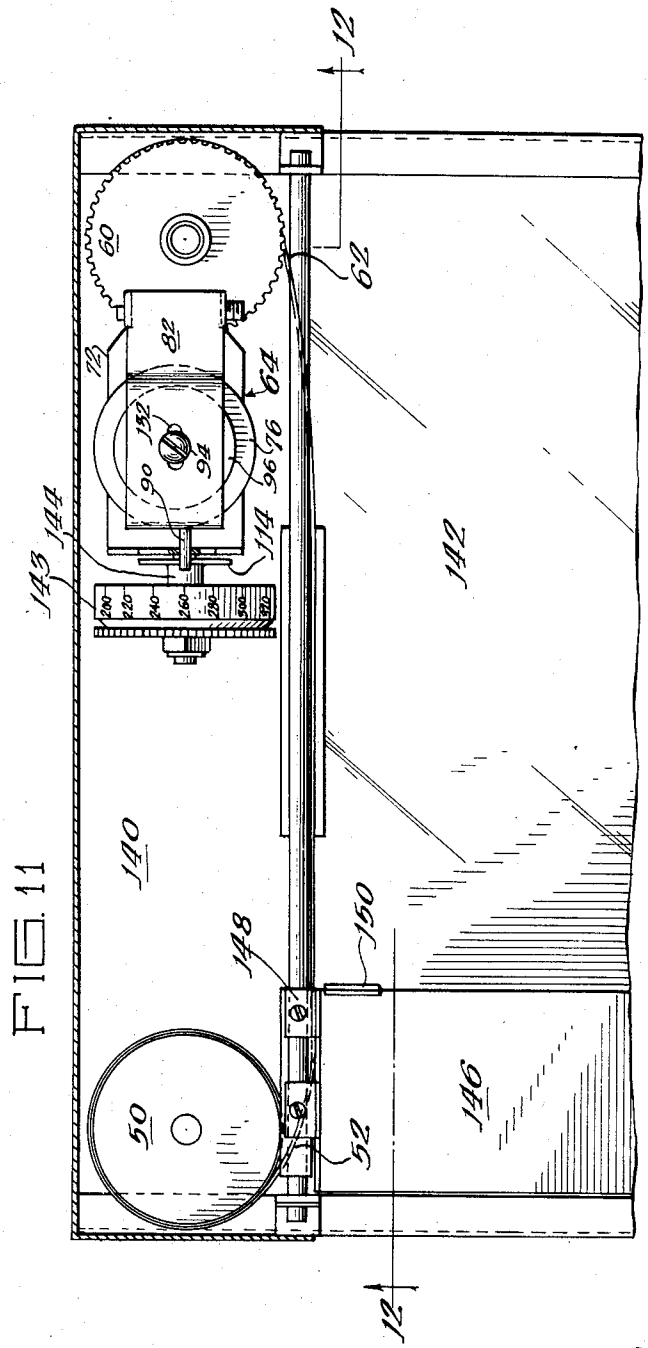


FIG. 11

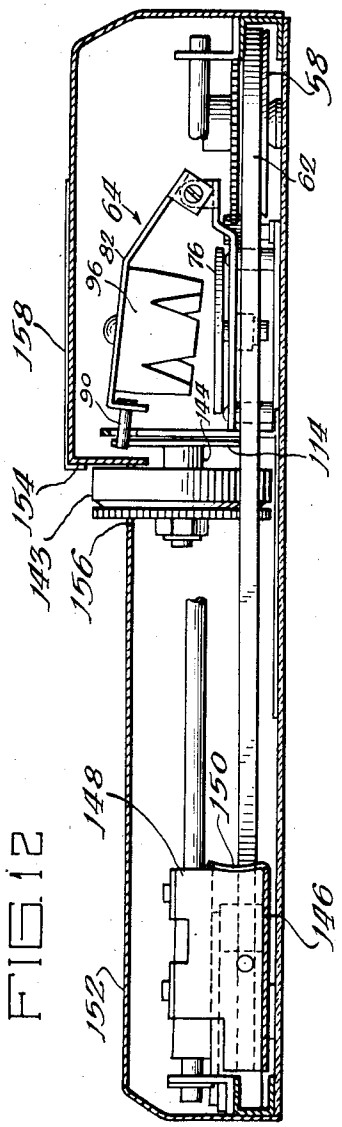


FIG. 12

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United States Patent Office 2,919,500
Patented Jan. 5, 1960

2,919,500

READING-TRAINING DEVICES

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Application August 21, 1956, Serial No. 605,403

11 Claims. (Cl. 35—35)

This invention relates to improvements in reading-training devices, and more specifically to devices employed for improvement of reading speed of the type which progressively indicate successive lines of printed matter at manually variable constant speeds, preferably masking or covering the lines immediately preceding the line instantaneously being indicated.

In the co-pending application of William E. Reynolds, filed June 21, 1954, Serial Number 437,928, assigned to the same assignee, there is described a machine for the same general purposes as the machines hereinafter to be described as illustrative of the present invention. The present invention has as its principal object the improvement of machines of this type from the point of view of simplicity, economy, and reliability of the drive mechanism by which the progressive indication of successive lines is produced. Other aspects of the invention provide an extremely compact and portable machine which is far simpler to transport and to use than are the machines previously available.

For understanding of the invention, reference is made to the embodiments thereof illustrated in the attached drawing, in which:

Figure 1 is a top plan view of a reading-training device made in accordance with the teachings of the invention;

Figure 2 is a transverse sectional view taken along the offset line 2—2 of Figure 1;

Figure 3 is a view in side elevation of the device of Figure 1;

Figure 4 is an enlarged sectional view of a portion of the drive mechanism of the device taken along the line 4—4 of Figure 1;

Figure 5 is a fragmentary enlarged sectional view taken along the line 5—5 of Figure 2;

Figure 6 is a fragmentary sectional view taken along the line 6—6 of Figure 2;

Figure 7 is a fragmentary more or less schematic view illustrating the condition of the end portion of a ribbon spring constituting a portion of the device in one portion of the operation of the device;

Figure 8 is a view similar to Figure 7 but illustrating the condition obtained in another portion of the operation;

Figure 9 is a top plan view of another and improved embodiment of the invention;

Figure 10 is a view in end elevation, partially in section of the embodiment of Figure 9;

Figure 11 is a view of the device of Figure 9 with a cover constituting a portion of that device removed; and

Figure 12 is a sectional view taken along the line 12—12 of Figure 11.

The device illustrated in Figures 1 to 8 comprises a generally rectangular frame including channel-shaped side pieces 20 and 22, secured as by welding to upper and lower end plates 24 and 26. Above and parallel to the right-hand side piece 22 extends a guide or slide rod 28 supported in brackets 30 and 32 mounted on the top and bottom plates 24 and 26 respectively. Slideable on

the guide rod 28 is a longitudinally apertured slide bar 34.

Secured to the under surface of the slide bar 34 is a line-indicating member or shutter 36. The line-indicating member 36 is a substantially rectangular flat plate, the left hand end at 38 resting slideably on the left side member 20 of the frame, and the right hand end having a tongue 40 secured to the slide bar 34. The line-indicating member 36 has a straight lower edge 42 adapted to indicate successive lines of printed matter and is of a height sufficient to mask off a substantial amount of material immediately above the edge 42 to prevent re-reading of printed material by the user. The line-indicating member 36 is maintained perpendicular to the side members 20 and 22 by the rigid connection to the bar 34.

To the under surfaces of the top ends of the side members 20 and 22 is secured as by welding a plate 44 from which extend apertured ears 46.

It will be recognized that the portions of the device thus far described are closely similar to the corresponding portions of the device for similar purposes described in the co-pending application mentioned above. For purposes of simplicity and the avoidance of duplication, there is omitted from the drawing a hollow rectangular cover which conceals and protects the four sides of the frame, and thus the mechanism, reference being made to the above-mentioned co-pending application for illustration of such a cover. It will also be recognizned that the ears 46 are designed to be used in connection with a book support illustrated and described in that co-pending application, the function of the ears 46 not being further described herein since they constitute no portion of the invention and may be omitted if a book support such as shown in the co-pending application is not to be employed.

Rotatably mounted on a shaft 48 mounted on the lower end plate 26 adjacent to the lower end of the slide rod 28 is a spool or drum 50. The inner end of a pre-stressed ribbon spring or tape 52 is wound upon the spool, the outer end of the spring 52 being coupled to the bar 34 by a screw 54.

The spring or tape 52 is a constant-force spring, such springs having been described in numerous places in patent and other literature and being familiar to persons skilled in the mechanical arts and commercially available as indicated in the co-pending application mentioned above. Where such springs are designed to wind themselves upon a spool, as in the present embodiment of the invention, the longitudinal portions of the spring are all stressed to a natural radius smaller than that of the spool upon which the spring is wound, thus providing a constant force or tension in the direction to wind the spring upon the spool, substantially the entire force being at all times exerted by the portion of the spring which is about to be wound on the spool.

Rotatably mounted on a shaft 56 near the right-hand side of the upper end plate 24 is a spool 58, generally similar to the lower end spool 50 except that there is affixed to the upper surface thereof, as by a suitable cement, a gear wheel 60. Wound on the spool 58 is a constant-force ribbon spring 62, of generally similar construction to the spring 52, but differing in certain important respects. The bulk of the length of the spring 62 is pre-stressed to a radius smaller than the radius of the spool 58. However, at the inner end (i.e., the end which is upon the spool), the natural radius of curvature is gradually tapered from the smaller radius to a natural radius of curvature which is slightly larger than the radius of the spool. With this construction, there is obtained a type of one-way clutch action. As shown in Figure 7, when the extending end of the tape 62 is pushed toward the spool, the enlarged natural radius of the

inner end of the tape prevents substantial friction with the spool, so that the spool remains stationary if it has a substantial load. On the other hand, as shown in Figure 8, when the extending end of the spring **62** is pulled upon, the tape is tightened on the spool, and is thus rigidly coupled to the spool after the first instant of pulling motion.

The design of this one-way clutching arrangement is not highly critical in the present structure, the principal requirement being that the natural radius of the spring or tape be tapered from a value smaller than the radius of the spool in the main body of the tape to a value somewhat greater than the radius of the spool at the innermost end of the tape. Since the tape must slide on the spool in one direction and seize the spool in the other direction, it is of course necessary that the surfaces of the spool and the tape be selected to produce a substantial, but not an excessive, frictional engagement. However, for reasons to be discussed later, the coefficient of friction between the members is not highly critical in the present application, it merely being necessary to assure that the surfaces are not highly polished, but on the other hand are not abrasive. In one embodiment of the machine illustrated, the main portion of the tape or spring **62** was pre-stressed with a natural diameter of 1.15 inches, the spool **58** having a diameter of $1\frac{13}{16}$ inches, the tape being of stainless steel and having a width and thickness sufficient to produce a constant force of approximately $\frac{1}{10}$ lb.; in this embodiment, $1\frac{7}{16}$ inches at the extreme inner end was pre-stressed to a natural diameter of $1\frac{7}{8}$ inches, the next $1\frac{7}{16}$ inches of length of the tape being tapered smoothly from a natural diameter of $1\frac{7}{8}$ inches to 1.15 inches, the natural or free diameter of the main portion of the tape. Where the spool **58** is of a material such as molded plastic having a glossy finish, it is desirable that the spool be lined with a suitable semi-friction lining such as plastic electrical tape.

Adjacent to the spool **58** on the upper end plate **24** is an assembly generally designated **64** shown in enlarged detail in Figure 4. The assembly **64** is mounted on an L-shaped bracket or plate **66** having a horizontal portion secured to the plate **24** and a vertical portion extending upwardly from the plate **24**. Supported on the bracket **66** by spacers **68** and **70** is a ferromagnetic plate member **72** of soft iron or similar material. Rotatably mounted on the member **72** by means of a suitable shaft **73** and bearing **74** is a conducting non-magnetic disc **76** of a material such as electrolytic copper or aluminum.

Pivoted at **78** on an extension **80** of the ferromagnetic member **72** is a holder plate **82**, ears **84** being provided on the extension **80** and the holder plate **82** to accommodate the pivot pin **78**, which is secured by fastener nuts **79**. The end of the holder plate **82** opposite the pivot **78** is bent vertical at **88** and has secured thereto a cam follower pin **90** which moves in a slot **92** in the bracket **66** in accordance with pivotal motion of the holder plate **82**. To the under surface of the main body portion of the holder plate **82** is secured, by means of a bolt **94**, a circular multi-pole magnet **96**, the poles of the magnet being alternated in polarity and separated by V-shaped gaps **98**.

The poles being distributed about the periphery of the circular magnet, which is substantially concentric with the axis of rotation of the disc **76**, the magnetic field (completed by the ferromagnetic member **72**) penetrates the disc **76** at points substantially spaced from the axis of rotation. It will be recognized that the assembly of the magnet, the non-magnetic conducting disc, and the ferromagnetic member constitutes a highly efficient structure of the type known as an eddy-current brake having a retarding torque at any given rotational speed which is readily variable by pivoting of the holder **82** with respect to the ferromagnetic plate **72**, thus varying the strength of the magnetic field penetrating the disc **76** and reducing or increasing both the magnetic field itself and the eddy-currents produced by the magnetic field which interact with the magnetic field to produce the braking action.

At the lower end of the shaft **73** is a pinion gear **100** which is coupled to the gear **60** on the spool **58** through a series of gears generally designated **102**, this coupling serving to produce relatively large rotational speeds of the disc **76** from slow rotation of the spool **58**.

Secured to the left-hand end of the upper end plate **24** is a bracket or support **104** in which is journaled the extending end **106** of a shaft **108**, the opposite end of which is journaled in a suitable aperture **110** in the bracket or plate **66**, a spring fastener **112** holding the shaft **108** in proper position. Secured to the inner end portion of the shaft **108** is a cam **114** of a more or less spiral configuration (see Figure 6). The cam follower pin **90** rests on the cam **114**, being held thereagainst by a spring **116** which is wound about the pivot **78** and urges the magnet holder **82** toward the disc **76**. Thus rotation of the shaft **108** varies the retarding force of the brake assembly at any single rotational speed of the disc **76**. To the extending end of the shaft **108** is secured a knob **116** having calibration markings cooperating with a fixed indicator assembly **118** secured to the bracket **104** by screws **120** to produce a calibrated indication of the speed of operation of the device.

The principal features of construction having been described, the mode of operation of the illustrated device will be readily understood. The slide bar **34** is provided with an apertured latch plate **121**. A latch **122** provided with an operating lever **124** is pivoted on a shoulder screw **126** and biased to latching position by a spring **128**. The shutter or line-indicating member **36** is provided with a thumb handle **130** which permits the shutter to be manually raised to its uppermost position, at which the latch engages. When the desired reading material has been placed beneath the device, manual actuation of the latch operating lever **124** releases the shutter **36**, which proceeds downward at a constant speed fixed by the reaching of equilibrium between the constant force exerted by the spring **52** (which is much greater than that exercised by the spring **62**) and the retarding force exerted by the brake assembly **64** (which is thus automatically the same at every equilibrium speed), coupled with the very small frictional losses in the system. Because of the small inertia of the moving parts, equilibrium speed is reached substantially instantaneously. The load on the spring **52** consists almost completely of the retarding force exercised by the brake assembly **64**. Thus the constancy of speed is substantially independent of small differences in friction caused by non-uniformities along the path of the shutter. The nature of the operation of the brake assembly **64** is such as to render its proper operation independent of extraneous matters such as dust or similar difficulties which have been encountered with prior drive mechanisms for devices of the present nature.

Thus the shutter or line indicator **36**, upon operation of the latch release lever **124**, proceeds down the page at a constant speed which is determined by the calibrated rotational position of the knob **116**. This progression continues until the shutter reaches the bottom of the path. The shutter may be stopped at any desired point by the user, or may, if so desired, be manually accelerated, as in by-passing portions of the reading material, such as illustrations; in such cases, the shutter will immediately regain its preset speed upon release, substantially without transient effects. The shutter is returned to the commencement of its stroke manually by the use of thumb handle **130**, and latched in position at the commencement of the stroke. In the downward stroke, the shutter **36** is directly coupled to the brake assembly **64** as set forth above. In the upward stroke, however, produced manually, such direct coupling would

require excessive effort in returning or resetting the shutter at the relatively rapid speed desirably used in such resetting. The one-way clutch structure provided above permits the resetting operation to be carried out rapidly and easily, substantially the only force required being that required to unwind the spring **52**. If desired, the latching mechanism described may be omitted, the shutter merely being positioned by the user at the proper place on the reading material and then released to commence its downward progression. It will be noted, however, that it is not necessary to satisfactory operation that the one-way clutch described be so perfectly constructed that there is no rotation of the upper spool **58** in the resetting operation. In this portion of the operation, if the friction between the upper spring **62** and the upper spool **58** is sufficient to commence rotation of the upper spool, resistance to rotation quickly develops because of the loading imposed by the brake **64** as it is accelerated, and the spring **62** will then commence to slip on the spool. In essence, then, in the return operation, the clutch need not completely decouple the shutter from the brake, but need only act as a slip friction clutch limiting the force or power transmitted through the clutch. This makes the design and fabrication of the clutch relatively simple, since the proper operation does not rely upon critical adjustments, variations in exact design of the clutch showing up merely as barely perceptible differences in the amount of effort required to reset the shutter manually. This slip friction clutch structure offers the additional advantage, as compared with, for example, a pawl-and-ratchet clutch, that it is essentially noiseless, an important feature in many applications of reading-training devices.

By the shaping of the cam **114**, the shutter speed may be made any desired function of the rotational position of the control knob **116**. Compensation of the calibration for slight differences in manufacture, etc., are readily made by a slight adjustment provided for the magnet **96** which is adjustable in a slot **132** in the holder **82** to permit positioning of the magnet with respect to the axis of the disc **76** over a small range and also by rotation of control knob **116** relative to cam **114**.

In Figures 9 through 12 is shown an improved reading-training machine designed to maximize the portability and convenience of use of such devices, and also to minimize their cost without in any way impairing their utility and accuracy. In the device illustrated in these figures, three sides of the reading frame over which the shutter progresses are composed of channel members **134**, **136** and **138**, the fourth side constituting a plate **140** upon which the entire drive mechanism is mounted. A transparent window **142** of, for example, methyl methacrylate, is secured to the under surface of the channels **134**, **136** and **138** over the entire reading frame area, and provides, with the plate **140**, a completely flat bottom surface for the machine. The parts of the mechanism are in general quite similar to those of the machine previously described, and are given corresponding numerals where identical, but the arrangement of the parts is such as to produce a much more compact and inexpensive construction than that previously described, without in any way impairing the performance.

In this construction, the upper spool **58** and the lower spool **50** are so located that the ends of the constant force springs **52** and **62** are tangential to the spools on the innermost side of the spools, rather than on the outermost side as in the previous embodiment. With this construction, the spools are enabled to both be placed on one frame member of the machine, thus minimizing the dimensional addition to the actual reading frame area required to provide space for the drive mechanism. The entire drive mechanism is mounted on one side of the frame, the brake assembly **64** being mounted between the spools **50** and **58**. In the present construction, the calibrated speed control knob also lies between the spools, driving the cam **114** through a short shaft **144**. The construction and mode of operation of the shutter **146** and slide bar **148** are generally similar to those previously described, the thumb handle **150** in this case being integral with the shutter **146** and being at the upper, rather than the lower, edge of the shutter. The entire mechanism is covered by a single hollow cover **152**, the lower portion of which is stepped down at **154** and open at **156** to expose the control knob **143**. A pointer strip **158** attached to the cover serves as a calibration marker.

It will be seen that the machine illustrated in Figures 9 through 12 is far more compact and simple to use than those previously available. The provision of the window **142** eliminates the problems and complexities heretofore introduced by the necessity of holding flat the pages of reading material employed with the machine. The incorporation of the entire mechanism in one side of the machine not only substantially reduces the cost and size, but also provides a form of machine which is easily and readily handled with one hand of the user.

Many modifications and alterations of the invention, far different both in appearance and details of construction from the embodiments herein illustrated but nevertheless utilizing the basic teachings of the invention, will be readily apparent or devised upon study by persons skilled in the art. Accordingly, the scope of the protection to be afforded the invention should not be limited by the particular embodiments illustrated and described, but should be determined from the descriptions of the essence of the invention which appear in the appended claims.

What is claimed as the invention for which patent protection is sought is:

1. In a reading device comprising a line-indicating member and means for driving the line-indicating member downwardly over successive lines of printed material at manually variable constant speeds, the improvement wherein the driving means comprises spools adjacent to the upper and lower ends of the path of the line-indicating member, a first constant-force ribbon spring wound upon the lower spool and having an upwardly extending end portion secured to the line-indicating member, a second constant-force ribbon spring of substantially less force than the first spring wound upon the upper spool and having a downwardly extending end portion secured to the line-indicating member, the inner end of the second ribbon spring having a larger natural radius than the natural radius of the remainder thereof, said natural radii being respectively at least equal to and less than the radius of the upper spool, a rotatably mounted conducting disc coupled to the upper spool, a ferromagnetic member closely adjacent to one side of the disc, a magnet, pivot means supporting the magnet adjacent to the other side of the disc, and calibrated camming means for pivoting the magnet about the pivot means to vary the distance between the magnet and the disc and thus to vary the speed of the line-indicating member.

2. In a reading device comprising a line-indicating member and means for driving the line-indicating member downwardly over successive lines of printed material at manually variable constant speeds, the improvement wherein the driving means comprises a spool adjacent to the lower end of the path of the line-indicating member, a constant-force ribbon spring wound upon the spool and having an upwardly extending end portion secured to the line-indicating member, a rotatably mounted conducting member, means including a one-way clutch coupling the line-indicating member to the conducting member, means for producing a magnetic field through the conducting member, and means to vary the retarding force exerted by the magnetic field at any given rotational speed of the conducting member.

3. In a reading device comprising a line-indicating

member and means for driving the line-indicating member downwardly over successive lines of printed material at manually variable constant speeds, the improvement wherein the driving means comprises a constant-force spring coupled to the line-indicating member to urge the line-indicating member downwardly, a rotatably mounted conducting member, means including a one-way clutch for coupling the conducting member to the line-indicating member, means for producing a magnetic field through the conducting member, and means for varying the strength of the magnetic field to vary the speed of the line-indicating member.

4. In a reading device comprising a line-indicating member and means for driving the line-indicating member downwardly over successive lines of printed material at manually variable constant speeds, the improvement wherein the driving means comprises means for exerting a constant force urging the line-indicating member downwardly, a rotatably mounted conducting member, means including a one-way clutch for coupling the conducting member to the line-indicating member, means for producing a magnetic field through the conducting member, and means for varying the strength of the magnetic field to vary the speed of the line-indicating member.

5. A reading device comprising, in combination, a frame adapted to be placed over printed material, spools at the upper and lower ends of one side of the frame, constant-force springs wound upon the spools and having the ends thereof extending upwardly and downwardly respectively tangentially from the spools on the innermost side of the spools, the lower spring having greater force than the upper, a line-indicating member extending across the frame and secured to the ends of the springs, a conducting disc rotatably mounted on said side of the frame between the spools, a magnet pivotally mounted adjacent to the disc to produce a magnetic field therethrough, a cam coupled to the magnet to move the magnet toward and from the disc, and a gear train interconnecting the disc and the upper spool.

6. A reading device comprising, in combination, a frame adapted to be placed over printed material, spools at the upper and lower ends of one side of the frame, constant-force springs wound upon the spools and having the ends thereof extending upwardly and downwardly respectively tangentially from the spools on the innermost side of the spools, the lower spring having greater force than the upper, a line-indicating member extending across the frame and secured to the ends of the springs, and manually variable retarding means disposed on said side of the frame between the spools and coupled to the line-indicating member.

7. In a reading device comprising a line-indicating member and means for driving the line-indicating member downwardly over successive lines of printed material at manually variable constant speeds, the improvement wherein the driving means comprises means for exerting a constant force urging the line-indicating member downwardly, an eddy-current brake, means including a one-way clutch for coupling the line-indicating member to the brake, and means for varying the retarding force exerted by the brake at any given speed of the conducting member to vary the equilibrium speed of the line-indicating member.

8. A reading device comprising a housing member, spools at the upper and lower ends of the housing member, an elongated flexible member assembly including a constant-force spring, the ends of said assembly being wound on the spools and extending tangentially from the spools on the same side as the line of the axes of the spools, a line-indicating member secured to said assembly and extending therefrom in the direction away from the line of the axes of the spools and a variable braking member coupled to one of the spools and mounted between the spools.

9. A portable reading device having a substantially rectangular uniformly transparent window forming at least a portion of the lowermost surface thereof, a line-indicating member extending across the window and having a straight edge closely overlying the upper surface of the window, guide means at both sides of the window to confine the line-indicating member to motion in a plane closely adjacent to the window and perpendicular to the straight edge, and mechanism including a spring coupled to an end of the line-indicating member to drive the line-indicating member over the window at manually variable constant speeds, whereby the window may be placed over reading material of any desired size and in a variety of positions to hold the reading material flat in closely spaced parallel relation with the plane of motion of the line-indicating member.

10. In a reading device comprising a line-indicating member and means for driving the line-indicating member downwardly over successive lines of printed material at manually variable constant speeds, the improvement wherein the driving means comprises means for exerting a constant force urging the line-indicating member downwardly, a rotatably mounted conducting disc, means for coupling the disc to the line-indicating member, means for producing a magnetic field transversely of the disc, and means for varying the strength of the magnetic field to vary the speed of the line-indicating member, the coupling means comprising members in frictional engagement such as to produce slippage therebetween upon reverse operation of the shutter at speeds greater than the speeds of forward operation, whereby the line-indicating member may be manually returned to the top of its stroke at high speed with a minimum of effort.

11. The device of claim 10 wherein the coupling means are constructed and arranged to produce tighter frictional engagement in the forward direction than in the reverse direction.

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1,977,546	Fornelius	Oct. 16, 1934
2,061,827	Brooks	Nov. 24, 1936
2,188,210	Smith	Jan. 23, 1940
2,265,924	Oerter et al.	Dec. 9, 1941
2,479,965	Ragsdale	Aug. 23, 1949
2,519,882	Bullard et al.	Aug. 22, 1950
2,528,271	Gibbs et al.	Oct. 31, 1950
2,568,577	Alexander	Sept. 18, 1951
2,662,306	McMaster	Dec. 15, 1953
2,662,307	Simpson	Dec. 15, 1953
2,673,694	Howell	Mar. 30, 1954
2,785,587	Lowe	Mar. 19, 1957
2,822,626	Keyes	Feb. 11, 1958