March 3, 1970 J. K. MACOMBER 3,498,700

TACHISTOSCOPE

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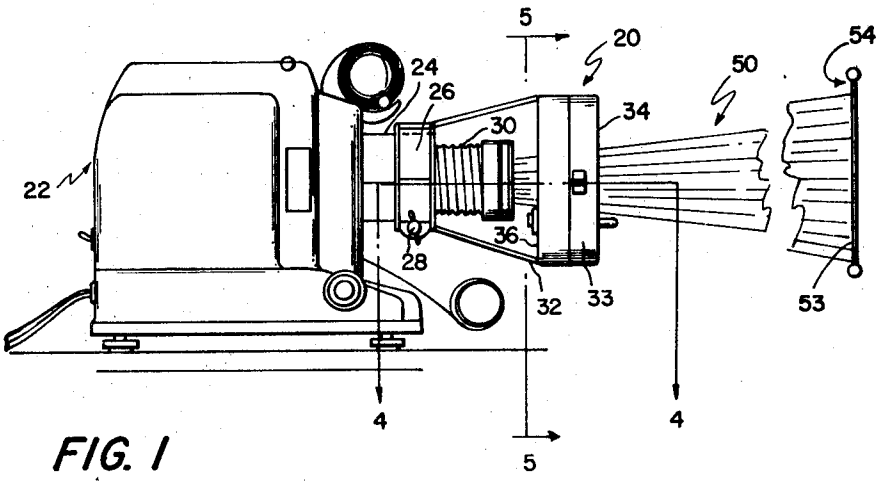


FIG. 1

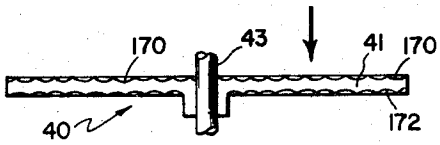


FIG. 3

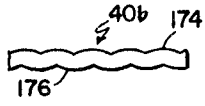


FIG. 3a

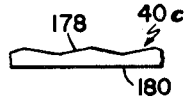


FIG. 3b

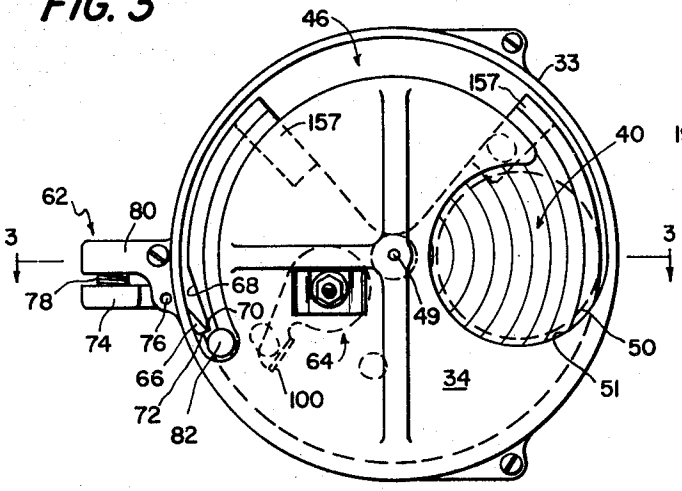


FIG. 2

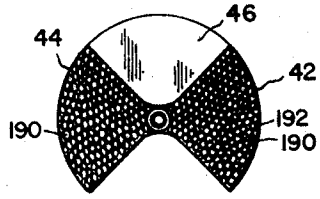


FIG. 3c

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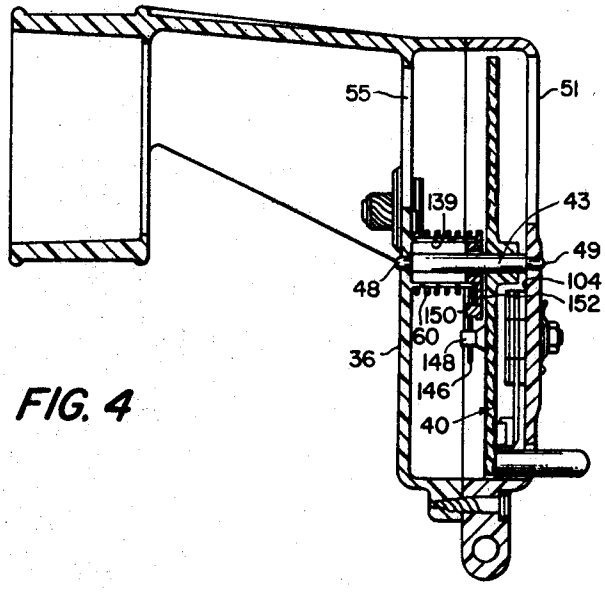


FIG. 4

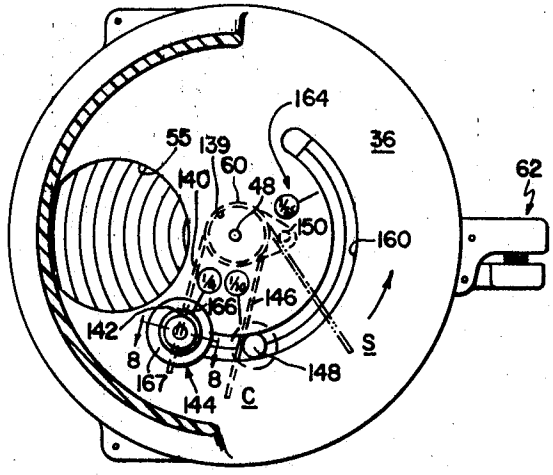


FIG. 5

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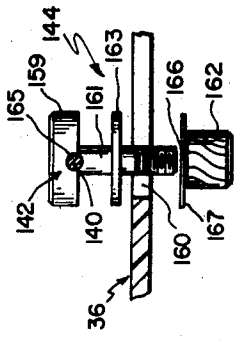


FIG. 8

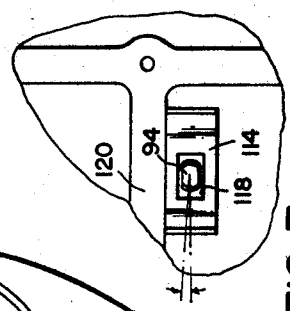


FIG. 7

FIG. 6

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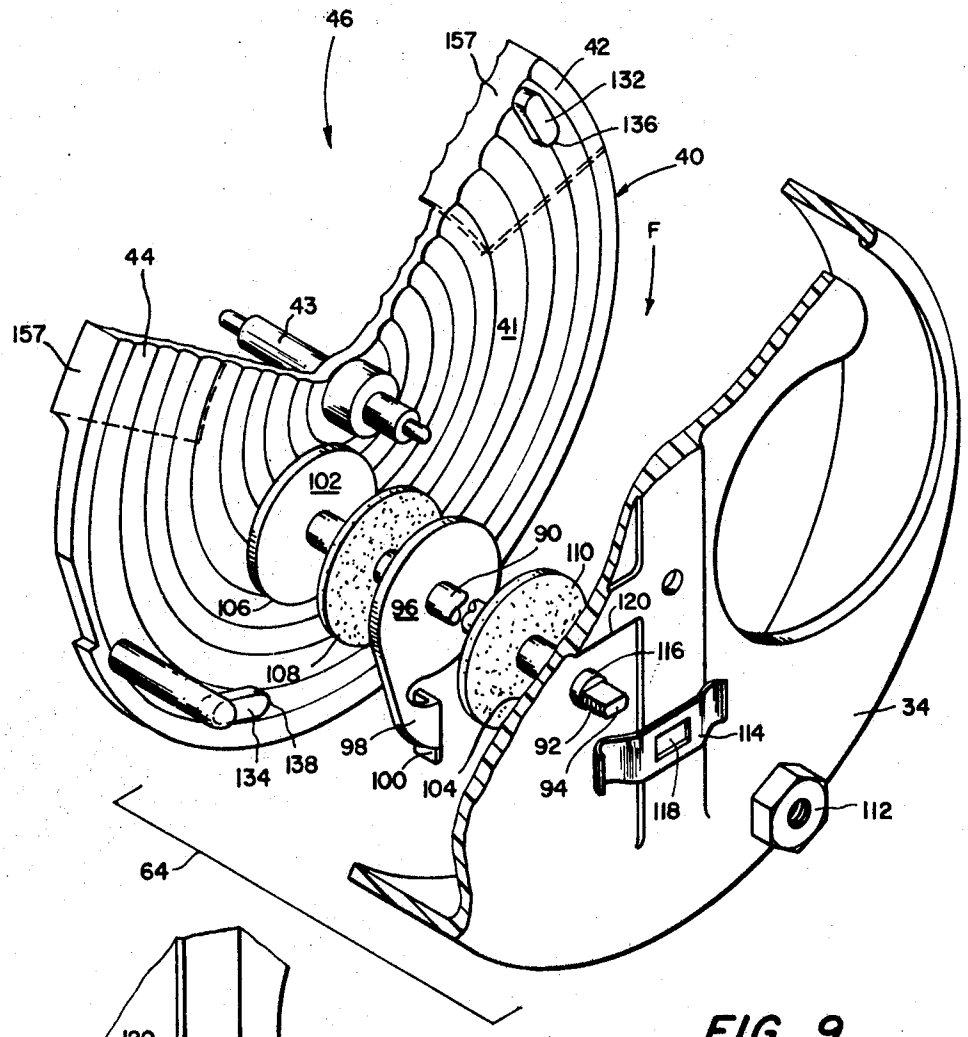


FIG. 9

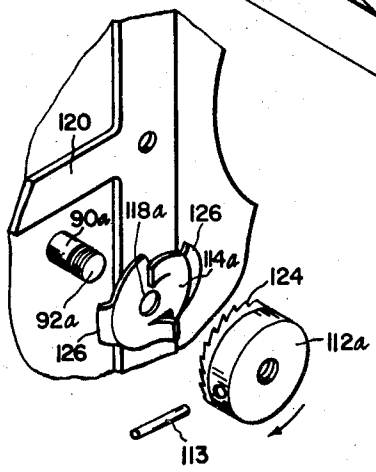


FIG. 9a

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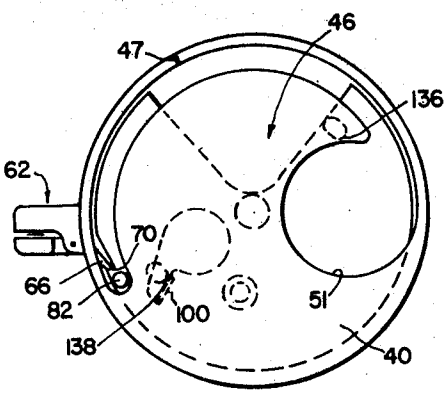


FIG. 10

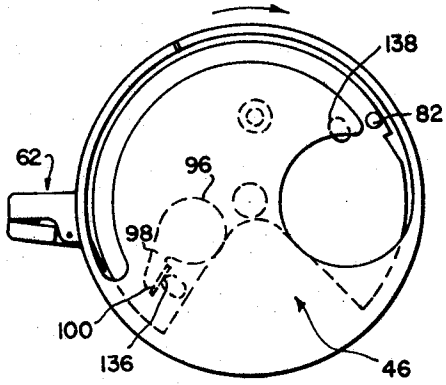


FIG. 13

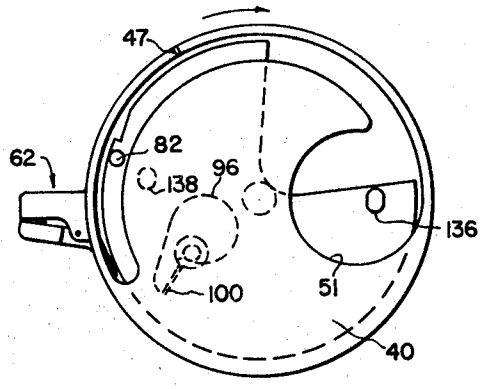


FIG. 11

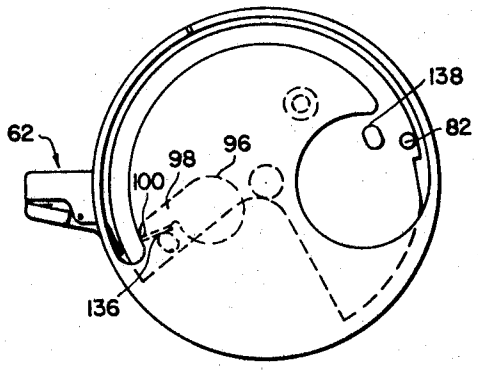


FIG. 14

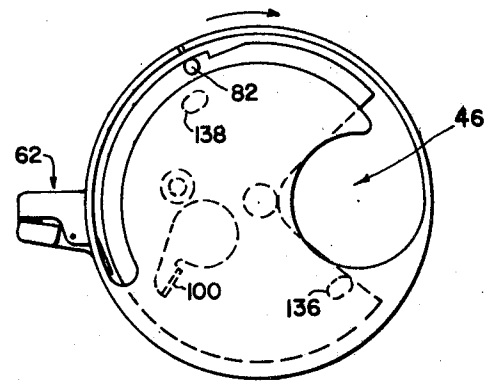


FIG. 12

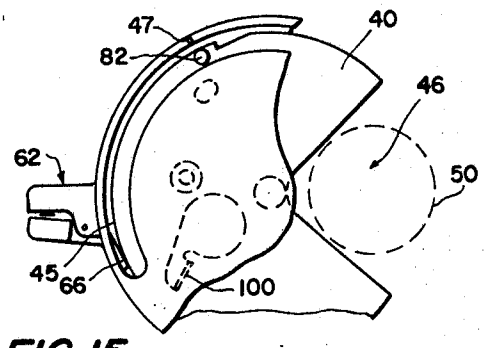


FIG. 15

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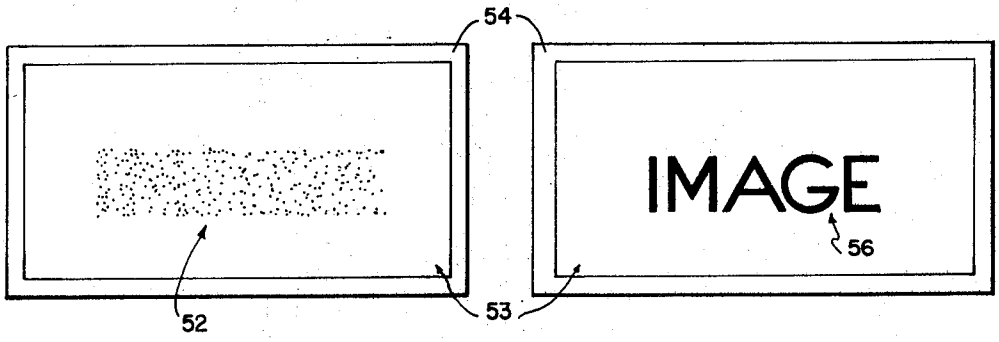


FIG. 16

FIG. 17

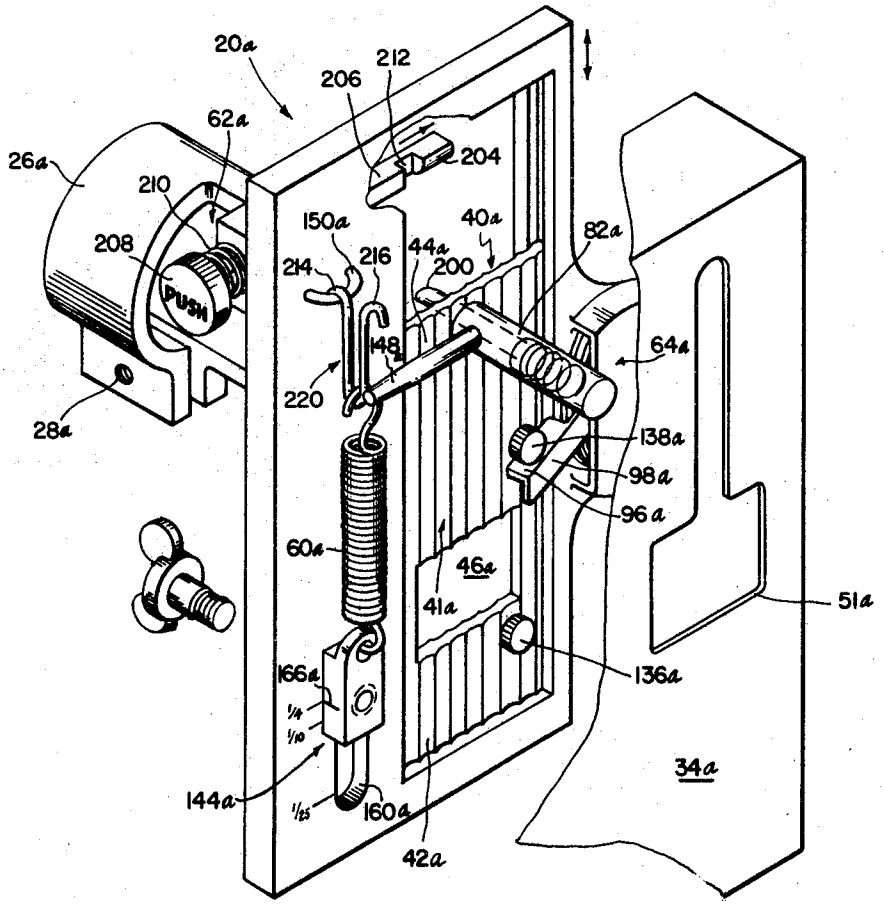


FIG. 18

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United States Patent Office

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Patented Mar. 3, 1970

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TACHISTOSCOPE

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Int. Cl. A61b 3/02
U.S. Cl. 351—31 21 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to tachistoscopes primarily for use as a part of, or an accessory for, a projector adapted to project an image on a projection screen or the like. The tachistoscope of the invention is provided with a scrambler including means to permit passage of the rays of light from the projector to the projection screen with at least one portion of the scrambler having refracting means to refract the rays to scramble the image at the same time permitting the scrambled rays to reach the projection screen to form an unintelligible image, and at least another portion of the scrambler being non-refractive, such as either an open portion or a transparent portion through which an intelligible image is projected on the projection screen.

The tachistoscope has a timing mechanism which may be adjusted to produce a tachistoscopic effect by presenting the unscrambled view on the screen for short intervals of time, let us say between ¼ and 1/25 second.

This invention relates principally to tachistoscopes and the like adapted to expose visual stimuli such as figures, pictures, or words for short intervals of time for purposes in the medical and educational fields that are well known in the arts. For instance, a bright student may read slowly because of slow rate of perception due to "lazy eyes." By testing the student's eyes with a tachistoscope, the teacher is able to detect this defect, and frequent eye exercises, using the tachistoscope, will improve the student's rate of perception and increase his reading speed.

The applicant's invention is particularly concerned with tachistoscopes which are either built into or adapted for use with projectors such as slide, or film strip projectors wherein visual stimuli, projected on a projection screen by light rays from the projector, are exposed for brief periods by said tachistoscope which is interposed in the light ray path, usually between the objective lens of the projector and the projection screen.

A simple example of such a tachistoscope would be an ordinary shutter which would completely block the light rays forming the beam of the light ray path at all times except when the shutter is open. The shutter speed could then be adjusted for flashing the visual stimuli on the projection screen for any interval desired, within the optimum range of ¼ to 1/25 of a second, or any other desired interval. Such a shutter type tachistoscope which goes from complete darkness to light and then to darkness again has the disadvantage of allowing the image of the visual stimulus to persist for a longer time on the retina of the eye of the viewer due to overloading the retina by temporarily allowing too much light to be received in the extreme contrast from dark to light. This persistence of the image defeats the purpose of the tachistoscope by both permitting the image to be retained on the retina and also by confusing the viewer. To shorten the time of image retention, improvements have been made in the art by providing a mechanized cam arrangement. The objective lens was focused in a focusing mount including a cam follower sitting in a cam dwell

with the lens in focused position. The lens was then moved out of focus by moving the cam follower out of the cam dwell. The tachistoscope operated by mechanically seating the cam follower back in the cam dwell for the desired fraction of a second and then moving it out again. This projected the material on the screen in focus for the desired period of time and out of focus before and thereafter. This construction and method had the advantage of providing illumination throughout the tachistoscope run eliminating retinal overload and image persistence.

This blur to focus system still had two disadvantages. First, since there was a certain amount of blurred readability before and after the focus period, eye strain was caused by the viewer attempting to focus his eyes on an image while it is still in a blurred state. Second, since the intelligence of the stimuli should be conveyed to the viewer only during the focus period and since the blurred intervals increased the time when the viewer could recognize the image, this method had the effect of extending the recognizable exposure period before and after the time interval when the image was in focus.

It is, therefore, an object of this invention to provide a tachistoscope for a projector which will provide for substantially constant intensity of illumination on a projection screen before, during, and after the image projection.

Another object of the invention is to project a tachistoscope image which is always in focus when discernible.

It is also an object of this invention to provide a light ray scrambler as a component of the tachistoscope to be interposed in the light ray path between a projector and a projection screen, adapted for movement through said light ray path to present refracting portion means to scramble the light rays and non-refracting portion means to permit said light rays to reach the projection screen for the desired exposure.

It is another object of the invention to provide means to adjust the exposure time of the image to conform with exposure times usually utilized in tachistoscopes.

It is also an object of this invention to provide a smooth, positive, braking mechanism with automatic change of friction force to stop the scrambler motion, without noticeable bouncing at either slow or high speeds, after image exposure.

Another object of the invention is to provide a scrambler which renders the words or other material in the image completely unintelligible without changing the intensity of illumination appreciably on the projection screen.

A further object is to provide a scrambler which changes the image to a gray area indicating to the viewer the spot where the image is going to appear.

Another object of the invention is to maintain the area of illumination and the intensity of light in the projected area on the screen as nearly constant as practical by scrambling the image in the direction of the longest dimension of the projected area.

Another object is to provide a triggering device which is operated by squeezing two elements between the thumb and forefinger. This action applies no unbalanced force or torque to the tachistoscope since the forces between the thumb and forefinger are balanced. There is, therefore, no danger of the operator moving the projector and thereby disturbing the image during exposure.

It is another object of this invention to provide a tachistoscope which will be simple to operate, and which may be attached to existing projectors or designed into new projectors.

Further objects and advantages will appear in the specification hereinbelow.

The invention is illustrated in the accompanying drawings in which:

FIG. 1 is a side elevation of a projector system including a tachistoscope of the invention and the representation of a light ray pathway and a screen with the light ray pathway broken to save space;

FIG. 2 is a front elevation of the tachistoscope only, with parts in phantom;

FIG. 3 is a sectional view of the scrambler of the tachistoscope as seen along the lines 3—3 in FIG. 2, with a portion of its shaft shown in full line; the sectional view does not have the usual cross hatching in order not to confuse the configuration of the surfaces **170** and **172**, it being understood that surface **170** and surface **172** are the outer surfaces of the scrambler **40** shown in FIG. 3, and that the clear space between surfaces **170** and **172** is in section, the arrow in the figure representing the direction of the light ray path through the position of the scrambler;

FIG. 3A is a portion of a view similar to FIG. 3 showing a section through a scrambler having surfaces **174** and **176** with the clear space between the surfaces being considered in section;

FIG. 3B is another view similar to FIG. 3A showing a scrambler having a different cross sectional configuration with the clear space between surfaces **178** and **180** considered as being in section;

FIG. 3C is a front elevation of another form of scrambler;

FIG. 4 is a sectional view along the lines **4**—**4** in FIG. 1;

FIG. 5 is a sectional view along the lines **5**—**5** in FIG. 1;

FIG. 6 is an exploded perspective view with parts cut away;

FIG. 7 is a detail in front elevation;

FIG. 8 is a sectional view along the lines **8**—**8** in FIG. 5 with the clamp nut portions shown in plan;

FIG. 9 is an exploded perspective detail showing the brake assembly;

FIG. 9A is a detail in exploded perspective of FIG. 9 showing another form of construction for a portion of the brake assembly;

FIGS. 10 through 14 are front elevations, with parts in phantom, illustrating positions of the scrambler of the tachistoscope and associated parts starting from the first position of rest or cocked position as shown in FIG. 10 and continuing to the second position of rest as shown in FIG. 14;

FIG. 15 is a detail view similar to that shown in FIG. 12 illustrating the trigger mechanism holding the scrambler at a fixed position;

FIG. 16 is an elevational view of a projection screen with a scrambled image projected upon it;

FIG. 17 is an elevational view of a projection screen similar to FIG. 16 with the image in focus projected upon it; and

FIG. 18 is a perspective view of an alternate form of the invention.

Similar numerals refer to similar parts throughout the several views.

The tachistoscope of this invention is provided with a main frame or housing **20** which may be incorporated into the housing **22** of the projector. It is to be understood that main frame **20** can be integral with the main housing **22** of the projector, or it may be supplied as a separate frame adapted to be attached to the projector housing **22** as shown in the drawings accompanying this specification. Reference to FIG. 1 shows frame **20** attached to the outside of objective lens barrel support **24** by means of a split collar **26** having a screw fastener **28** to clamp the collar **26** around the lens barrel support **24**. The main frame **20** of the tachistoscope is positioned in front of the objective lens barrel **30** of the projector, and is attached to collar **26** by connecting means such as side bracket **32** as shown in FIG. 1, or by any other suitable means (such as bracket arms) between the collar **26** and the main frame **20**.

The main frame **20** may be of any suitable size or shape adapted to hold the various elements of the tachistoscope. It is illustrated in the drawings as having a peripheral wall **33**, a front wall **34** and a rear wall **36**. At present, it is preferred to manufacture the housing **20** out of a high impact plastic by any suitable molding means. However, it may be made of wood or metal or any other suitable material.

Element **40** is a scrambling means generally referred to as the scrambler of the invention. It is comprised of at least one refracting portion **41**, and a non-refracting portion **46**. The refracting portion **41** is designated as having two areas **42** and **44** on both sides of the non-refracting portion **46**. These may be two areas **42** and **44** of one portion **41** as shown in FIGS. 6 and 9, or may be two separate portions as shown in FIG. 3C. The non-refracting portion **46** may be clear (free from any material) as in FIGS. 6 and 9, or a transparent material as shown in FIG. 3C.

In the preferred form of the invention as illustrated in FIGS. 1 through 17 of the drawings, the scrambler **40** on shaft **43** is adapted for rotation on two journal bearings **48** and **49** positioned with a rotational axis parallel to the optical axis of the objective lens in the objective lens barrel **30**. Bearings **48** and **49** are offset with relation to the optical axis of projection lens barrel **30** a distance sufficient to permit both the refracting areas or portions **42** and **44** and non-refracting portion **46** of the scrambler **40** to be interposed across, or transversely through the light ray path **50** as shown in FIG. 1 of the drawings, and as designated by the dotted line circle **50** in FIG. 2 of the drawings. Openings **51** and **55** are provided in the main frame **20** to permit the light ray path **50** to pass through the frame **20**.

Thus, as scrambler **40** moves, or rotates on its bearing means **48** and **49**, refracting portion **42**, non-refracting portion **46** and refracting portion **44** may be passed successively transversely across the light ray path **50**. The refracting portions **42** and **44**, as will be more fully explained hereinbelow, act to scramble the light rays in the light ray path **50** to present a gray scrambled area **52** (FIG. 16) in place of the normally focused image **56** (FIG. 17) in the bright projected area **53** on the projection screen **54**. When the non-refracting portion **46** replaces the refracting portion **42** in the light ray path **50**, the image **56** will appear in focus and clearly visible on the projection screen **54**. It is the scrambler **40**, therefore, that is the heart of the invention inasmuch as it permits a clear exposure during the period when the non-refracting portion **46** allows the light ray path **50** to reach the screen uninhibited, and yet it renders the image **56** completely unintelligible to the observer as a gray area **52** before and after the period of exposure when the refracting areas or portions **42** and **44** respectively scramble the light rays. This is accomplished by the scrambler **40** of the invention without blurring the focus of the image before, during, or after exposure and without varying the intensity of illumination on the projection screen before, during, and after exposure as will be more fully explained hereinbelow.

OPERATION

The movement of the mechanism in the preferred form represented in FIGS. 1 through 17 is accomplished by spring means **60** which acts to force the scrambler **40**, from an initial or first position of rest as shown in FIG. 10 of the drawings, to rotate in the direction of the arrow shown in FIGS. 11 to 13, until the scrambler **40** reaches a second position of rest as shown in FIG. 14. The scrambler **40** is held at its first position of rest (as at FIG. 10) by means of a trigger assembly **62** which holds the scrambler **40** against action of spring **60** and after the scrambler **40** moves, it is stopped at the second position of rest by the brake assembly **64**.

The trigger assembly **62** comprises detent means such as a trigger foot **66** adapted to fit into a detent receiver

or receiving means **68** on the scrambler **40** (FIG. 2). The detent receiving means **68** has a stop **70** which is adapted to cooperate with a toe portion **72** of the trigger foot **66** to define the first position of rest of the scrambler **40**. The position of detent receiver **68** on scrambler **40** is determined by placing it, with relation to trigger means **62**, to provide for scrambler means **40** to be in first position of rest as shown in FIG. 10 of the drawings when toe **72** abuts stop **70**. Trigger foot **66** is attached to an element such as arm **74** which is pivoted at pivot point **76** to an element such as stationary arm bracket **80** at a position on peripheral side wall **33**. Movement of arm **74** on pivot **76** will remove toe **72** from stop **70** and permit spring **60** to move scrambler **40** from first position of rest toward second position of rest. Arm **74** is continuously spring urged by spring **78** which is seated against arm **74** and bracket arm **80**. Thus, arm **74** may be urged toward bracket arm **80** by pressing the thumb and a finger of the operator's hand against both parts respectively to start the device by removing toe **72** from stop **70**. Foot **66** may also act as a brake for the mechanism during the resetting motion when the operator moves the scrambler **40** back from second position of rest as shown in FIG. 14 to cocked, or first position of rest as shown in FIG. 10. This braking action results from foot **66** being spring pressed against a periphery portion **45** of scrambler **40** as shown in FIG. 15 which will prevent any drifting movement of the scrambler **40** if the hand pressure of the operator is removed. A reset handle **82** is provided to aid in resetting the device and to return the scrambler **40** to first position of rest.

As shown in FIG. 15, the trigger foot **66** holds the scrambler at periphery **45** with non-refracting portion **46** across the light ray path **50**. This position can be ascertained by moving reset handle **82** to position marker **47**. Foot **66** is provided as a convenience to permit the operator to place the device positively in this position for purposes of focusing, or for purposes of explanation to viewers, at a time when the image is focused on the projection screen for a period of unlimited exposure.

BRAKE ASSEMBLY

After the device is triggered by the operation of trigger assembly **62** and the scrambler **40** is accelerated up to speed, the scrambler **40** must be stopped (after exposure of the non-refracting portion **46**) at a second position of rest with refracting area **44** in the light ray path **50**. This is accomplished by means of the brake assembly **64**. Brake assembly **64** comprises a round shaft **90** having a threaded end portion **92** with a rectangular or keyed cross section **94** and a headed portion **106**.

The brake assembly further comprises acting friction brake element **96** which includes a striker arm **98** having a striker portion **100**, as well as reacting friction brake elements **102** and **104**. Element **102** is the inside surface of shaft head **106**, and element **104** is the inner side of wall **34**. The heart of the brake assembly **64** is the acting element **96** and the reacting elements **102** and **104**. A brake comprising these three elements would work satisfactorily. However, in order to improve the action of the brake as well as the wearing qualities of the brake, I provide discs **108** and **110** of a friction brake material which will lie around shaft **90** and between elements **96**, **102** and **104** as shown in FIG. 9 of the drawings in exploded relationship.

These elements are assembled on shaft **90**, and are pressed against inner side **104** of wall **34** and held by headed portion **106** of shaft **90** against inner side **104** of wall **34** when nut **112** is fastened to threaded portion **92** of shaft **90** against spring **114**. Shaft **90** and its threaded portion **92** fit through opening **116** in wall **34**. Spring **114** has a central rectangular or keyed hole **118** adapted to fit rod end **94** with some lost motion. Spring **114** is also seated snugly against rib **120** on outside of wall **34** to prevent it from rotating. The scrambler **40** is provided with striker means **132** and **134** having end portions **136** and **138** respectively, adapted to strike the striker portion **100** of acting brake striker arm **98**. This may be in the form of a single means having ends **136** and **138** in a proper position on the scrambler **40**, or it may be in the form of separate lugs **132** and **134** as shown having the proper end portions **136** and **138**, or the striker means on the scrambler may be attached to the scrambler **40** in any manner suitable to the operation of the invention. In FIG. 9 of the drawings, the device is shown in cocked position at its first position of rest, ready to be triggered, similar to the position of FIG. 10. After triggering, the scrambler **40** moves in the direction of the arrow F in FIG. 9. The extent of movement of the scrambler **40** will be approximately one-half of a revolution. As the scrambler **40** reaches the end of its forward motion (FIG. 13), striker end **136** of lug **132** will engage strike portion **100**, moving striker arm **98** to cause the braking action. It is at this moment that the lost motion provided between elements **94** and **118**, as indicated by double headed arrow in FIG. 7, comes into play, as follows:

LOST MOTION

The tachistoscope is designed to be run at different speeds to provide for different exposures such as between $\frac{1}{25}$ of a second and $\frac{1}{4}$ of a second. The kinetic energy of the rotating scrambler **40** varies as the square of its velocity. There is, therefore, a vast difference in kinetic energy at the rotational speed which produces an exposure of $\frac{1}{25}$ of a second compared to that which produces an exposure of $\frac{1}{4}$ of a second. The brake must be powerful enough to absorb the energy at the high speed without bouncing the scrambler **40** to an undesirable extent. A brake setting at the same friction would not be sensitive enough to act most efficiently at the lower speeds.

Reference to FIG. 10 of the drawings will show the tachistoscope in cocked position. At this point, the brake has been reset and the lost motion between shaft end **94** and opening **118** in spring **114** has been taken up in a counter-clockwise direction. The trigger is operated to start the device, and the scrambler **40** rotates in a clockwise direction as shown by the arrows in FIGS. 11, 12 and 13 of the drawings until striker end **136** of the scrambler strikes strike portion **100** of arm **98** of acting friction brake element **100**, thereby causing acting element **100** to rotate in a clockwise direction.

Until the lost motion as illustrated in FIG. 7 (see double headed arrow) is taken up, reacting element **102** will rotate with acting element **96** together with shaft **90**. During the taking up of the lost motion, friction occurs between acting element **96** and reacting element **104**. After the lost motion is taken up, shaft **90** can no longer rotate, and twice the friction will be generated because reacting element **102** will be held motionless and friction will be generated by further movement of acting element **96** between it and both reacting element **102** and reacting element **104**. Thus, the full friction of the brake is developed after the lost motion is taken up and only half of the friction is developed during the take-up of the lost motion. Thus, the lost motion feature makes is possible to automatically double the brake friction at high speeds compared to the brake friction generated at low speeds. If the whole friction was operative at all times, the bouncing would be more apparent at low speeds because the parts would spring more. As was said previously, the lost motion is taken up in the reverse or counter-clockwise direction when the scrambler is reset for its next operation.

Small lightweight projectors may be easily tipped over by an unbalancing force in resetting the scrambler. It is, therefore, important to keep the resetting force as small as possible when using lightweight projectors. While resetting the mechanism with the right hand, if the projector starts to tip, the natural reaction of the operator

is to grab the top of the projector housing with the left hand. Since the top of the housing may be hot, the operator might be burned. In FIG. 9A of the drawings, I show a modification to the brake mechanism which permits resetting with less force. In this form of the brake mechanism, there is a shaft **90***a* which has a circular end **92***a* and a serrated nut **112***a* which is held firmly against rotation about shaft **90***a* by means of a pin **113**. A spring **114***a* similar to spring **114** except that it has a circular opening **118***a*, is held against rotation by rib **120**. Ratchet teeth **124** in nut **112***a* prevent rotation of the nut against pawls **126** in spring **114***a* in the direction of the arrow in FIG. 9A. However, the ratchet teeth **124** permit the nut **112***a* to be rotated in the opposite direction.

With the type of brake assembly illustrated in FIG. 9 of the drawings, the full friction of the brake is exerted during resetting after the lost motion is taken up. With the type of brake mechanism illustrated in FIG. 9A, only half of the friction of the brake is exerted during resetting after the lost motion is taken up. The ratchet action of the form in FIG. 9A permits the resetting, therefore, with less force than would occur without the ratchet action. When the mechanism is again triggered, the ratchet teeth **124** will hold the shaft **90** in proper position for braking action to stop the scrambler **40** at the end of its forward movement.

SPRING OPERATION

Reference is now made to FIG. 5 of the drawings to describe the action of spring **60**. Spring **60** is a helical spring disposed around shaft housing **139** and having a first tail or end **140** connected to seat means **142** in a speed adjustment assembly **144**. The other end or tail **146** of spring **60** bears against a pin **148** on the scrambler **40**. Thus, when the device is in cocked position as shown in FIG. 10, the spring **60** will be in position around shaft housing **139** with one end **140** seated in the speed adjustment assembly **144** affixed to a wall such as wall **36** of the frame **20**, with the other end **146** of spring **60** being urged against pin **148**, as shown at C in FIG. 5. There is another stop pin **150** fixed to a bracket **152** on the inner side of the shaft housing **139**. Shaft housing **139** is connected to the main frame **20** at wall **36**.

Because the stop pin **150** is so mounted, it is in effect fixed with relationship to the main frame **20** whereas pin **148** will rotate with scrambler **40**. Because of this relationship of construction, when scrambler **40** has rotated in the direction of the arrow to a point where pin **148** and pin **150** are both engaged by spring end or tail **146**, as at S in FIG. 5, stop pin **150** will stop further circular movement of spring tail **146** and scrambler **40** will continue to rotate with pin **148** now free of any further urging by spring end **146**. Thus, from the point of triggering until the point that spring end **146** reaches stop pin **150**, the scrambler **40** will be continuously accelerated from a dead stop, and from that point on will continue its movement subject to being decelerated by the small forces of friction from the bearing means **48** and **49**. I provide gravitational balance means, such as weighted portions **157** (as shown in FIG. 9), to counteract these small forces of friction, to maintain substantially constant rotational velocity until the scrambler **40** is stopped by the brake **62**.

EXPOSURE TIME ADJUSTMENT

The exposure (i.e. the time during which the clear non-refracting portion **46** of the scrambler **40** permits the image **56** to be viewed, unscrambled, on the screen) is of critical importance. The time of this exposure will be a fraction of a second. In the preferred form of the invention, the exposure time range from ¼ to 1/25 second. This range may, of course, be increased. The device has an exposure time adjustment **144** which is constructed as follows. Spring seat **142** (shown in detail in FIG. 8) is, in fact, in the form of a bolt head **159** held in place through an elongated opening **160** in wall **36** by means of a clamp nut **162**. There is a bolt shaft **161**, a washer **163** and a hole **165** through the bolt where the head **159** and the shaft **161** join. End **140** of spring **60** fits into hole **165**, for seating, and because hole **165** is partially in head **159** and partially in shaft **161**, the washer **163** will clamp spring end **140** firmly in place when clamp nut **162** is tightened.

Opening **160** describes the arc of a circle on a radius from the axis of bearing means **48**. When spring seat **142** holds spring end **140** at a position as shown in FIG. 5 of the drawings, the device will be at its slowest speed or set to give an exposure time of ¼ of a second. As spring end **140** is reset to different positions along the circle described by curved opening **160**, the tension of spring **60** will be progressively increased thereby increasing the acceleration of scrambler **40** so that the greater the spring tension, the greater the speed of the scrambler **40** thereby shortening the exposure time.

I have, therefore, provided a scale designated by reference numeral **164**. There is a pointer **166** on another element such as a washer **167**, held in place by clamp nut **162**, to show the operator of the device the various points along the scale **164** on curved opening **160** at which the clamp nut arrangement may be fixed to set the spring **160** for the speeds of the device. Scale **164** shows the designation ¼, 1/10 and 1/25. Any other scale of speeds may be used. This scale is calibrated at the factory or elsewhere by using a spring of known strength which will operate the device at ¼ of a second when shown in the position of FIG. 5 of the drawings, and then actually checking the device against performance for the other positions of the scale. Any calibration means known to the art may be used.

THE REFRACTING FEATURE OF THE SCRAMBLER

The scrambler **40** contains refracting portion **41** with areas **42** and **44** and non-refracting portion means **46**. The refracting portion **41**, when viewed in cross section as shown in FIG. 3 of the drawings, shows a lens-like arrangement which, when placed in the path **50** comprising the light rays from the objective lens (see arrow in FIG. 3), will change the direction of the light rays in said light ray path. When this is done, a visual image **56** on a screen, which would be in focus and unscrambled without the interposition of a refracting portion **41** (or its areas **42** or **44**), will become scrambled as in FIG. 16, and completely unintelligible to the viewer. For example, if the visual stimuli were a series of letters or a word **56** as shown in focus on a screen in FIG. 17, the interposition of the refracting portion **42** of the scrambler **40** across light ray path **50** would give the projected image the appearance as shown at reference numeral **52** in FIG. 16 of the drawings. Both effects, that as shown in FIG. 17 and that as shown in FIG. 16 would be obtained with the objective lens in a position to provide an exact focus of the projected image **56** on a projection screen **54**. Thus, the change in image **56** is accomplished while the apparatus is always in a position of exact focus. Rendering the focused image **56** unintelligible, as at **52**, is accomplished by the deflection of the rays **50** with the refracting mechanism of the refractor **42** with the balance of the projection mechanism being in proper position for exact focus.

The result is that the viewer will see an illuminated screen **54** having a generally grayish area **52** where the image should be, when a refracting portion is across path **50**. This will momentarily resolve into a sharply focused image **56** with substantially the same screen illumination when the refracting portion is away and clear of path **50**. The image **56** will then dissolve into a generaly grayish portion **52** again on white area **54** with the same intensity of screen illumination when the refracting portion **44** comes across the path **50**.

Where the image **56**, projected, is a word or words, these will appear as black words on a white background as shown in FIG. 17 of the drawings during the exposure, starting as a grayish area **52** as seen in FIG. 16 when the tachistoscope is in cocked position, appearing in sharp focus **56**, of FIG. 17, during the exposure, and then dissolving again into the grayish area **52** of FIG. 16 after the exposure. There will be no discernible change of light intensity before, during and after the exposure, and there will be no blur due to de-focusing immediately before and after the exposure. The viewer will, however, see a gradual appearance at the beginning of the exposure and a gradual disappearance at the end of the exposure while it is always in exact focus.

When the image of this invention is caused to appear, there is no focus from a blurred, out-of-focus position which would strain the eye attempting to focus on a blurred image. The exposed image **56** produced by the tachistoscope of the invention is increased in intensity by successively allowing the light rays to assume their normal paths by moving the refracting part of the scrambler away from the path of the light beam. The reverse procedure is used to cause the image to disappear. When intelligible, the image is always in focus but varies in intensity from zero to maximum and back to zero. No physical eye effort is necessary to adapt to the transition from the gray area **52** to the image **56** and vice versa. In other methods, which depend upon moving a lens along the beam axis to blur out the image, the image is shown in various degrees of blur while coming into and departing from view. Eye strain caused by the viewer attempting to focus his eye on a blurred image is eliminated in applicant's device.

REFRACTING LENS MEANS

The refracting portion **41** of the circular type of scrambler **40** as illustrated in FIGS. 3 and 9 of the drawings (or **41***a* as illustrated in FIG. 18 of a second form of the invention to be described hereinbelow), may comprise a lenticular lens means. In this specification and in the claims appended hereinbelow, the term "lenticular lens" is defined to mean a lens having refracting surfaces other than surfaces of spheres. In FIGS. 3 and 9 (and in FIG. 18), the lenticular lens shape in cross section comprises a plurality of concave elements in each surface **170** and **172** (as shown in FIG. 3) in offset relationship. This is the preferred form of lenticular lens for use with the invention. There are many other forms of lenticular lenses which will perform satisfactorily. For example, in FIG. 3A, I show the cross section of a scrambler **40***b* in which surfaces **174** and **176** are substantially parallel and have a plurality of offset convex surface shapes. In FIG. 3B, I show a section of a scrambler **40***c* in which surface **178** has a plurality of prism shaped portions and surface **180** is planar.

The lenticular lens illustrated in the drawings are a small sample of the total number of lenses that can be designed for use with the invention. For example, the lenses shown in the drawings have a plurality of parallel elements. A lenticular lens suitable for the invention may be comprised of only one convex or concave or prism-like element.

In FIG. 3C of the drawings, I show another form of refracting means. Referring to scrambler portions **42** and **44** in FIG. 3 will show a series of spherical lens elements **190** with the space **192** between the spherical elements **190** being rounded to be non-planar. The form of refracting means for a scrambler produced by elements **190** on a surface **192** should not be confused with the lenticular lens means just described. Although the form shown in FIG. 3C will work satisfactorily for a tachistoscopic effect to obliterate the image **56** in accordance with the invention, the lenticular form as described above and as illustrated in FIGS. 3, 3A and 3B has two additional advantages. First, it produces a smaller enlargement of the illuminated area, and second, it produces an unintelligible gray area as illustrated by reference numeral **52** in place of the image **56** when scrambled.

By scrambling the letters of a word in the direction of the longest dimension of the word, multiple images of a given letter, due to refraction, are super imposed over the adjacent letters on both sides. This makes the letters unintelligible. If the letters are only scrambled in the other direction, ghost-like images which might be intelligible might appear in the spaces above and below the word. Thus, the lenticular lens of the invention is adapted to scramble the word image in the direction of its longest dimension. The preferred deflection is an amount equal to 2 letter spaces on each side of a given letter.

In FIG. 18 of the drawings, I show another form of the invention. This form is substantially similar to the form shown in FIGS. 1 through 17 except that the scrambler **40***a* with its refracting means **41***a* moves the reciprocal translation in the direction of the double headed arrow in FIG. 18 instead of in a rotary direction. Some of the components of the form of invention in FIG. 18 have been labeled with reference numerals suffixed by the letter "*a*," and unless some special explanation is given herein, it is to be assumed that these parts function in a similar manner to the parts of FIGS. 1 through 17 having the same reference numerals without the suffix "*a*." For example, the scrambler **40***a* has refracting portion **41***a* which is comprised of an area **42***a* and an area **44***a* with a non-refracting portion **46***a*.

In FIG. 18 the scrambler is shown at its second position of rest. It is cocked by moving operating handle **82***a* upwardly. Operating handle **82***a* has a spring loaded detent end **200** which is adapted to be cammed inwardly into handle **82***a* by setting-cam surface **204** of trigger rod **206**. Thus, when handle **82***a* is pushed upwardly as far as it will go, end **200** will be cammed around and rest on the end of trigger rod **206** placing the device of FIG. 18 in cocked position. Trigger rod **206** is part of a trigger assembly **62***a* which has a push button **208** acting against a spring **210**. Trigger rod **206** has a cutout opening **212** which is offset to end **200** when the device is in cocked position, but is in line with opening **212** when the trigger button **208** is pushed in moving trigger rod **206** in the direction of the arrow. This results in triggering the device so that it may move from a first position of rest to a second position of rest as shown in FIG. 18. This operational movement is accomplished by both the forces of gravity and the force of spring **60***a* and is resisted by friction approximately equal to the force of gravity. Spring **60***a* acts between a speed adjustment assembly **144***a* and the scrambler **40***a* through a connecting bar **148***a* which serves a purpose similar to element **148** on the scrambler **40**. There is a stop means **150***a* mounted on the main frame **20***a* which serves the same purpose as stop **150** in the form of the invention shown in FIG. 5 of the drawings. In other words, it limits or stops the spring action against bar **148***a* when hook **214** engages stop means **150***a*. Connecting bar **148***a* has, up to this point, been engaged by hook **216** to spring urge it downwardly. When hook **214** is stopped, hook **216** stops with it because both hooks **214** and **216** are part of a U-shaped system **220** which is attached to spring **60***a*. Thus, when the device of FIG. 18 is in cocked position, connecting bar **148***a* will be within the turn of hook **216**. As the trigger button **208** is pushed, the scrambler **40***a* will start moving downwardly under spring pressure until hook **214** engages stop **150***a*. Then bar **148***a* and its scrambler **40***a* will continue to move downwardly without spring assistance.

There is also a brake assembly **64***a* having an acting friction brake arm element **98***a* with a strike portion **96***a* which is hit by striker edge **138***a* to institute braking action which is similar to the braking action of the brake as-

sembly **64** in the first form of the invention. Striker end **136***a* will act to reset the brake in the same manner when the device is moved back to first or cocked position.

I claim:

1. A tachistoscope comprising a main frame including a light ray pathway, scrambling means including at least one refracting portion and at least one non-refracting portion movably positioned substantially transverse the light ray pathway, together with means to move said scrambling means from a first position of rest with a refracting portion interposed in said light ray pathway to a second position of rest with a refracting portion interposed in said light ray pathway, said non-refracting portion traversing said light ray pathway for an interval of time between said first position of rest and said second position of rest of said scrambling means, and spring means acting between the scrambling means and the main frame for spring urging scrambling means from the first position of rest to the second position of rest.

2. The tachistoscope as defined in claim **1**, in which said spring means bear on an adjustable seat which is movable to selected positions relative to said main frame to vary the tension of the spring to set the speed of the tachistoscope.

3. The tachistoscope as described in claim **1**, in which the non-refracting portion is comprised of a transparent material having a pair of substantially parallel surfaces.

4. The tachistoscope as defined in claim **1**, in which the non-refracting portion of the scrambler is provided with an opening positioned between refracting portions.

5. The tachistoscope as described in claim **1**, in which said light ray pathway comprises light rays, and in which said refracting portion comprises at least one non-planar surface portion for deflecting the light rays within said light ray pathway in scrambling directions substantially within said pathway.

6. The tachistoscope as described in claim **5**, in which means are provided on the non-planar surface of the refracting portion for deflecting the light rays laterally in scrambling directions.

7. The tachistoscope as described in claim **1**, in which said light ray pathway comprises light rays, and in which the refracting portion comprises lens means having at least one non-planar surface area for deflecting the light rays within said pathway to scrambled positions substantially within said pathway.

8. The tachistoscope as described in claim **1**, in which said light ray pathway comprises light rays, and in which the refracting portion comprises lenticular lens means for deflecting the light rays within said pathway to scrambled positions substantially within said pathway.

9. The tachistoscope as described in claim **8**, in which the light rays are projected toward a screen to form a word image and in which the lenticular lens means scrambles the word image in the direction of its longest dimension.

10. The tachistoscope as defined in claim **7**, in which said scrambling means is positioned for rotation on bearing means on the main frame, and includes at least one refracting portion and at least one non-refracting portion rotating on said bearing means as parts of said scrambler.

11. The tachistoscope as defined in claim **8**, in which said scrambling means is positioned for rotation on bearing means on the main frame, and includes at least one refracting portion and at least one non-refracting portion rotating on said bearing means as parts of said scrambler, and in which said lenticular lens means comprises a plurality of portions substantially concentric to the axis of rotation.

12. The tachistoscope as described in claim **1**, in which there are trigger means mounted on the main frame including detent means adapted to hold the scrambler at said first position of rest.

13. The tachistoscope as defined in claim **12**, in which the trigger mechanism is comprised of two elements, at least one of which is movable toward the other of said elements, each of said elements comprising a bearing surface respectively for an operator's thumb and finger, said bearing surfaces being in line with each other.

14. A tachistoscope comprising a main frame including a light ray pathway comprising light rays, scrambling means including at least one-refracting portion and at least one non-refracting portion movably positioned substantially transverse the light ray pathway, together with means to move said scrambling means from a first position of rest with a refracting portion interposed in said light ray pathway to a second position of rest with a refracting portion interposed in said light ray pathway, said non-refracting portion being adapted to traverse said light ray pathway for an interval of time between said first position of rest and said second position of rest of said scrambling means, in which the refracting portion comprises lens means having at least one non-planar surface area for deflecting the light rays within said pathway to scrambled positions substantially within said pathway, and in which the scrambling means is positioned for rotation on bearing means on the main frame, and in which there are trigger means mounted on the main frame including detent means for holding the scrambling means at said first position of rest, and spring means acting against the scrambling means and the main frame for spring urging the scrambling means to rotate on said bearing means.

15. The tachistoscope as described in claim **14**, in which there is a stop means on the main frame adapted to engage that portion of the spring acting against the scrambler to stop further spring action against the scrambler during the rotation of the scrambler.

16. The tachistoscope as described in claim **14** which includes braking means to stop the scrambler at the second position of rest.

17. The tachistoscope as described in claim **16** which includes a friction brake comprising at least one movably mounted acting friction brake element including a strike arm and at least one reacting friction brake element, said scrambler having striker means for striking said brake strike arm from a first direction during the forward rotation of the scrambler and striker means for striking said brake strike arm from another direction during resetting rotation of the scrambler.

18. The tachistoscope as defined in claim **17**, comprising a plurality of reacting friction brake elements, at least one of which is fixed relative to the main frame, with at least another of said reacting friction brake elements being mounted on shaft means for movement relative to the main frame, said main frame being provided with stop means to limit the motion of said shaft means to a motion shorter than the motion of said acting friction brake element.

19. The tachistoscope as defined in claim **17**, comprising a reacting friction brake element disposed around a shaft and fixed relative to the main frame, and another reacting friction brake element disposed around said shaft and fixed relative to the shaft, with said acting brake element positioned between and in contacting relationship to said reacting friction brake elements, said shaft having ratchet means for cooperating with pawl means associated with the main frame whereby said shaft may rotate in a direction opposite to said spring urged rotation of said scrambler, but will be held against rotation in the same direction as said spring urged rotation of said scrambler.

20. The tachistoscope as defined in claim **15**, in which that portion of the spring acting against the main frame bears on an adjustable seat which is movable to selected positions relative to said main frame to vary the tension of the spring to set the speed of the device.

21. The tachistoscope as defined in claim **15**, in which the scrambler rotates on bearing means and comprises gravitational balance means for counteracting the friction of said bearings to provide substantially constant

rotational velocity to the scrambler after said spring is engaged by said stop means.

References Cited

UNITED STATES PATENTS

1,335,744	4/1920	Lehman	352—212
1,349,214	8/1920	Lehman	352—212
1,349,215	8/1920	Lehman	352—212
1,422,410	7/1922	Blanton	352—212
2,840,925	7/1958	Dunson	35—35.2
3,018,686	1/1962	Kurz	351—31
3,021,751	2/1962	Barnette	351—31

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