Jan. 9, 1968 E. C. WEBB ETAL 3,362,286

AUTOMATIC BOWLING SCORE PROJECTOR

Filed May 24, 1965 5 Sheets-Sheet 1

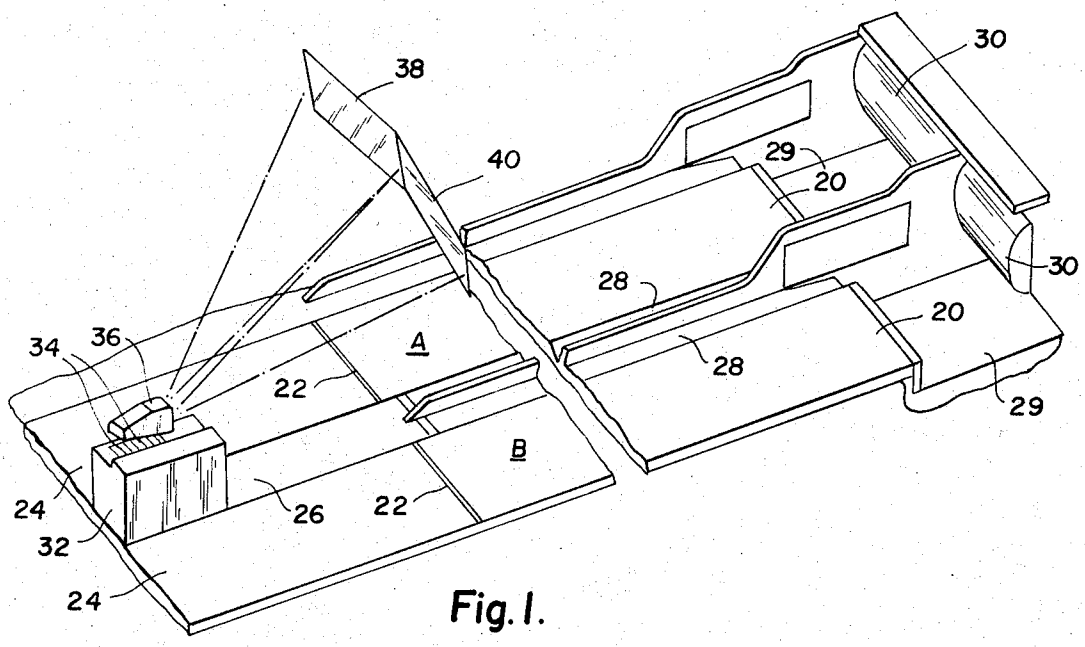


Fig. 1.

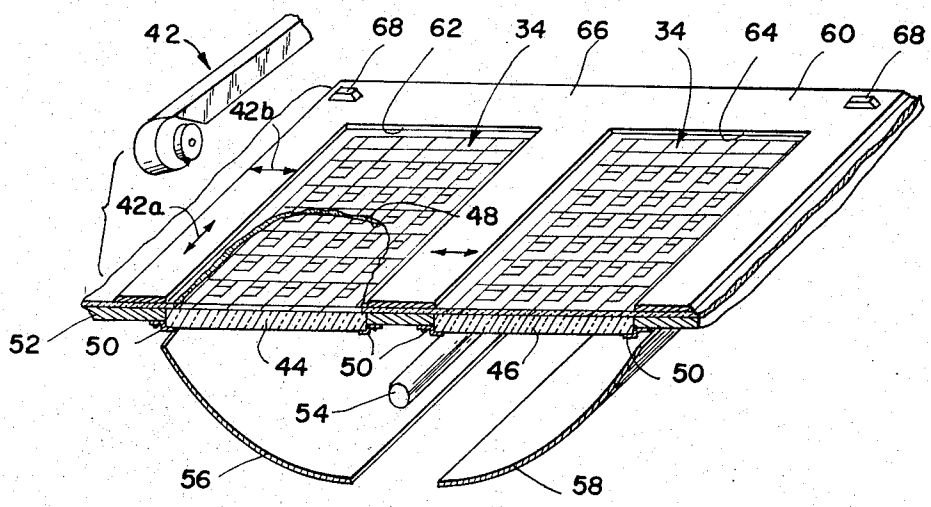


Fig. 2.

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AUTOMATIC BOWLING SCORE PROJECTOR

Filed May 24, 1965 5 Sheets-Sheet 2

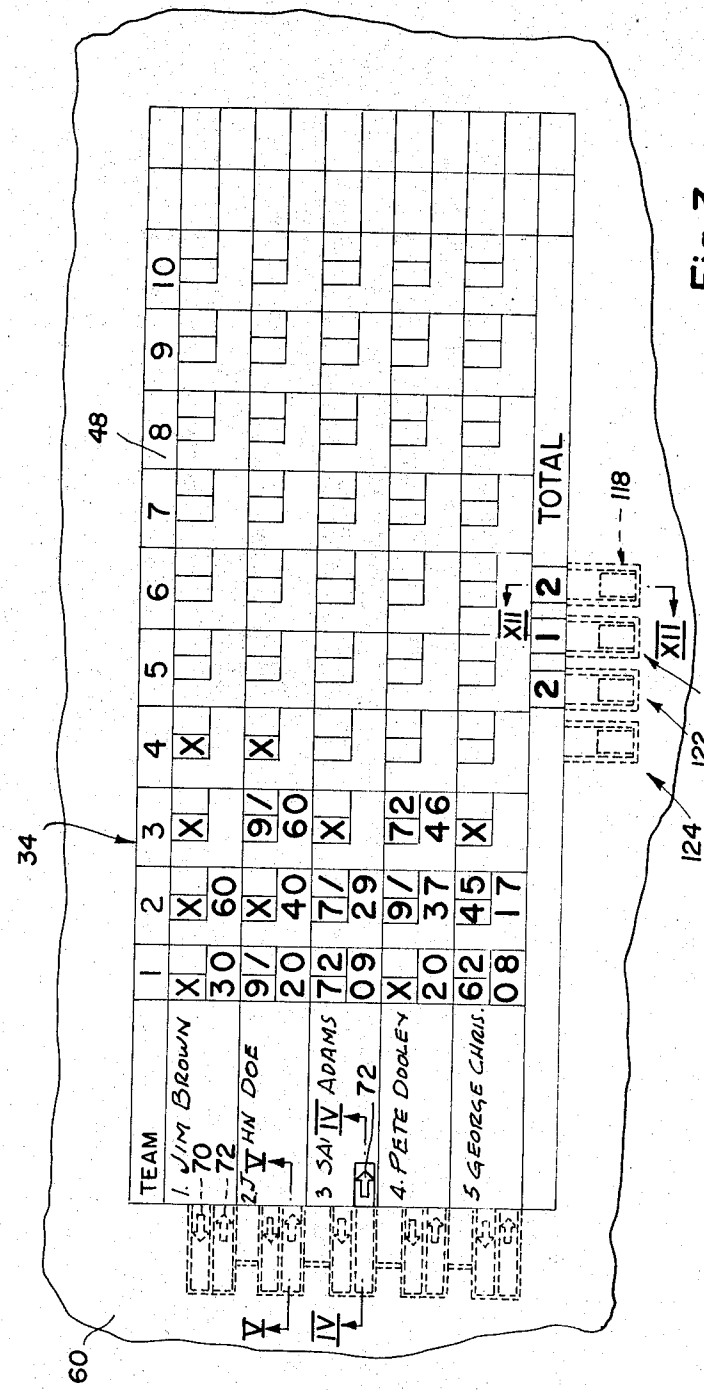


Fig. 3.

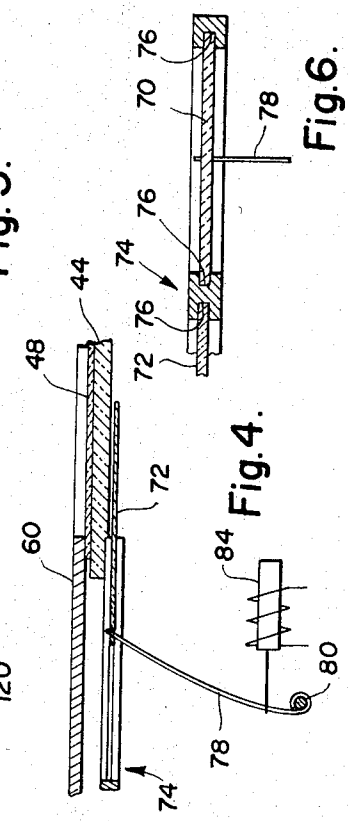


Fig. 6.

Fig. 4.

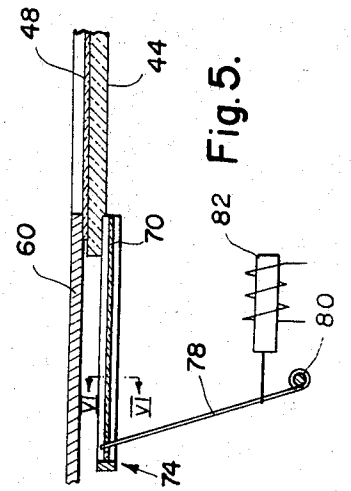


Fig. 5.

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AUTOMATIC BOWLING SCORE PROJECTOR

Filed May 24, 1965 5 Sheets-Sheet 3

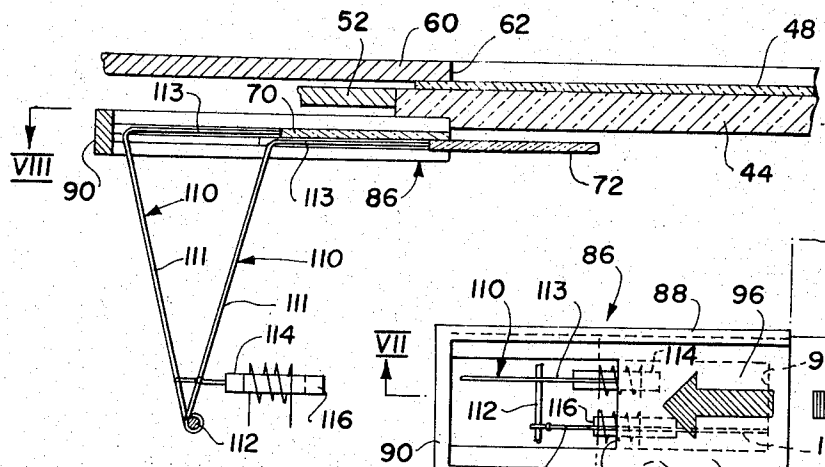


Fig. 7.

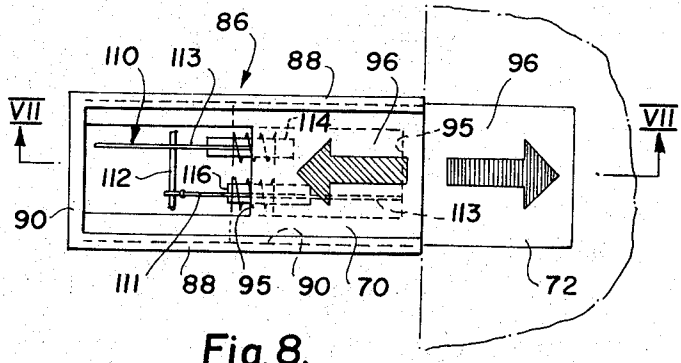


Fig. 8.

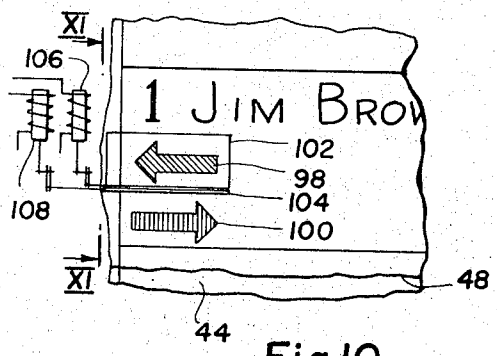


Fig. 10.

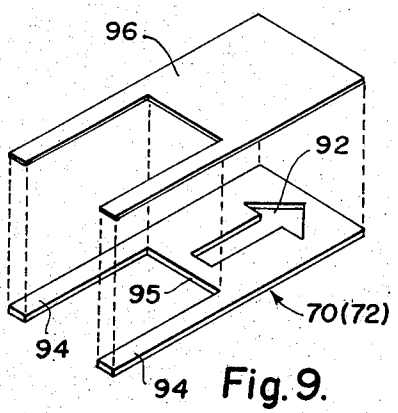


Fig. 9.

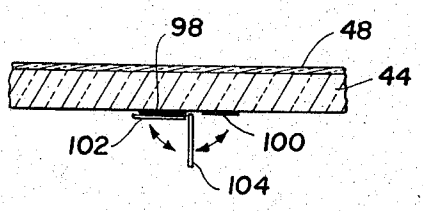


Fig. 11.

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AUTOMATIC BOWLING SCORE PROJECTOR

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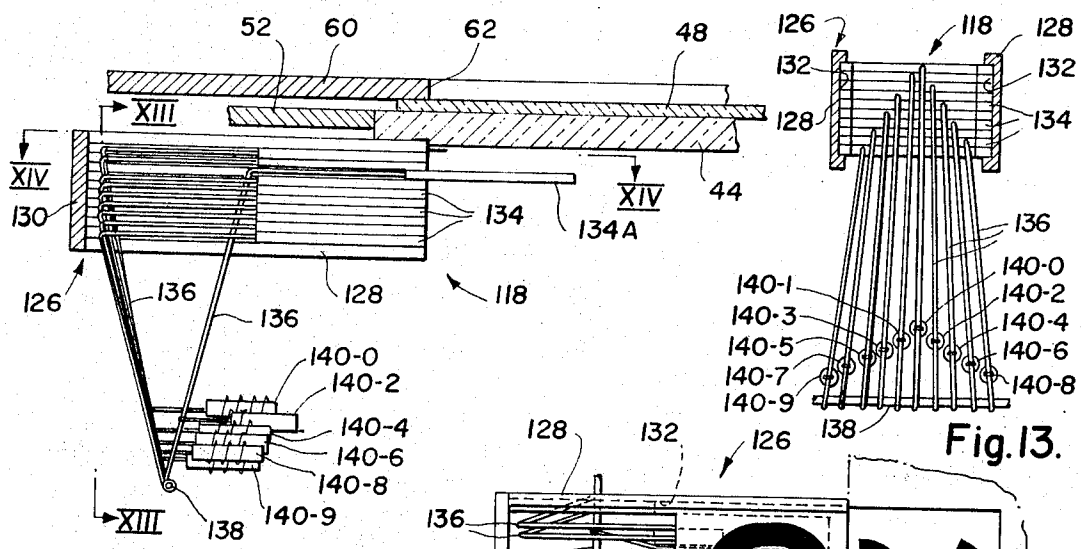


Fig.12.

Fig.13.

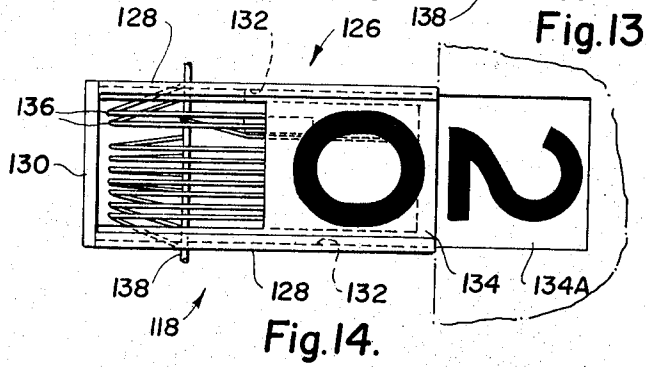


Fig.14.

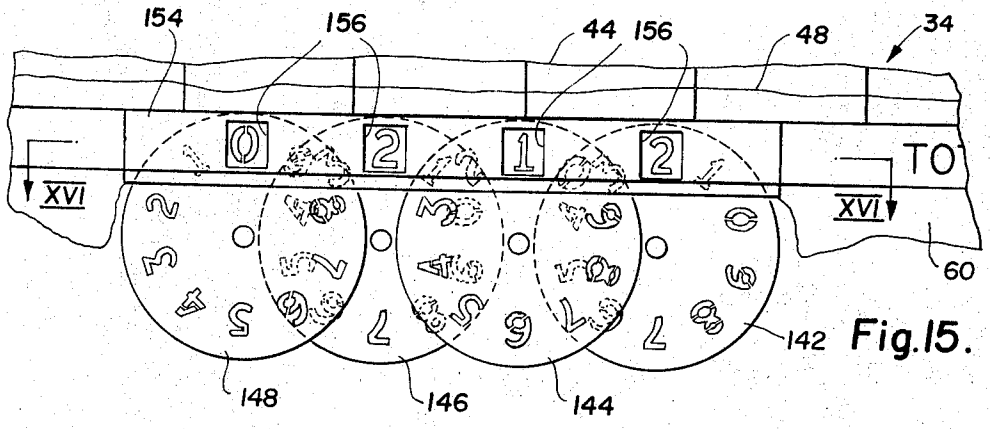


Fig.15.

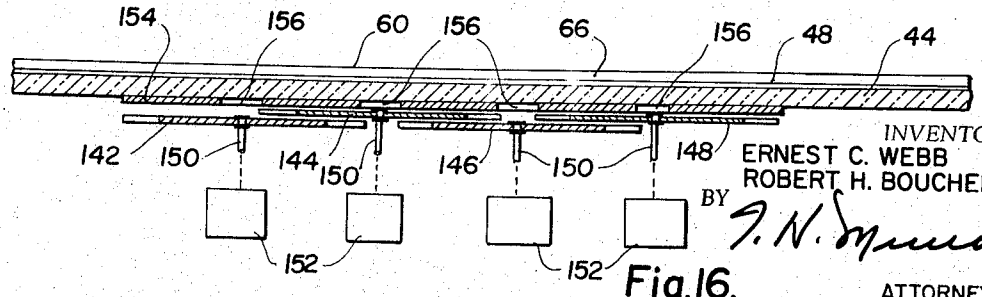


Fig.16.

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AUTOMATIC BOWLING SCORE PROJECTOR

Filed May 24, 1965 5 Sheets-Sheet 5

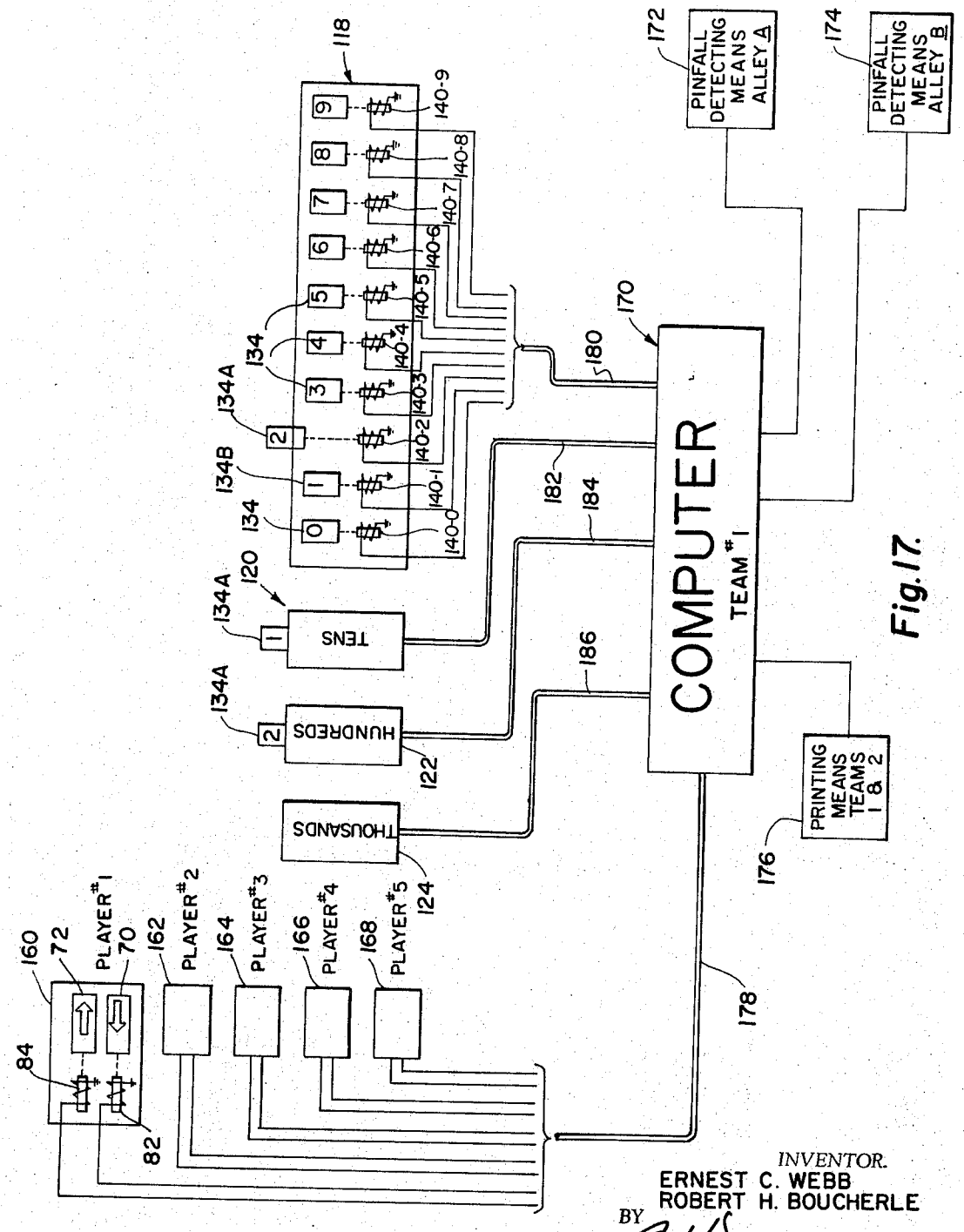


Fig. 17.

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United States Patent Office 3,362,286
Patented Jan. 9, 1968

3,362,286

AUTOMATIC BOWLING SCORE PROJECTOR

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Filed May 24, 1965, Ser. No. 458,263
16 Claims. (Cl. 88—24)

This invention relates to apparatus for projecting images of numerals, letters, symbols and the like onto a screen, and more particularly to apparatus of the type described for use with automatic scoring, totalizing, printing and projecting apparatus for a bowling game.

Automatic bowling game scoring units are known wherein the successive frame score of each player of two teams is printed on a score sheet. Projection means incorporated into the apparatus, projects during the course of the bowling game, a continuous image of the score sheets and hence the scores printed theron, onto screens for viewing by the players and the spectators. Hence, each player is made aware of his cumulative score at all times during the progress of the bowling game. The projection means may be of the transparent projection type wherein light is transmitted directly through the score sheet onto a lens means, or of the opaque projection type wherein light is reflected from the score sheets and directed onto the lens means.

In scoring apparatus of this type, a computer is provided for each team. The computer serves to "read" electrical impulses received from the pin detecting means residing at the pit, so as to control printing means for printing the score of each individual player at the appropriate frame on the score sheet. As the bowling game progresses, each player will be tied into the computer so that at the completion of the frame, the pinfall detecting means and the print means cooperate to print his score on the score sheet. In the event a spare or a strike is made, printing of the score in that frame is delayed until the player has delivered his bowling ball once in the following frame to complete his score in that frame with respect to the spare previously made, or has delivered his bowling ball twice to complete his score in that frame with respect to the strike previously made.

When two opposing teams are bowling, two adjacent bowling alleys normally are employed. Each player of the first team bowls with a player of the second team. Each player alternates between the alleys, that is, each player bowls one frame on the first alley, the next frame on the second alley, the next succeeding frame on the first alley, and so forth. Simultaneously therewith, a player of the second team bowls on a frame on the second alley, the next frame on the first alley, the next succeeding frame on the second alley and so forth. Consequently, when automatic scoring units of the type described are used, it is important that each player be made aware of when he is tied into the computer and on which alley he is to bowl. This should be evident, since if a player bowls on the wrong alley, his score will be printed on the frame space of the corresponding player of the other team.

When two opposing teams are bowling, it is highly desirable to have the cumulative team score of each team displayed on the screens in the general area of the projected score sheet image of each team. In this instance, each team is made fully aware of its total team score and, hence, each team may compare its total team score with the total team score of the opposing team.

Accordingly, as an overall object, the present invention seeks to provide means for projecting images of numerals, letters, symbols and the like onto a screen.

Another object of the present invention is to provide apparatus employing the projection means of automatic

scoring units, for introducing light restricting elements into the field of view of the projection means whereby images of numerals, letters, symbols and the like, related to the bowling game, are projected onto a screen in the same general area of the score sheet image.

Still another object of the invention is to provide apparatus for projecting images onto a screen in the general area of the score sheet image, for indicating the player who is keyed into the computer and the alley on which he should bowl.

Still another object of the invention is to provide apparatus for projecting images onto a scren in the general area of the score sheet image, for indicating the progressively increasing total team score for each team during the progress of the bowling game.

Although not limited thereto, the present invention is particularly adapted for use with the automatic bowling game score printing and projecting apparatus described and illustrated in copending application Ser. No. 350,738, filed Mar. 10, 1964, now Patent No. 3,295,439 and assigned to the assignee of the present invention. In that scoring apparatus, spaced, transparent plates are provided having a score sheet permanently printed thereon. A transparent sheet is disposed over the transparent plates so that the light from a light source disposed below the plates passes therethrough to lens means for projecting an image of the score sheet onto the viewing screen for viewing by the players and the spectators. Printing apparatus is provided for printing the scores of each player during the progress of the bowling game. Consequently, a continuous image of the score sheets and, hence, the score printed thereon is projected onto the viewing screen.

In accordance with the present invention, apparatus is provided for introducing numerals, letters, symbols and the like into the field of view of the lens means so that an image thereof will be projected onto the viewing screen. The numerals, letters, symbols and the like will hereinafter be termed "characters".

In one form of the invention, thin strips or discs having the desired characters thereon are moved into the path of the light source at approximately the same focal plane as the score sheets. The strips or discs may take any one of a plurality of forms. For example, the strips or discs may be formed from transparent material and have the characters printed thereon. In this instance, a dark image of the character will be projected onto the viewing screen. The strips or discs alternatively may be formed from opaque material and have portions thereof cut out to correspond in shape to the character. In this instance, an image of the character in light surrounded by a dark area will be projected onto the viewing screen. Where different colored characters are desired, sheets of transparent colored materials may be placed over the cutout areas of the opaque strips so that the resulting image will be in colored light.

In another form of the invention, the characters may be permanently printed, for example, on the transparent plate on which the score sheet is permanently printed. Mask means is provided whereby the image of a selected one of the characters is permitted to be projected onto the viewing screen.

In the description to follow, the apparatus of the present invention is incorporated into the automatic bowling game score printing and projecting apparatus described above. In one instance, characters in the form of arrows of opposite orientation, are projected at or near the area of the score sheet in which the players' names are written. When an image of one of the arrows is projected onto the viewing screen, it serves two functions, namely, it tells the player he is next in line to bowl and it directs the player to the proper alley. In another instance in the description to follow, the characters comprise a row of

numerals which are projected onto the viewing screen. The row of numerals corresponds to the total team score which progressively changes as each player completes his frame.

The above and other objects and advantages of the present invention will become apparent from the following detailed description by reference to the accompanying drawings, in which:

FIGURE 1 is a fragmentary isometric view of a pair of adjacent bowling alleys on which is provided an automatic bowling game score printing and projecting apparatus;

FIG. 2 is a fragmentary isometric view, in cross-section, illustrating a pair of adjacent bowling score sheets as supported on the automatic scoring apparatus of FIG. 1;

FIG. 3 is a fragmentary plan view of the top of the automatic scoring apparatus of FIG. 1, illustrating the use of strips having characters thereon in relation to one of the bowling game score sheets;

FIG. 4 is a cross-sectional view taken along the line IV—IV of FIG. 3, illustrating a strip positioned within the general area of the score sheet and having a directional arrow thereon;

FIG. 5 is a cross-sectional view taken along the line V—V of FIG. 3, illustrating the normal recessed position of the strips;

FIG. 6 is a cross-sectional view taken along the line VI—VI of FIG. 5;

FIG. 7 is a cross-sectional view taken along the line VII—VII of FIG. 8, illustrating an alternative arrangement of the directional arrow strips;

FIG. 8 is a view taken substantially along the line VIII—VIII of FIG. 7;

FIG. 9 is an isometric view illustrating the construction of a directional arrow strip;

FIG. 10 is a fragmentary plan view illustrating an alternative arrangement of the directional arrows;

FIG. 11 is a cross-sectional view taken along the line XI—XI of FIG. 10;

FIG. 12 is a cross-sectional view taken along the line XII—XII of FIG. 3, illustrating a plurality of stacked strips employed for indicating the total team score;

FIG. 13 is a cross-sectional view taken along the line XIII—XIII of FIG. 12;

FIG. 14 is a cross-sectional view taken along the line XIV—XIV of FIG. 12;

FIG. 15 is a fragmentary plan view illustrating an alternative means for indicating the total team score;

FIG. 16 is a cross-sectional view taken along the line XVI—XVI of FIG. 15; and

FIG. 17 is a schematic control circuit diagram associated with the directional arrows and the total team score indicating strips of the invention.

Referring now to the drawing, and in particular to FIG. 1, a pair of adjacent bowling alleys A and B are each provided with a pin deck **20** at the forward end of the alley and a foul line **22** at the opposite end. Ahead of each foul line **22** is an approach area **24**; and between the approach areas **24** is a space **26**, which space is occupied between the alleys A and B proper by gutters **28**. In the usual case, a ball return, not shown, will also be provided, said ball return having a ball rack in the area **26**. Behind each of the pin decks **20** is a pit, generally indicated at **29**; and behind each pit is a backstop **30**.

In the space **26** and ahead of the foul lines **22**, there is provided a console **32** which houses apparatus for automatically scoring and totalizing a bowling game score, such as that shown in U.S. Patent No. 3,124,355. Actually, the console **32** houses two automatic scoring and totalizing units or computers, one for each of the alleys A and B. Each unit controls the printing apparatus disclosed in the aforesaid copending application Ser. No. 350,738, now Patent No. 3,295,439, for printing the score on the upper surface of a transparent sheet, through which a

ruled score sheet **34** is visible. Above the score sheets **34** there is positioned a projector **36** which projects a continuous image of the score sheets **34** onto adjacent screens **38, 40** which are suspended above the alleys A and B. Projected onto the screens **38, 40** are the score sheets for the two opposing teams.

Referring now to FIG. 2, the score printing apparatus referred to above includes a cantilever arm **42** which projects outwardly from the console **32** over the score sheets **34**. The cantilever arm **42** is positioned with respect to a certain frame of one of the score sheets **34** by movement parallel to the frames as indicated by the arrow **42***a* and by movement parallel to the player lines as indicated by the arrow **42***b*. The cantilever arm **42** includes a print wheel (not shown) which is employed to print the score in the appropriate space on the score sheets. A complete description of the cantilever arm **42** and the mechanisms for positioning the same and for positioning the print wheel is described in copending application Ser. No. 350,378, now Patent No. 3,295,439, cited above.

As can be seen in FIG. 2, two transparent plates or platens **44** and **46** are provided each of which is adapted to support a transparent sheet **48** upon which the bowling game scores are printed. Each of the transparent plates **44, 46** has permanently printed thereon a score sheet form comprising, as is conventional, a plurality of player lines and the ten score boxes. Each of the transparent plates **44, 46** are carried by brackets **50** which are secured to an upper wall **52** of the console **32**. Beneath the transparent plates **44, 46** is a lamp **54** which directs light, by means of reflectors **56, 58**, up through the transparent plates **44, 46** and through the transparent sheet **48** positioned thereon. After passing through the plates **44, 46** and the transparent sheet **48**, the light is directed through a series of mirrors and lenses of the projector **36** (FIG. 1) and is directed forwardly onto the aforesaid spaced screens **38, 40** (FIG. 1). In this respect, the mirror and lens system of the projector **36** is such that it will project the image of one score sheet from one team onto one of the spaced screens and the image of the other score sheet for the other team onto the other of the spaced screens. One type of mirror and lens system suitable for this purpose is shown, for example, in copending application Ser. No. 305,591, filed Aug. 30, 1963, now Patent No. 3,289,574, and assigned to the assignee of the present invention.

In order to hold the transparent sheet **48** in position during a printing operation, a clamping mechanism is provided comprising a clamping plate **60** having two rectangular openings **62, 64** cut therein to coincide with the transparent plates **44, 46** and separated by a center strip **66**. At the four corners of the clamping plate **60** are slideable clamping elements **68** each of which may be moved into a first position wherein the clamping plate **60** is raised upwardly and into a second position wherein the clamping plate **60** is moved downwardly into engagement with the transparent sheet **48** to clamp the same between the clamping plate **60** and the upper wall **52** of the console **32**.

As stated above, it is important when using the automatic scoring unit described above, for each player to be aware of when he is tied into the computer, that is, when it is his turn to bowl, and to be aware of or be directed to the proper one of the two adjacent alleys A and B. Accordingly, and with reference to FIG. 3, a plurality of light restricting elements **70** are provided each having a directional arrow printed thereon pointing in the same direction and a plurality of light restricting elements **72** each having a directional arrow printed thereon which, however, points in the opposite direction. As can be seen in FIG. 3, each space provided in the score sheet **34** for writing the player's name, has associated therewith one each of the light restricting elements **70, 72** which are preferably positioned beyond the edge of the score sheet **34**. The overall arrangement is such

that, as can be seen in the third player line of the score sheet 34, the light restricting element 72 is displaced into the general area of the score sheet 34 so that its arrow, pointing to the right of FIG. 3, will have its image projected onto one of the aforementioned screens. That image will signal the third player that he is tied into the computer, that it is his turn to bowl, and will direct him to the right-hand alley B. Although not illustrated, the light restricting element 70, for example, associated with the third player of the opposing team will be displaced into the general area of the score sheet 34 so that an image thereof is projected onto one of the aforesaid screens. Hence, the third player of the opposing team also is made aware of the fact that he is tied into the computer, that it is his turn to bowl, and that he is to use the left-hand alley A.

Referring now to FIGS. 3–6, inclusive, each set of light restricting elements 70, 72 associated with each of the player lines, is supported in side-by-side relation by means of a frame 74 provided with opposed grooves 76 (FIG. 6) in which the light restricting elements 70, 72 are freely slideable. The frame 74 supports the light restricting elements 70, 72 beneath the transparent plate 44 and for movement parallel to the plane of the plate 44. Each of the light restricting elements 70, 72 are movable from a normal recessed position beneath the clamping plate 60, as illustrated in FIG. 5, to a projection position within the general area of the score sheet 34 as illustrated in FIG. 4. In order to move the light restricting elements 70, 72 between the above-described positions, each element 70, 72 is provided with a thin, spring element 78 having one end projecting through an opening provided in the element 70, 72 and its other end rigidly secured to a stationary rod or member 80. The spring member 78 is in a relaxed condition when the element 70 or 72 is in the recessed position illustrated in FIG. 5. However, for example, when the light restricting element 72 is displaced into the general area of the score sheet 34, as illustrated in FIG. 4, the spring element 78 is placed under tension and tends to return to its normal relaxed condition and, hence, also tends to return the light restricting element connected thereto to its normal recessed position. In order to move the light restricting elements 70, 72 from the recessed position indicated in FIG. 5 to the projection positioned indicated in FIG. 4, each of the spring elements 78 preferably is provided with a solenoid 82, 84, respectively. As will be described later in the specification, each of the solenoids 82, 84 is electrically connected to the computer and is energized thereby to move the selected one of the light restricting elements from the recessed position to the projection position and vice versa.

As an alternative arrangement, the light restricting elements 70, 72 may, as illustrated in FIGS. 7 and 8, be positioned in stacked relation, that is, one on top of the other. In this arrangement, a frame 86 supports the light restricting elements 70, 72 beneath the transparent plate 44 and for movement parallel to the plane of the transparent plate 44. The frame 86 includes side rails 88 each having a slot of sufficient width to receive two of the light restricting elements and in which the light restricting elements are freely slideable. The frame 86 further includes a back rail 90 which limits the movement of the light restricting elements 70, 72.

In this arrangement and as can be seen in FIG. 9, each of the light restricting elements 70, 72 preferably is formed from opaque material having an arrow-shaped portion thereof cut out so as to provide an arrow-shaped opening 92. Each of the light restricting elements 70, 72 also has a rectangular portion cut away from the other end to provide arms 94 and a transverse edge 95. The extreme ends of the arms 94 abut the back rail 90 and limit the movement of the elements 70, 72 into the frame 86.

As can be seen in FIGS. 7 and 8, a thin spring element 110 is provided for each of the light restricting elements 70, 72. The spring element 110 includes a first leg 111 secured to a stationary rod or member 112 and a second leg 113 secured to the transverse edge 95 (FIG. 9) of each element 70, 72 adjacent to the arrow-shaped opening 92. Solenoids 114 and 116 are operatively connected to the thin spring elements 110 associated with the elements 70, 72, respectively, and serve to selectively displace each of the elements 70, 72 from the recessed position illustrated by the element 70 to the projection position illustrated by the element 72 and vice versa.

In the arrangement illustrated in FIGS. 7 and 8, it is preferred to have a transparent colored sheet 96, illustrated in FIG. 9, secured in overlying engagement with at least the front portion and preferably over the entire face of the light restricting elements 70, 72. In this manner, the opposite orientation of the arrows is emphasized and therefore easily distinguishable since an image of the arrows will be projected onto the aforesaid screens in different colored light. For example, and as illustrated in FIG. 8, the transparent sheet 96 associated with the light restricting element 70 is green while the transparent sheet associated with the light restricting element 72 is red. These arrows have, in FIG. 8, been lined to indicate the green and red colors.

It should also be noted at this time that the light restricting elements 70, 72 of the arrangement illustrated in FIGS. 3–6, inclusive, also are provided with green and red transparent colored sheets so that the opposite orientations of the arrows associated therewith may be easily distinguished.

A further alternative arrangement of the directional arrows is illustrated in FIGS. 10 and 11. In this arrangement, two oppositely directed arrows 98, 100 are provided on the lower face of the transparent plate 44. The arrows 98, 100 may be permanently imprinted on the plate 44 or may be printed on transparent sheets which are secured to the plate 44. The arrow 98 is imprinted with a transparent green pigment while the arrow 100 is imprinted with a transparent red pigment.

In FIG. 10, a pair of the arrows 98, 100 is shown positioned in the first player line, that is, that area of the score sheet wherein the first player writes or prints his name. Similarly, the other player lines 2 to 5 (FIG. 3) also will be provided with a pair of the arrows 98, 100. Associated with each of the arrows 98, 100 is a flapper or mask member 102, 104, respectively, each of which is supported for pivotal movement about an axis adjacent to the lower face of the transparent plate 44. The mask member 102 is positioned to mask the arrow 98 so that an image thereof cannot be projected onto the screen. However, the mask member 104 is shown positioned perpendicular to the transparent plate 44 so that light is permitted to pass through the transparent plate 44 and an image of the arrow 100 is produced on one of the aforesaid screens. Solenoids 106, 108 are operatively connected to the mask members 102, 104 respectively and serve to displace the mask members 102, 104 from a masking position such as illustrated by the mask member 102 to an unmasked position such as illustrated by the mask member 104. The solenoids 106, 108 are preferably spring-biased whereby when no current is applied to the solenoids 106, 108, the mask members 102, 104 will be biased into the masked position. Consequently, when the first player, for example, has completed his frame, the mask members 102, 104 will mask the arrows 98, 100. However, when the first player is to bowl, one of the mask members 102, 104 will be displaced into the unmasked position whereby the arrows 98 or 100 will be exposed and an image thereof projected onto one of the aforesaid screens. The first bowler will then be made aware that it is his turn to bowl, and be directed to the proper one of the alleys A or B (FIG. 1).

Total team score indication

As stated above, it is extremely desirable to have the total team score for each team projected onto the screen in the general area of the score sheet during the course of the bowling game. As each player completes his frame, the total team score will, of course, change. Consequently, any means provided for projecting the total team score must, of necessity, permit the projected score to be changed as each player completes his frame.

As can be seen in FIG. 3, four sets of light restricting elements **118**, **120**, **122** and **124** are positioned in side-by-side relation adjacent to the lower end of the score sheet **34**. As illustrated in the score sheet **34**, the first two players have completed four frames and the ball results and score associated with their play has been printed on the transparent sheet **48**. Furthermore, the remaining three players have completed three frames and the ball results and score associated with their play has been printd on the transparent sheet **48**. Up to this point in the play, the total team score is 212 as indicated by the sets of light restricting elements **118**, **120** and **122**. That is to say, selected ones of the light restricting elements from each set of light restricting elements **118**, **120** and **122** have been displaced into the general area of the score sheet **34** so that a row of numerals, namely, 2, 1 and 2, are introduced into the path of light whereby images of these numerals will be projected onto one of the aforesaid screens.

It is often desirable to add 10 to the total team score for each mark achieved by the players. For example, in the score sheet illustrated in FIG. 3, a total of five strikes has been achieved by players 1, 2, 3 and 5. These marks have not, as yet, been scored and, hence, the total team score is 212. However, if desired, the total team score could be increased by 50 pins (10 pins for each of the five strikes) so that a total team score of 262 would be indicated.

Reference is now directed to FIGS. 12–14 inclusive wherein the construction of the set of light restricting elements **118** is illustrated. It should be noted at this time that the sets of light restricting elements **120**, **122** and **124** are identical with the set of light restricting elements **118**. Therefore, the description that follows applies equally as well to the sets **120–124**.

As can be seen in FIGS. 12–14 inclusive, the set of light restricting elements **118** includes a frame **126** having side rails **128** and a back rail **130**. Each of the side rails **128** includes a groove **132** of sufficient width to receive a plurality of light restricting elements in stacked relation. The set of light restricting elements **118** includes ten light restricting elements **134** each of which is preferably formed from a thin, transparent material and has one of the numerals 0–9 imprinted thereon. As can be seen in FIG. 14, two of the light restricting elements **134** are shown having the numerals 0 and 2 imprinted thereon.

In FIGS. 12–14, the light restricting elements **134** of the set **118** have, for the purpose of clarity, been illustrated on an enlarged scale. It should be noted, however, that the light restricting elements **134** are formed from a relatively thin transparent material, having a thickness in the range of from about .002 inch to about .010 inch. The thinness of the light restricting elements **134** permits them to be stacked one above the other as illustrated and yet the difference between the position of the focal plane of the score sheet on the transparent plate **44** and the position of the lowest of the strips will not appreciably effect the image projected onto the aforesaid screens.

In order to move a selected one of the light restricting elements **134** into the general area of the score sheet, that is, in the path of light from the light source, a plurality of thin, L-shaped spring elements **136** are provided each having one end secured to a stationary rod or member **138** and its opposite end secured to one of the light restricting elements **134**. In this embodiment, the light restricting elements **134** have the same general shape as the light restricting element illustrated in FIG. 9.

Each of the light restricting elements **134** are positioned below the transparent plate **44** and are movable parallel to the plane of the transparent plate **44**. Each of the light restricting elements **134** is movable from a normal recessed position within the frame **126** to a projection position such as illustrated by the light restricting element **134A** in FIGS. 12 and 14. Since each of the L-shaped spring elements **136** has one end rigidly secured to the stationary rod **138**, movement of the light restricting elements **134** into the projection position will cause the associated spring element **136** to be placed under tension. Consequently, when a light restricting element **134** is in the projection position, the tensioned spring element **136** tends to return that light restricting element to the normal recessed position.

Each of the light restricting elements **134** is preferably moved between the aforesaid positions by means of a solenoid **140**. As can best be seen in FIG. 13, the solenoids associated with the light restricting elements **134** are numbered **140–0** through **140–9** and are positioned in a staggered relationship. For example, in FIG. 12, the solenoid **140–2** is shown energized to displace the light restricting element **134A** (having the numeral 2 printed thereon) from its normal recessed position within the frame **126** into the projection position. When the solenoid **140–2** is deenergized, the tension in the spring element **136** associated therewith will move the light restricting elements **134A** as well as the core of the solenoid **140–2** back to the normal recessed position. As will hereinafter be described, each of the solenoids **140–0** through **140–9** is connected into the computer carried within the console **32**. Consequently, each of the solenoids **140–0** through **140–9** may be selectively energized to displace the associated light restricting element **134** into the projection position.

Reference is now directed to FIGS. 15 and 16 wherein an alternative arrangement for indicating the total team score is illustrated. In this arrangement, four opaque discs **142**, **144**, **146** and **148** are arranged in side-by-side relation and supported for rotation about parallel axes extending perpendicular to the transparent plate **44**. Each of the opaque discs **142** have the numerals 0–9 cut out of their peripheral surfaces so that when light passes through the disc cutouts, an image of the numeral in light will be produced on the aforesaid screens. Alternatively, the discs **142** could be made from transparent material having the numerals 0–9 printed thereon with an opaque printing medium.

Each of the opaque discs **142–148** includes a shaft **150** which is connected to rotating and positioning means indicated generally at **152** in FIG. 16. The rotating and positioning means **152** may, for example, comprise a conventional stepping switch which when a number of impulses corresponding to the number desired to be projected is received from the computer housed within the console **32** (FIG. 1), the disc driven thereby will be rotated so that the desired numeral will be in a projection position. A masking plate **154** is provided which is preferably positioned above the opaque discs **142–148** and within the general area of the score sheet **34**. The masking plate **152** has spaced openings **156** through which one and only one of the numerals carried on the discs **142–148** is visible. The masking plate **154** is of sufficient length and width whereby the portions of the opaque discs **142–148** residing within the area of the score sheet **34** will be hidden. The overall arrangement is such that a darkened area will be produced on the aforesaid screens within which a row of numeral images in light will be visible. The row of numerals will, of course, correspond to the total team score as the bowling game progresses.

In operation, as each of the opaque discs **142–148** is rotated into a predetermined angular position wherein a cutout numeral will be positioned directly beneath one of the openings **156** thus permitting light to pass through

the cutout numeral and cast its image, in light, onto the aforesaid projection screen.

Control circuit arrangement

Reference is now directed to FIG. 17 wherein there is schematically illustrated a control circuit associated with the light restricting elements **70, 72** and **134** of one of the score sheets **34**. As stated above, the console **32** (FIG. 1) houses two computers, one for each team, each of which is responsive to the pinfall detecting means residing in the pits of the bowling alleys A and B and each of which controls the printing apparatus for printing the resultant scores of each of the two opposing teams. Consequently, the description to follow is applicable to both computers, to both score sheets and to the light restricting elements associated with each of the two score sheets.

In FIG. 17, the directional arrow light restricting elements **70, 72** and the solenoids **82, 84** associated therewith are illustrated for player No. **1**. These components are shown contained within a square **160**. For the sake of simplicity, the corresponding components associated with player Nos. **2–5** are schematically illustrated by squares **162–168**, respectively. With respect to the sets of light restricting elements **118–124**, only the light restricting elements **134** and the associated solenoids **140–0** to **140–9** of the set **118** has been fully illustrated. The remaining sets **120, 122** and **124** are schematically illustrated by squares.

A computer **170**, serving team No. **1**, receives impulses from pinfall detecting means **172** for alley A and from pinfall detecting means **174** for alley B. These impulses or electrical intelligence are read by the computer **170** and converted into control signals which operate printing means **176**, serving both team Nos. **1** and **2**, for printing the resultant ball score in the appropriate frame space on the score sheets **34**.

Extending from the computer **170** is a cable **178** housing five pairs of conductors extending to the solenoids **82, 84** of each set of light restricting elements **70, 72** associated with the player Nos. **1–5**. Also extending from the computer **170** are cables **180, 182, 184** and **186**, each of which contains the electrical conductors associated with the solenoids **140–0** through **140–9** of the light restricting elements **134** of each set **118–124**. Each of the cables **178–186** has, of course, their conductors electrically interconnected with the computer whereby signals from the computer may be transferred to selected ones of the light restricting elements whereby these elements are displaced into the path of light for projection of an image carried thereon onto the aforesaid screens.

Let us assume now that player No. **1** is to bowl on alley A. The computer **170** emits a signal which energizes solenoid **84** to displace the light restricting element **72** into the path of light. Consequently, an image of the arrow on the light restricting element **72** will be projected onto the aforesaid screen below or opposite the name of player No. **1**. At this time, player No. **1** knows that it is his turn to bowl by virtue of having an arrow image below his name. Furthermore, player No. **1** is directed to alley A since the arrow image points to alley A.

Assume now that player No. **1** knocks down nine pins with both ball deliveries and that prior to his bowling, the total team score was 212 as indicated by the light restricting elements **134A** of the sets **118, 120** and **122**. It will be noted at this time that the set of light restricting elements **118** corresponds to the units digit while the sets **120, 122** and **124** correspond to the tens digit, the hundreds digit and the thousands digit, respectively.

Since player No. **1** has knocked down nine pins, the pinfall detecting means **172** of alley A will, of course, emit nine impulses to the computer which, in turn, operates the printing means **176** for printing the corresponding ball results. Simultaneously, the solenoid **140–2** associated with the light restricting element **134A** will be deenergized whereby the element **134A** is retracted within the frame described above and the solenoid **140–1** is energized to displace the light restricting element **134B** into the field of view whereby an image of the numeral 1 is projected onto the aforesaid screens. However, the total team score is now 221. Therefore, the tens digit must be changed from 1 to 2. Accordingly, the solenoid **140–1** associated with the light restricting element **134A** of the set **120** is de-energized so that the light restricting element **134A** is retracted within the frame. Simultaneously, the solenoid **140–2** associated with the light restricting element carrying the numeral 2 in the set **120** is energized whereby the light restricting element is displaced into the field of view. An image of the numeral 2 will now be projected onto the aforesaid screen. In this manner, after each player has completed a frame, the total team score indication is changed to advance the total score attained by that player's team. It should be noted, however, that the total team score indication is not changed after each player has bowled. Each player must complete the frame in order to have a change occur in the total team score indication. For example, assume that player No. **3** is ready to bowl in frame **4** as illustrated in FIG . 3. If player No. **3** has an open frame, i.e., does not make a mark, the total team score is changed by adding the number of pins knocked down. However, if player No. **3** makes a mark, i.e., a spare or a strike, the total team score indication is not changed with respect to the score achieved in frame **4** by player No. **3** since player No. **3** has not completed frame **4**. When player No. **3** bowls again in the following frame or frames and completes his score with respect to frame **4**, the total team score indication is, at that time, changed to advance the total score attained by his team. Consequently, a progressively changing total team score is projected onto the aforesaid screens for each team which scores are easily viewed and compared by the players and by the spectators.

When player No. **1** has completed his frame, the computer **170** deenergizes the solenoid **84** whereby the light restricting element **72** is retracted within the frame, as described above. Thereafter, the appropriate one of the directional arrow light restricting elements **70, 72** associated with the next player will be activated to indicate to that player that it is his turn to bowl and to direct him to the proper alley. When that player completes his frame, corresponding changes will be made in the score indicating light restricting elements **134** to reflect the score attained by that player.

Although the invention has been shown in connection with certain specific embodiments, it will be readily apparent to those skilled in the art that various changes in form and arrangement of parts may be made to suit requirements without departing from the spirit and scope of the invention. In this respect, it should be evident that, for example, the position of the total team score indicating elements need not be positioned within the general area of the score sheet and that these elements may be projected onto the screens in any desired position.

We claim as our invention:

1. In combination with automatic bowling game scoring, printing and projecting apparatus having at least one bowling game score sheet for each team residing in a field of view of a lens means which is disposed in spaced cooperating relation with light source means for projecting an image of said score sheet and hence the score printed thereon on screen means during the course of a bowling game: a plurality of characters related to said bowling game and whose image may be projected; means supporting said characters for projection; means for masking said characters to prevent projection thereof; means for selectively exposing said characters to said light source means whereby an image thereof is projected onto said

screen means; and means for selectively operating said exposing means.

2. In combination with automatic bowling game scoring, printing and projecting apparatus having at least one bowling game score sheet for each team residing in a field of view of a lens means which is disposed in spaced cooperating relation with light source means for projecting an image of said score sheet and hence the score printed thereon on screen means during the course of a bowling game: a plurality of light restricting elements having characters thereon related to said bowling game and whose image may be projected; means for supporting said light restricting elements for movement substantially parallel to the plane of said score sheet; means for masking said light restricting elements to prevent projection thereof; means operatively connected to each of said light restricting elements for displacing each element from a normal position behind said mask means to a position within said field of view and vice versa; each element when in said field of view having an image of the character thereon projected onto said screen means; and means for selectively operating the appropriate ones of said displacing means whereby selected ones of said light restricting elements are displaced into said field of view.

3. The combination of claim 2 wherein each of said light restricting elements is formed from transparent material and the characters thereon are opaque.

4. The combination of claim 2 wherein each of said light restricting elements is formed from opaque material having portions thereof cut out to correspond in outline to the desired character.

5. In combination with automatic bowling game scoring, printing and projecting apparatus having at least one transparent bowling game score sheet for each team residing in a field of view of a lens means which is disposed in spaced cooperating relation with light source means for projecting an image of said transparent score sheet and hence the score printed thereon on screen means during the course of a bowling game: a plurality of light restricting elements having characters thereon related to said bowling game and whose image may be projected; means for supporting said light restricting elements adjacent to said transparent score sheet and for movement substantially parallel to the plane of said transparent score sheet; means for masking said light restricting elements to prevent projection thereof; means operatively connected to each of said light restricting elements for displacing each element from a normal position behind said mask means to a position within said field of view and vice versa; each light restricting element when in said field of view having an image of the character thereon projected onto said screen means; and means for selectively operating the appropriate ones of said displacing means whereby selected ones of said light restricting elements are displaced into said field of view.

6. In combination with automatic bowling game scoring, printing and projecting apparatus having at least one transparent bowling game score sheet for each team residing in a field of view of a lens means spaced from one face of said score sheet and which cooperates with light source means spaced from the opposite face of said score sheet for projecting an image of said score sheet and hence the score printed thereon on screen means during the course of a bowling game: a plurality of light restricting elements having characters thereon releated to said bowling game and whose image may be projected; means for supporting said light restricting elements adjacent to said transparent score sheet and for movement substantially parallel to the plane of said transparent score sheet; means for masking said light restricting elements to prevent projection thereof; means operatively connected to each of said light restricting elements for displacing each element from a normal position behind said mask means to a position within said field of view and vice versa; each light restricting element when in said field of view having an image of the character thereon projected onto said screen means; and means for selectively operating the appropriate ones of said displacing means whereby selected ones of said light restricting elements are displaced into said field of view.

7. The combination with automatic bowling game scoring, printing and projecting apparatus having at least one bowling game score sheet for each team residing in a field of view of a lens means which is disposed in spaced cooperating relation with light source means for projecting an image of said score sheet and hence the score printed thereon on screen means during the course of a game, of means for directing the player about to bowl to the proper one of two adjacent alleys comprising: a set of light restricting elements for each player, each light restricting element having an arrow thereon whose image may be projected, said arrows being oriented so that their images point to different alleys of a pair of adjacent alleys; means for supporting each set of light restricting elements for movement parallel to the plane of said score sheet and adjacent to the name space provided on said score sheet; means for masking said light restricting elements to prevent projection thereof; means operatively connected to each of said light restricting elements for moving said elements from a normal position behind said mask means to a position within said field of view and vice versa; and means for selectively operating the element moving means of the player who is next in line to bowl whereby an arrow image is projected on said screen means pointing to the bowling alley on which he is to bowl.

8. The combination of claim 7 wherein said support means comprises a frame for each light restricting element, the frames of each set of light restricting elements being positioned in side-by-side relation.

9. The combination of claim 7 wherein said support means comprises a frame carrying the light restricting elements of each set in stacked relation.

10. The combination of claim 7 wherein said light restricting elements and the arrows thereon are formed from transparent materials, the materials from which said arrows are formed being of different color.

11. The combination of claim 7 wherein each light restricting element is formed from opaque material having a portion thereof cut out in the shape of an arrow; and a layer of transparent colored material overlying the cutout in the light restricting element.

12. The combination with automatic bowling game scoring, printing and projecting apparatus having at least one bowling game score sheet for each team residing in a field of view of a lens means which is disposed in spaced cooperating relation with light source means for projecting an image of said score sheet and hence the score printed thereon on screen means during the course of a bowling game, of means for directing the player about to bowl to the proper one of two adjacent bowling alleys comprising: a plurality of oppositely oriented pairs of arrow characters whose images may be projected, the projected image of each of said arrow characters being oriented to point to one of said two adjacent bowling alleys; means for supporting each pair of arrow characters in said field of view; means for masking each of said arrow characters to prevent projection thereof; means operatively connected to each of said masking means for displacing the same into and out of masking relation relative to the character; and means for selectively operating said displacing means whereby an arrow image is projected onto said screen means adjacent to the name of the player about to bowl and which points to the bowling alley on which he is to bowl.

13. The combination with automatic bowling game scoring, printing and projecting apparatus having spaced transparent plate means supporting a score sheet form for each team and residing in a field of view of lens means disposed in spaced cooperating relation with light source

means for projecting an image of said score sheet and hence the score printed thereon on screen means during the course of a bowling game, of means for directing the player about to bowl to the proper one of two adjacent bowling alleys, comprising: a plurality of oppositely oriented pairs of arrow characters carried on said plate means in the region of the players' names and whose images may be projected, the projected arrow image of each of said arrows, being oriented to point to one of said two adjacent bowling alleys; means for masking each of said arrow characters to prevent projection thereof; means operatively connected to each of said masking means for displacing the same into and out of masking relation with each of said arrow characters; and means for selectively operating said displacing means whereby an arrow image is projected onto said screen means adjacent to the name of the player about to bowl and which points to the bowling alley on which he is to bowl.

14. The combination with automatic bowling game scoring, printing and projecting apparatus having at least one bowling game score sheet for each team residing in a field of view of a lens means which is disposed in spaced cooperating relation with light source means for projecting an image of said score sheet and hence the score printed thereon, on a screen during the progress of a bowling game, of means for indicating the cumulative team score during the progress of said bowling game comprising light restricting elements having numerals thereon whose image may be projected; means for supporting said light restricting elements for movement substantially parallel to the plane of said score sheet; means for masking said light restricting elements whereby only one numeral thereof is visible at one time; means operatively connected to said light restricting elements for moving the numerals thereof from a position behind said mask means to a position within said field of view and vice versa, whereby a row of numerals is presented whose images are projected onto said screen, and means for selectively operating said moving means whereby selected ones of said numerals are moved into said field of view.

15. The combinatiaon with automatic bowling game scoring, printing and projecting apparatus having at least one bowling game score sheet for each team residing in a field of view of a lens means which is disposed in spaced cooperating relation with light source means for projecting an image of said score sheet and hence the score printed thereon, on screen means during the course of a bowling game, of means for indicating the cumulative team score comprising sets of light restricting elements of generally rectangular shape, each light restricting element having a numeral on one end portion thereof whose image may be projected; means for supporting each set of light restricting elements in stacked relation and for movement substantially parallel to the plane of said score sheet; said sets of light restricting elements being positioned in side-by-side relations; means for masking said light restricting elements to prevent projection thereof; means operatively connected to each light restricting element of each set for moving the same and hence said one end portion thereof from a position behind said mask means to a position within said field of view and vice versa; the numeral on said one end portion being projected onto said screen when said one end portion is moved into said field of view; and means for operating selected ones of said element moving means of certain of said sets of light restricting elements whereby a row of numeral images corresponding to the cumulative team score is projected on said screen means.

16. The combination with automatic bowling game scoring, printing and projecting apparatus having at least one bowling game score sheet for each team residing in a field of view of a lens means which is disposed in spaced cooperating relation with light source means for projecting an image of said score sheet and hence the score printed thereon, on screen means during the course of a bowling game, of means for indicating the cumulative team score comprising a plurality of discs each having numerals thereon whose image may be projected; means for supporting said discs for rotation and in side-by-side relation; means for masking said discs, said mask means having a row of spaced apertures therein with which a single numeral of each disc is registered for projecting its image onto said screen means; means for rotating said discs independently of one another; and means for controlling the operation of said rotating means whereby numerals corresponding to the cumulative team score are positioned in registry with said apertures whereby images of said numerals are projected onto said screen.

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