Dec. 6, 1966 E. C. WEBB 3,289,574

SETTABLE TYPE WHEEL PRINTING APPARATUS FOR A BOWLING GAME

Filed Aug. 30, 1963 5 Sheets-Sheet 1

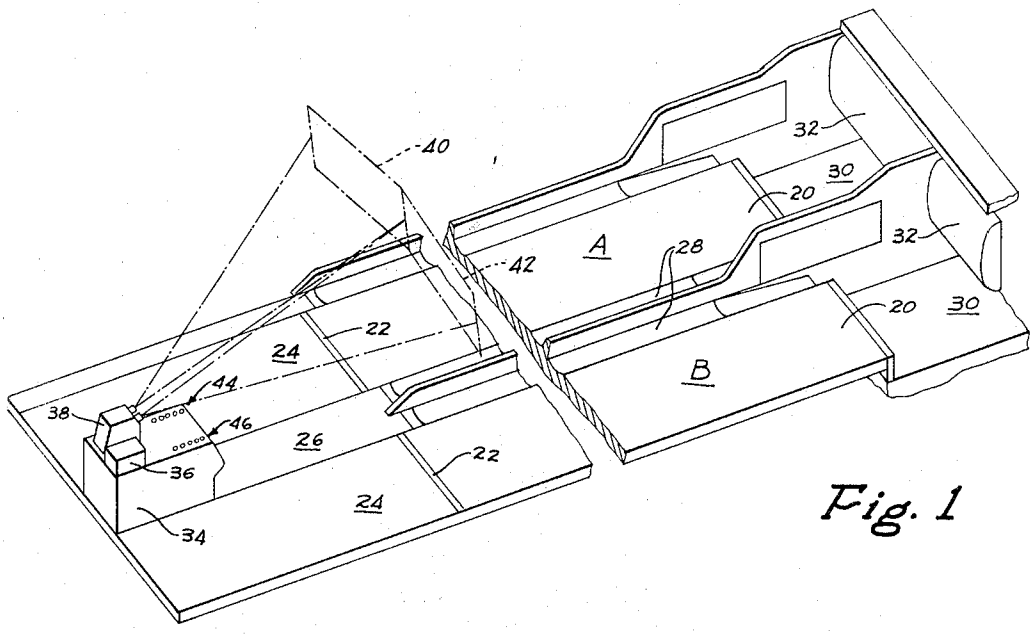


Fig. 1

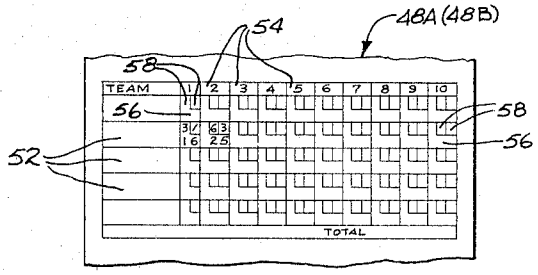


Fig. 3

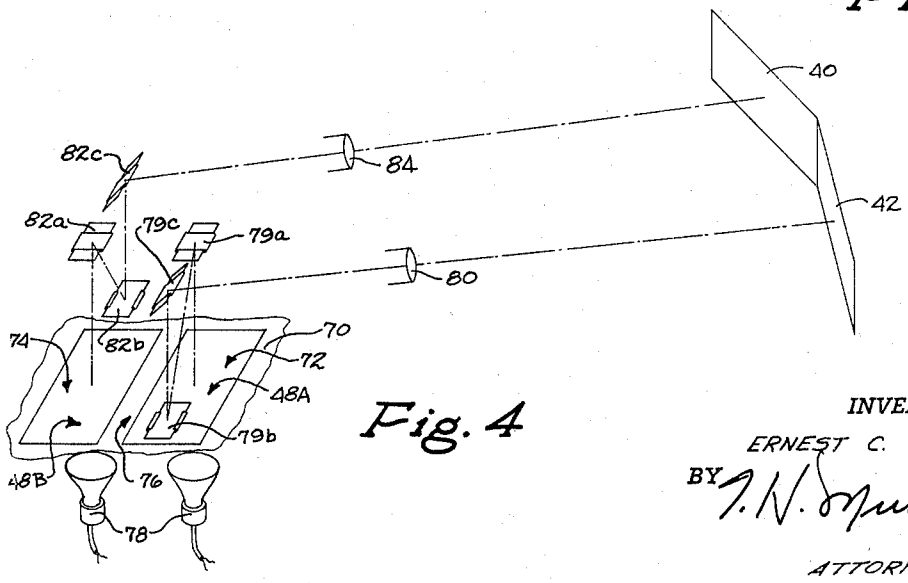


Fig. 4

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SETTABLE TYPE WHEEL PRINTING APPARATUS FOR A BOWLING GAME

Filed Aug. 30, 1963 5 Sheets-Sheet 2

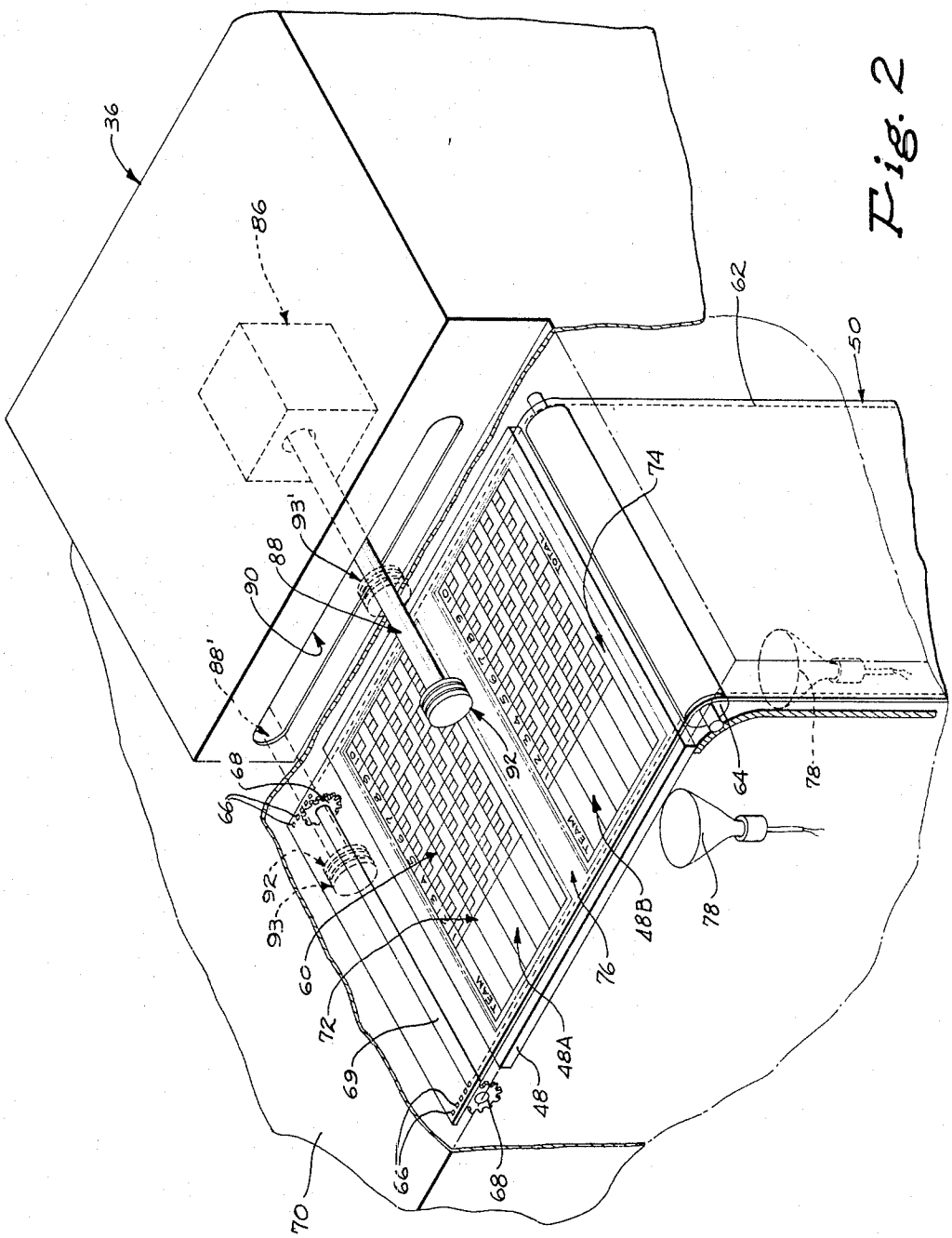


Fig. 2

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SETTABLE TYPE WHEEL PRINTING APPARATUS FOR A BOWLING GAME

Filed Aug. 30, 1963 5 Sheets-Sheet 3

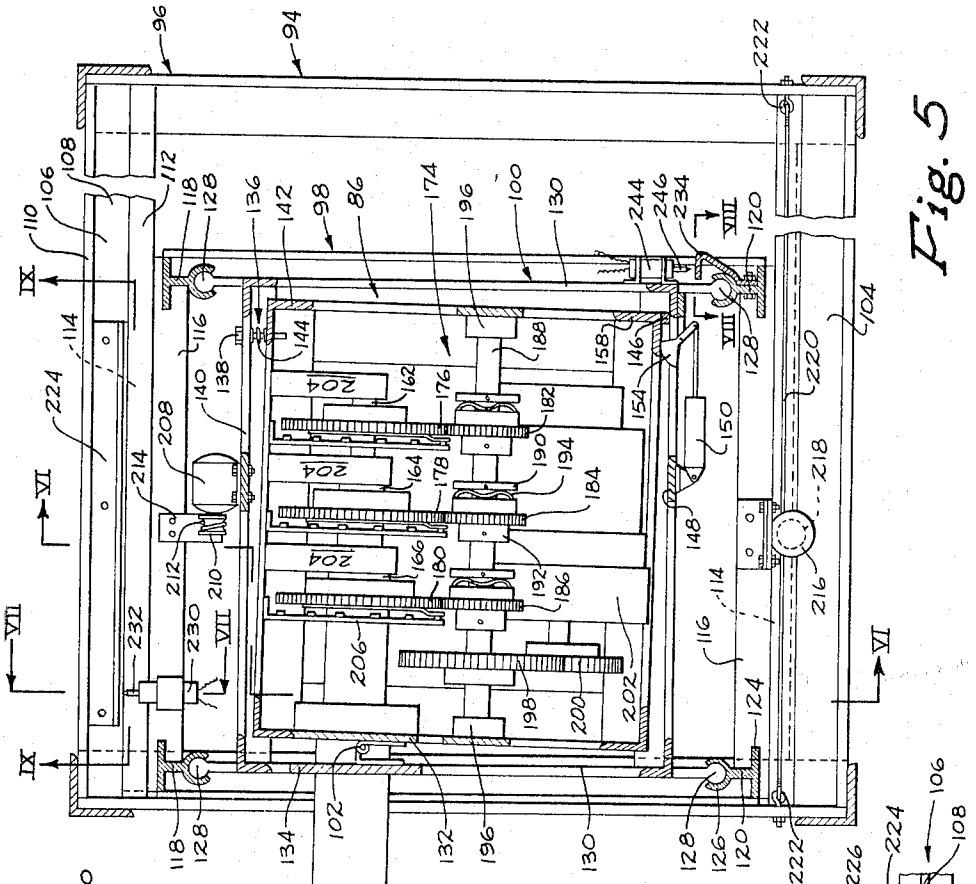


Fig. 5

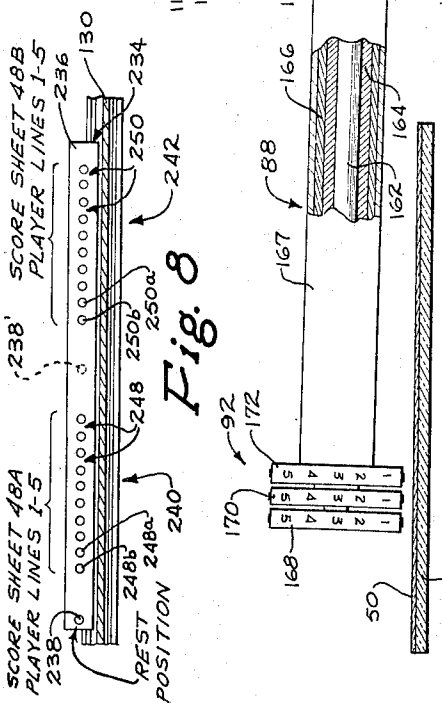


Fig. 8

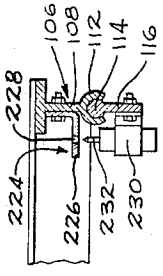


Fig. 7

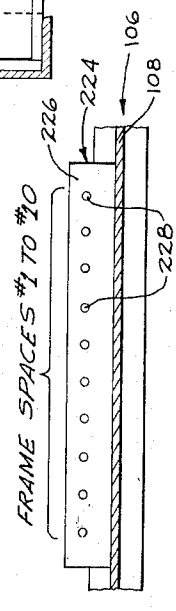


Fig. 9

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SETTABLE TYPE WHEEL PRINTING APPARATUS FOR A BOWLING GAME

Filed Aug. 30, 1963 5 Sheets-Sheet 4

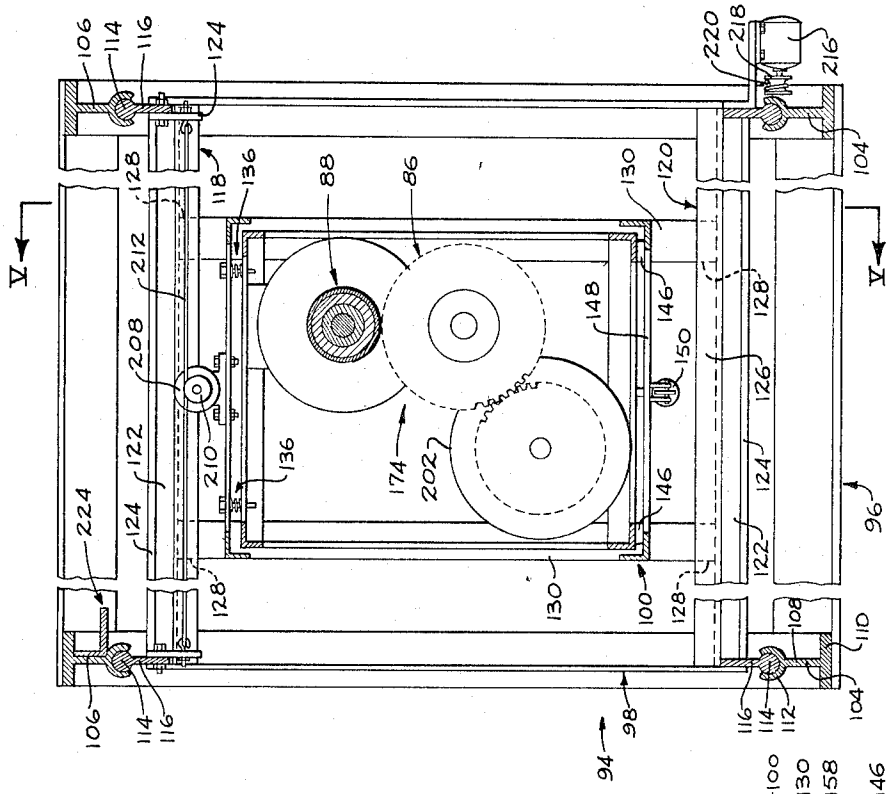


Fig. 6

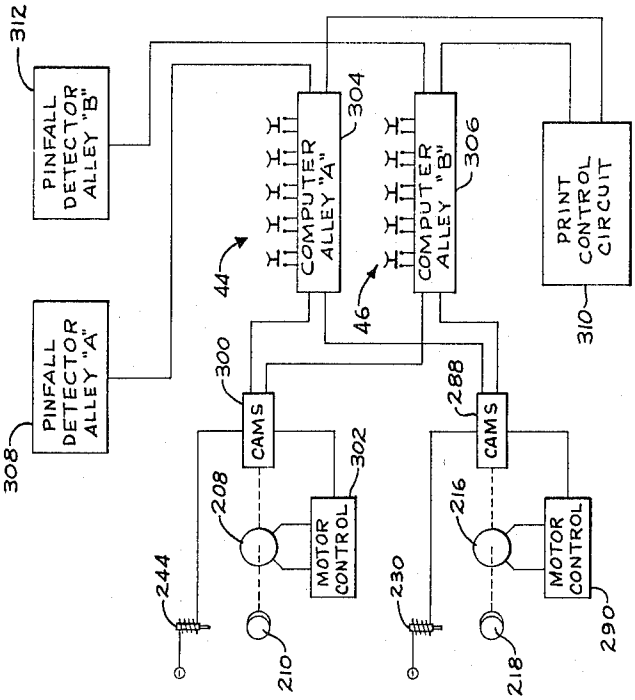


Fig. 11

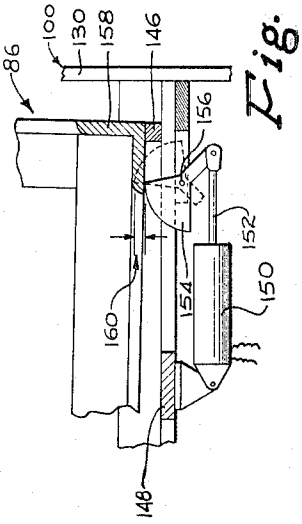


Fig. 10

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SETTABLE TYPE WHEEL PRINTING APPARATUS FOR A BOWLING GAME

Filed Aug. 30, 1963 5 Sheets-Sheet 5

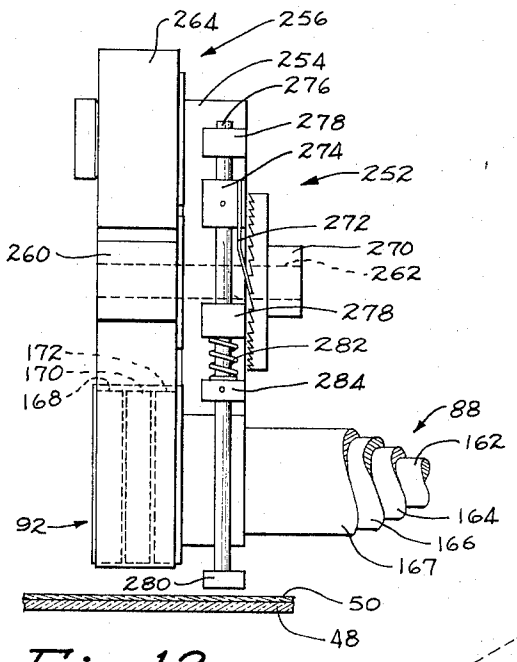


Fig. 12

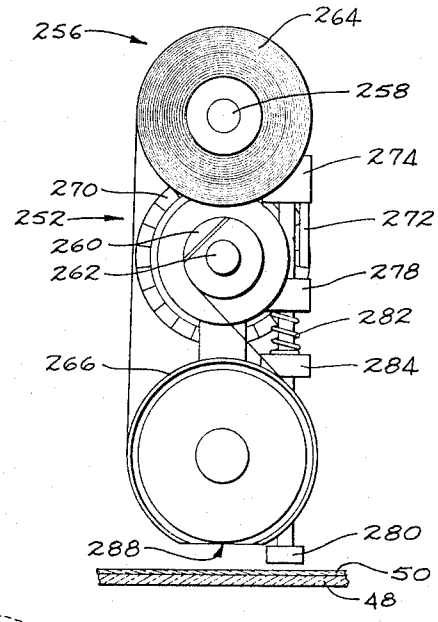


Fig. 13

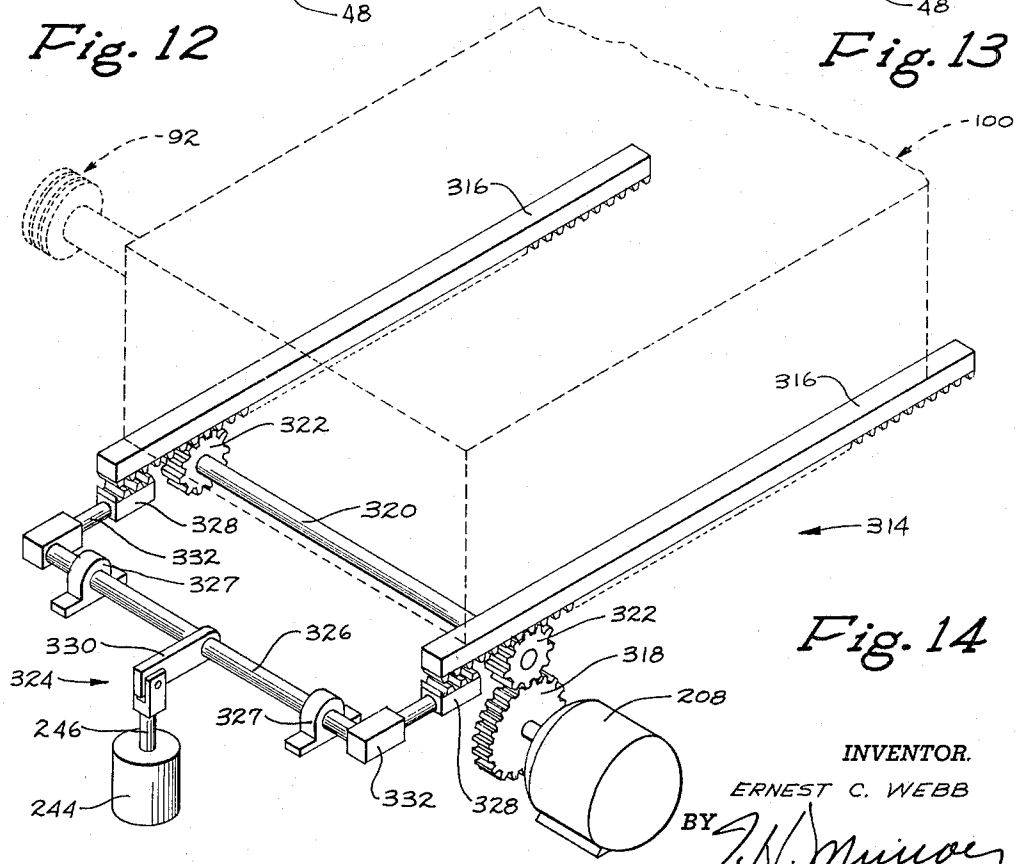


Fig. 14

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United States Patent Office

3,289,574

Patented Dec. 6, 1966

3,289,574

SETTABLE TYPE WHEEL PRINTING APPARATUS FOR A BOWLING GAME

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Filed Aug. 30, 1963, Ser. No. 305,591
5 Claims. (Cl. 101—93)

This invention relates to printing apparatus adapted to produce printed characters at any one of a plurality of places over the surface of sheet material or the like, and more particularly to apparatus for printing the ball results and scores of a bowling game score sheet.

Although not limited thereto, the present invention is particularly adapted for use in automatically printing the score on a bowling game score sheet and, in this respect, is usable with an automatic scoring and totalizing system such at that shown in U.S. Patent No. 3,124,355, issued March 10, 1964 and assigned to the assignee of the present invention.

In copending application Serial No. 281,279, filed May 17, 1963 and assigned to the assignee of the present invention, there is shown and described a printing apparatus wherein only three axially-aligned printing wheels are employed to print the ball results and scores on a bowling game score sheet. The bowling game score sheet is divided into player lines each of which is divided into a plurality of frame spaces. Each frame space is divided into score spaces and ball results boxes positioned directly above the score spaces. The size of the modified score sheet is materially reduced and permits the use of only one set of three printing wheels for printing the ball results and scores whereas heretofore six printing wheels were necessary for each score sheet. The reduced size of the modified score sheet also permits a substantially increased magnification of the printed characters whereby when they are projected onto a screen they will be more easily discernible.

As an overall object, the present invention seeks to provide apparatus for printing the ball results and scores on a bowling game score sheet wherein the apparatus itself is greatly simplified over previous devices of this type.

Other important objects of the invention include:

To provide printing apparatus in which the score sheet is exposed whereby the printed results may be viewed directly and/or projected onto a screen;

To provide printing apparatus in which the score sheet is exposed whereby the printed results may be manually corrected during progress of the bowling game;

To provide printing apparatus in which the printing wheels are positioned above the score sheet and the mechanism which positions the printing wheels with respect to the score sheet is disposed at one side of the score sheet thereby considerably simplifying the projection of the score sheet;

To provide printing apparatus in which means is provided for positioning the printing wheels exteriorly of the score sheet whereby there results an unobstructed view of the score sheet both for the direct viewing by the players and for the projection of the score sheet; and

To provide printing apparatus for printing the scores and ball results achieved in bowling games played simultaneously on adjacent alleys, as in the case of team play.

According to the present invention, there is provided a generally horizontal support plate which preferably is formed from transparent material such as glass. The support plate is provided with a pair of score sheets which are ruled or printed in side-by-side relation. Each score sheet preferably is divided into player lines each of which is divided into frame spaces. In turn, each frame space is further divided into score spaces and ball results boxes

which are directly above the score spaces. An elongated sheet is provided, formed from transparent material, which sheet overlies the support plate and is adapted to receive the printed ball results and scores of bowling games. Alternatively, the elongated sheet may be provided with a plurality of pairs of score sheets preferably printed on the upper surface thereof.

Extending over the score sheet are three coaxial shafts each of which has a printing wheel connected at its free end. The coaxial shafts are connected to a positioning mechanism which is disposed along one side of the support plate. Hence, the coaxial shafts extend from the positioning mechanism in cantilever beam relation.

Cooperating means are provided in the positioning mechanism whereby the wheels may be positioned at any one of the score spaces and ball results boxes of each of the score sheets. Means also is provided which lowers the printing wheels into printing engagement with the sheet material.

Light sources preferably are provided beneath the support plate which serve to illuminate the support plate whereby the printed results may be more clearly viewed directly by the players and for projection thereof. Projection means also is provided for simultaneously projecting the printed results, if desired, onto a screen for general viewing by the players and spectators. Means also is provided for positioning the printing wheels exteriorly of the score sheets so that they do not obstruct the score sheets when viewed by the players or when projected.

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 perspective view of a pair of bowling alleys with which the printing apparatus of the present invention may be used;

FIG. 2 is a fragmentary perspective view of the present printing apparatus;

FIG. 3 is a plan view illustrating the preferred configuration of the score sheet;

FIG. 4 is a schematic illustration of a projector means employed in the present printing apparatus;

FIG. 5 is a cross-sectional view, taken along the line V—V of FIG. 6, illustrating a positioning means;

FIG. 6 is a cross-sectional view, taken along the line VI—VI of FIG. 5, further illustrating the positioning means in FIG. 5;

FIG. 7 is a cross-sectional view, taken along the line VII—VII of FIG. 5, illustrating an indexing means;

FIG. 8 is a cross-sectional view, taken along the line VIII—VIII of FIG. 5, illustrating an indexing rail;

FIG. 9 is a cross-sectional view, taken along the line IX–IX of FIG. 5, illustrating a second indexing rail;

FIG. 10 is a fragmentary cross-sectional view, on an enlarged scale, illustrating a cam means used to lower the printing wheels;

FIG. 11 is a schematic illustration of the control circuit of the present invention;

FIGS. 12 and 13 are side and front elevation views repectively illustrating a carbon paper dispensing means; and

FIG. 14 is an isometric view illustrating an alternative embodiment of a drive and indexing means.

Referring now to the drawings, and more particularly 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 the foul line **22** is an approach area **24**; and between the approach areas 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 which will include a ball rack in the area **26**. Behind each

of the pin decks **20** is a pit, generally indicated at **30**, and behind each pit is a backstop **32**. In the area **26** is a console **34** which houses automatic scoring and totalizing apparatus such as that shown in the aforementioned U.S. Patent No. 3,124,355, and the printing apparatus of the present invention. Actually, the console **34** houses two automatic scoring and totalizing units, one for each of the alleys A and B. Each unit is adapted for connection to the printing apparatus, hereinafter described in detail, which prints the score on the upper face of a transparent sheet, not visible. At the rear of the console **34** there is provided a housing **36** within which a positioning mechanism is housed; and projector means **38** which serves to project an image of the score sheets onto screens **40**, **42** position in side-by-side relation above the bowling alleys A and B.

In front of the housing **36** and projector **38** are sets of pushbuttons **44** and **46**, one set of pushbuttons being provided for each of the alleys A and B. By reference to the aforesaid U.S. Patent No. 3,124,355, it will be understood that as each bowler from alley A, for example, prepares to bowl, he will push one of the pushbuttons **44** which is beside his name on a tab inserted adjacent to the pushbuttons **44**. Thereafter, when he delivers balls in each frame, the ball results of each ball will be printed on the appropriate score sheet and the score added to his previous score in the circuitry within the console **34**. In addition, upon completion of the frame, his score will be printed in his score space corresponding to the frame being played if no mark has been made in that frame. If a mark, such as a spare or a strike, has been made in the frame being played, then the score is not printed at that time but stored preparatory to printing after the next or successive frames in accordance with the rules of the American Bowling Congress.

Referring now to FIG. 2, the console **34** is shown with a portion cut away to show some of the internal details. As can be seen, a support plate **48**, preferably formed from glass, is positioned adjacent to the housing **36**. The support plate **48** is provided with a pair of score sheets **48A** and **48B** which are ruled or printed thereon in side-by-side relation. Alternatively, a plurality of pairs of the score sheets **48A** and **48B** could be ruled or imprinted on a transparent sheet **50** shown overlying the support plate **48**. In this instance, the transparent sheet **50** preferably would be provided with three sets of score sheets **48A** and **48B** so that each team would receive the printed results of three complete bowling games. The sets of score sheets may be printed on the upper surface of the transparent sheets and the results reproduced by any of the well known reproduction methods. After the printed score sheet has been reproduced, the printed results may be readily wiped off for reuse of the sheet. Thereafter, the upper surface of the transparent sheet **50** preferably is coated with a suitable thin clear film to protect the lines from being rubber off in too short of time as a result of the cleaning operation.

The preferred configuration of the score sheets **48A** and **48B** is illustrated in FIG. 3. As in conventional practice, the score sheet is divided into a plurality of player lines **52** each being divided into a plurality of frame spaces **54** which are numbered **1–10**. Each frame space **54** is divided into score spaces **56** and ball results boxes **58**. However, in contrast with conventional score sheets wherein the ball results boxes are at the upper right-hand corner of each frame space, the ball results boxes **58** are directly above the score spaces **56** in each frame space **54**. It will be noted that in the first frame space, only two score spaces **56** and two ball results boxes **58** are provided. In the second and succeeding frames, three score spaces **54** and three ball results boxes **58** are provided for scores exceeding one hundred. The present apparatus is adapted to print the scores and ball results directly above one another in the manner shown in frames **1** and **2** of the second player line.

Referring again to FIG. 2, the transparent sheet **50** is adapted to receive printed characters corresponding to the ball results and scores of simultaneously played games. As for example, the scores and ball results of the bowling games played by a first team on alley A would be printed on that portion of the sheet **50** overlying the score sheet **48A** and the scores and ball results of the bowling games played by a second team on alley B would be printed on that portion of the transparent sheet **50** overlying the score sheet **48B**. The transparent sheet **50** includes a leading portion **60** which is supported by the plate **48** in a generally horizontal orientation, and a trailing portion **52** which extends over and depends from a roll **64**. The transparent sheet **50** preferably is provided with a plurality of spaced, perforations **66** adjacent each side edge which perforations are engaged in driving relation by means of sprockets **68** mounted on a common shaft **69**. The shaft **69** is connected to a suitable drive means (not shown) for moving the sheet **50** over the support plate **48** whereby an unused portion thereof is positioned over the score sheets **48A** and **48B** for the purpose of printing the scores and ball results of subsequently played bowling games.

In the top wall **70** of the console **34** there are provided two rectangular openings **72**, **74** through which the score sheets **48A** and **48B** and portions of the sheet **50** are visible.

As best shown in FIGS. 2 and 4, a strip **76** of the top wall **70** is disposed between the score sheets **48A** and **48B**. The purpose of the strip **76** will become apparent later in the specification.

Positioned beneath the support plate **48** is a light source which has been schematically illustrated as comprising a pair of lights **78**, one each mounted directed beneath each of the score sheets **48A** and **48B**. It is to be understood that any suitable light source may be employed. The lights **78** serve to illuminate the score sheets **48A** and **48B** so that they may be viewed directly by the players. As can be seen in FIG. 4, if desired, the projector means **38** may be disposed directly above the plate **48** whereby images of the score sheets **48A** and **48B** may be projected onto the screens **40**, **42**, respectively. One form of the projector means **38** is schematically illustrated in FIG. 4. As can be seen, a set of three mirrors **79*a***, **79*b*** and **79*c*** are so positioned above the score sheet **48A** whereby the image of the score sheet **48A** is reflected into a suitable lens **80** for projecting the image onto the screen **42**. Similarly, a set of three mirrors **82*a***, **82*b*** and **82*c*** are so positioned above the score sheet **48B** whereby the image of the score sheet **48B** is reflected into a suitable lens **84** for projecting the image onto the screen **40**. It should be understood that a suitable hood (not shown) will be provided for covering the mirror system shown. Furthermore, it is preferable that the projector means **38** be so mounted on the console **34** whereby it may be lowered into a projecting position or raised out of the way so that the score sheets **48A** and **48B** may be viewed directly by the players.

Referring again to FIG. 2, a movable frame means **86**, illustrated in dotted outline as residing within the housing **36**, includes a coaxial shaft means **88** which extends therefrom in cantilever beam relation and through an elongated opening **90** provided in housing **36**. At the free ends of the coaxial shaft means **88** is a set of three printing wheels **92**. The coaxial shaft means **88** are adapted to move in a first direction, as for example, parallel with the frame spaces **54** and in a second direction, as for example, parallel with the player lines **52**. Hence, the printing wheels **92** are moved in quadrature whereby they may be aligned in printing relation with the score spaces or ball results boxes of successive frame spaces of either of the score sheets **48A** or **48B**.

Dispensing means (not shown in FIGS. 2 and 5) will be provided for supporting carbon paper or the like in engagement with the printing wheels **92** whereby imprints

of the printing characters may be transferred to the transparent sheet 50. This means will be described in conjunction with FIGS. 12 and 13.

Reference is now directed to FIGS. 5 and 6 wherein a printing wheels positioning mechanism 94 is shown and comprises stationary frame means 96 which is rigidly secured to the console 34 (not shown); first carriage means 98 slideably supported on the stationary frame means 96; second carriage means 100 slideably supported on the first carriage means 98; and the movable frame means 86 pivotally connected to the second carriage means 100 by means of hinge means 102 (only one shown in FIG. 5).

As can be seen, the stationary frame means 96 includes two pairs of opposed track members 104, 106 which extend in a direction which is parallel with the player lines 52 of the score sheets 48A and 48B. Each of the track members 104, 106 may comprise a web portion 108 having a transverse flange 110 at one end thereof and an arcurate trough portion 112 at the other end thereof.

The first carriage means 98 includes four rod members 114 each of which is contiguous with a web 116 forming a part of the framework of the first carriage means 98. The rod members 114 are disposed within the arcuate trough portions 112 of the track members 104, 106 and are slideable therealong whereby the first carriage means 98 is supported for reciprocal movement in a direction which is parallel with the player lines 52.

The first carriage means 98 includes two pairs of opposed track members 118, 120 which are identical with the track members 104, 106 of the stationary frame means 96. However, the track members 118 and 120 extend in a direction which is normal to the direction in which the track members 104, 106 extend, i.e., the track members 118, 120 extend in a direction which is parallel to the frame spaces 54 of the score sheets 48A and 48B. As in the case of the track members 104, 106, the track members 118, 120 may comprise a web portion 122 having a transverse flange 124 contiguous with one end thereof and an arcuate trough portion 126 contiguous with the other end thereof.

As can be seen by comparing FIGS. 5 and 6, the second carriage means 100 includes rod members 128 which are disposed within the trough portion 126 of the track members 118 and 120 of the first carriage means 98 and are slideable therealong whereby the second carriage means 100 is supported for reciprocal movement in a direction which is parallel with the frame spaces 54. Pairs of the rod members 128 are connected together by means of an elongated web 130 disposed at the four corners of the second carriage means 100.

As stated above, the movable frame means 86 is pivotally connected to the second carriage means 100 by means of hinge means 102. One of the hinge means 102 has one leaf thereof secured to a crossplate 132 of the movable frame means 86 and a second leaf secured to a crossplate 134 of the second carriage means 100. In FIG. 5 only one of the hinge means 102 is visible and it should be understood that on the other side of the coaxial shaft means 88 there is positioned a second hinge means 102 whereby an axis is defined which extends transversely of the coaxial shaft means 88. Hence, the movable frame means 86 is pivotal about the axis defined by the hinge means 102.

As can be seen, the movable frame means 86 is provided with a pair of resilient means 136, one each disposed at the upper rear corner thereof which means force the movable frame means 86 to rotate in a clockwise direction about the axis defined by the hinge means 102. Each of the resilient means 136 may comprise a bolt 138 extending through the webs of angle members 140 and 142 of the second carriage means 100 and the movable frame means 86, respectively. The bolt 138 is rigidly secured to the angle member 140 by being threaded thereon and extends through a clearance aperture (not visible) in the web of the angle member 142. Interposed between the webs of the angle members 140 and 142 is a spring member 144 which serves to bias the movable frame means 86 in a downward direction.

Referring now to FIGS. 5 and 10, the second carriage means 100 includes a pair of blocks 146 upon which the movable frame means 86 rests. Pivotally secured to a second crossplate 148 of the second carriage means 100 is a solenoid 150 which includes a plunger 152 pivotally secured to a cam means 154 which is pivotal about a center at 156. The cam means 154 is engaged with the web of an angle member 158 associated with the movable frame means 86. As can be seen in FIG. 10 when the solenoid is activated, the plunger 152 retracts within the solenoid 150 whereupon the cam member 154 is rotated about the center 156. As the cam member 154 rotates about the center 156, the movable frame means is simultaneously elevated through a distance indicated at 160. The purpose of elevating the movable frame means 86 through the distance 160 will become apparent later in the specification.

As can be seen in FIG. 5, the coaxial shaft means 88 comprises three coaxial shafts 162, 164 and 166 which have connected at their free ends printing wheels 168, 170 and 172 respectively. The coaxial shaft means 88 are housed within a support shaft 167 whose function will be described later in the specification. The printing wheels 168, 170 and 172 comprise the aforesaid set of three printing wheels 92. The coaxial shaft means 88 extends from the movable frame means 86 in cantilever beam relation. The coaxial shaft means 88 are connected to a printing wheels drive mechanism 174 (best shown in FIG. 5) which serves to rotate each of the printing wheels 168, 170 and 172 whereby the appropriate printing characters carried thereby will be positioned in printing relation with the transparent sheet 50.

A detailed description of the printing wheels drive mechanism 174 will be found in the aforesaid copending Application Serial No. 281,279. However, for the purposes of the present invention a brief description of the operation of the printing wheels drive mechanism 174 will now follow. Referring in particular to FIG. 5, it will be seen that the coaxial shafts 162, 164 and 166 each has a gear 176, 178 and 180, respectively, rigidly secured to the right-hand ends thereof. The gears 176, 178 and 180 engage gears 182, 184 and 186, respectively, each of the latter gears being slideably received on a main drive shaft 188. Each of the gears 182, 184 and 186 has a first hub 190 rigidly secured to the main drive shaft 188 and disposed on one side of the respective gear; while on the other side of the gear there is a second hub 192 also rigidly secured to the main drive shaft 188. Interposed between the first hubs 190 and the gears 182–186 are spring members 194 which urge the gears 182–186 into frictional engagement with the second hubs 192, the arrangement being such that the frictional engagement between each gear and the second hub will cause the gear to rotate with the main drive shaft 188. When, however, any one of the gears 176, 178 and 180 is braked or positively stopped, its associated gear 182–186 on the main drive shaft 188 will also stop and slide on the shaft 188. That is, the frictional engagement between each gear 182–186 and its associated hub 192 is such that it will rotate one of the gears 176–180 and its associated printing wheel only in the absence of any braking applied to the latter gears. In this respect, it will be appreciated that the assemblies of gears 182, 184 and 186 comprise slip clutch arrangments.

As can be seen, the main drive shaft 188 has its ends supported in bearing members 196 which, in turn, are rigidly secured to the movable frame means 86. The main drive shaft 188 also has rigidly secured thereon a main drive gear 198 which engages a second drive gear 200 driven by a main drive motor 202 supported on the movable frame means 86.

As can be seen, the shaft 162 is a solid shaft while the shafts 164, 166 comprise tubular shafts, all of which are coaxially aligned and each of which is rotatable independently of the others. The shafts 162, 164 and 166 are all supported on plastic bearing supports 204 extending downwardly from a crossplate of the movable frame means 86 such that the gears 162, 164 and 166 and their associated printing wheels 168, 170 and 172 will pivot about the transverse axis defined by the hinge means 102 when the cam means 154 engages the web of the angle member 158 (see FIG. 10). Hence, the counterclockwise displacement of the frame means 86 through the distance 160 will cause the printing wheels 168, 170 and 172 to be lowered into engagement with the transparent sheet 50 for printing the ball results or scores in the appropriate score space or ball results box.

Each of the gears 176, 178 and 180 has associated therewith an insulating board 206 which surrounds each of the shafts 162, 164 and 166 and which is secured to the movable frame means 86. Each of the insulating boards 206 is disposed adjacent to an associated one of the gears 176, 178 and 180. By reference to the aforesaid copending Application Serial No. 281,279, it will be found that the insulating boards 206 and the gears 176–180 are electrically connected and that each of the gears 176–180 has associated therewith two solenoids (not shown herein) which solenoids serve to control the rotation of the gears 176–180 and hence the printing wheels 168–172.

A first of the solenoids serves as an indexing means whereby each of the printing wheels 168–172, after having completed a printing cycle, is returned to a predetermined orientation. That is to say, each of the printing wheels 168–172 are returned to a predetermined position wherein, as for example, the printing character adjacent to the sheet 50 comprises the numeral 1. A second of the solenoids serves to stop the associated printing wheel when the desired numeral is adjacent to the transparent sheet 50. Hence, during each printing cycle the first solenoid is disengaged from one of the gears 176–180 whereby the gear will rotate. As the appropriate printing character approaches the transparent sheet 50 the second of the solenoids will be activated to stop the gear whereby the appropriate numeral is positioned adjacent to the transparent sheet 50 and in printing relation therewith. It should be understood at this pont, that the selection of the appropriate printing characters for each of the printing wheels 168–172 occurs simultaneously. After the printing wheels 168–172 have been lowered to print the ball results or scores on the transparent sheet 50, the second solenoids are disengaged from the gears 176–180 whereupon they rotate until such time as they reach the predetermined orientation whereupon the first of the solenoids stops the gears 176–180.

The printing wheels positioning mechanism 94 also includes means by which the printing wheels are moved in a direction parallel to the frame spaces 54 (see FIG. 3) whereby they may be positioned in printing relation with any one of the ball results boxes or score spaces of each of the player lines 52; and means for moving the printing wheels in a direction which is parallel to the player lines 52 whereby the printing wheels may be positioned in printing relation with any of the frame spaces.

In order to move the printing wheels in a direction which is parallel with the frame spaces 54, the second carriage means 100 has mounted thereon a first motor means 208 which includes a sheave 210 adapted to receive a cable 212. The cable 2112 extends from either side of the first motor means 208 and is connected to plates 214 which are rigidly secured to the webs 116 extending from the rod members 114. As can best be seen in FIG. 6, the second carriage means 100 will be moved to the right as viewed in FIG. 6 when the sheave 210 is rotated in a counterclockwise direction; and the second carriage means 100 will be moved to the left as viewed in FIG. 6 when the sheave 210 is rotated in a clockwise direction. It will be appreciated then that the first motor means 208 preferably comprises a reversible motor. The reciprocal movement of the second carriage means 100 is guided by the rod members 128 which, in turn, are guided by the arcuate troughs 126 associated with the pairs of track members 118 and 120.

The first carriage means 98 has associated therewith a second motor means 216 which includes a sheave 218 adapted to receive a cable 220. The cable 220 extends from either side of the sheave 218 and is connected at its opposite ends to the stationary frame means 96 as indicated at 224 (see FIG. 5). Thus, the first carriage means 98 will be moved to the right as viewed in FIG. 5, when the sheave 218 is rotated in a counter-clockwise direction; and the first carriage means 98 will be moved to the left as viewed in FIG. 5 when the sheave 218 is rotated in a clockwise direction. The reciprocal movement of the first carriage means 98 is guided by the rod members 114 which, in turn, are guided by the arcuate trough portions 112 associated with the track members 104 and 106.

Referring now to FIGS. 5, 7 and 9, the stationary frame means 96 includes a first indexing plate 224 which is secured to the web portion 108 of an upper one of the track members 106. The first indexing plate 224 comprises an angle member having a leg 226 extending substantially horizontally from the web portion 108. The leg 226 is provided with a plurality of equally spaced apertures 228 which, as indicated in FIG. 9, correspond to the frame spaces of the score sheets 48A and 48B which are numbered from 1 to 10. Secured to the web portion 116 of the rod member 114 which is engaged in the trough portion 112 of the track member 106, is an indexing solenoid 230 having a plunger 232 adapted to be engaged in one of the apertures 228 of the indexing plate 224. The plunger 232, although shown spaced from the indexing plate 224, preferably is spring-biased whereby it is normally engaged with the indexing plate 224 when the solenoid 230 is deenergized, and it is pulled out of engagement with the indexing plate 224 when the solenoid 230 is energized.

Referring now to FIGS. 5 and 8, one of the track members 120 is provided with a second indexing plate 234 which is secured to the web portion 122 thereof. The second indexing plate 234 includes a horizontally disposed leg 236 which has provided thereon, in order, a single aperture 238 and first and second sets of apertures 240 and 242. As indicated in FIG. 8 the single aperture 238 corresponds to a rest position (hereinafter to be described), the first set of apertures 240 corresponds to the player lines 1 to 5 of the score sheet 48A, and the second set of apertures 242 corresponds to the player lines 1 to 5 of the score sheet 48B. As can be seen in FIG. 5, a second indexing solenoid 244 is secured to one of the webs 130 extending between the rod members 128. The second indexing solenoid 244 includes a plunger 246 which is adapted to be engaged in one of the apertures provided in the second indexing plate 234. Although the plunger 246 is shown spaced from the second indexing plate 234, the plunger 238 preferably is spring-biased whereby it is urged toward the second indexing plate 234.

Referring now to FIGS. 2 and 8, the single aperture 238 corresponds to a rest position of the set of printing wheels 92. This rest position is shown in dotted outline in FIG. 2 and is indicated by the numeral 93. As can be seen in FIG. 2, the rest position 93 of the set of printing wheels 92 is disposed exteriorly of the score sheet 48A, i.e., it is positioned above the top wall 70 wherein it will not interfere with the projection of the score sheets 48A and 48B and will not obstruct the view of the score sheets 48A and 48B when viewed by the players. Means (to be described later) are provided

to transport the set of printing wheels 92 into the rest position 93 (shown in dotted outline) which is forward of the support plate 48 after the printing of the ball results and/or scores of each frame space of each player line. If desired, means may be provided to transport the set of printing wheels 92 into the rest position 93' (shown in dotted outline) which is to the right of the support plate 48. In either case, the set of printing wheels 92 resides exteriorly of the score sheets 48A and 48B.

Alternatively, means may be provided for positioning the set of printing wheels 92 in that position illustrated in FIG. 2 i.e., above the strip 76 in the upper wall 70 (see FIG. 4). In this alternative position, the set of printing wheels 92 and the coaxial shaft means 88 are again so position whereby they will not interfere with the projection of the score sheets 48A and 48B. However, in this alternative position, difficulty will be encountered by the player in manually correcting the printed results on the scrore sheet 48A. Hence, the alternative positioning of the set of printing wheels 92 and the coaxial shaft means 88 is preferred when the score sheets 48A and 48B are to be projected and where access to the score sheets 48A and 48B is not provided for the players. The alternative positioning of the set of printing wheels 92 and the coaxial shaft means 88 is desirable since the distance traveled by the set of printing wheels 92 from score sheet-to-score sheet will be minimized. As can be seen in FIG. 8, the second indexing plate 234 may be provided with an aperture 238', shown in dotted outline, into which the plunger 246 will drop when the set of printing wheels 92 is positioned in the aforesaid alternate rest position.

Referring again to FIGS. 5 and 8, the first set of apertures 240 comprises five pairs of apertures 248, each pair of apertures 248 comprises aperture 248*b* and aperture 248*a* corresponding to the ball results boxes and score spaces, respectively, of each player line of the score sheet 48A. Similarly, the second set of apertures 242 comprises five pairs of apertures 250, each pair of apertures 250 comprising aperture 248*b* and 248*a* corresponding to the ball results boxes and score spaces, respectively, of each player line of the score sheet 48B.

Referring now to FIGS. 12 and 13, there is illustrated dispensing means 252 which serves to support carbon paper or the like in engagement with the printing wheels 92 whereby when the printing wheels 92 are lowered into engagement with the transparent sheet 50 an imprint of the printing characters will result. As can be seen, the dispensing means 252 includes a vertical support member 254 which is secured to the support shaft 167 by any suitable means. The vertical support member 254 carries a feed roll 256 secured to a shaft 258 and a takeup roll 260 secured to a shaft 262. The shaft 262 is rotatably supported by the support member 254 and extends beyond the other side thereof. A roll of carbon paper 264 is supported on the feed roll 256 and extends therefrom downwardly around an arcuate deflecting plate 266 surrounding the printing wheels 92 and having a split 268 disposed adjacent to the bottom of the printing wheels 92. The carbon paper 264 extends across the split 268 and upwardly around the deflecting plate to the takeup roll 260.

Secured to the other end of and rotatable with the shaft 262 is a ratchet wheel 270 whose teeth are engaged by a pawl 272 formed from resilient material such as spring steel. The pawl 272 depends from a carrier block 274 secured to a vertically extending shaft 276. The vertically extending shaft 276 is supported for vertical sliding movement in bearing members 278 secured at spaced points on the vertical support member 254.

At the lower end of the vertically extending shaft 276 is a pad 280 which is adapted to engage the transparent sheet 50 and lifts the vertically extending shaft 276 relative to the printing wheels 92. A spring member 282 is provided which surrounds the vertically extending shaft 254 and is adapted to be compressed between the lower bearing block 278 and a block 284 secured to the shaft 276 whereby the vertically extending shaft 276 is biased downwardly toward the transparent sheet 50.

In operation, then, each time a score or ball result is to be printed, the printing wheels 92 are lowered into engagement with the transparent sheet 50 whereupon the printing characters carried thereby will impress their symbols onto the transparent sheet 50 by means of the carbon paper 264. Notice, however, that in the downward stroke of the printing wheels 92, the spring member 282 is compressed and the pawl 272 is elevated and engaged with the next in line tooth of the ratch member 270. Hence, when the printing wheels 92 are again elevated to their normally raised position, the spring member 282 lowers the vertically extending shaft 276 whereupon the ratchet member 270 will be rotated through a predetermined distance to bring a fresh portion of carbon paper beneath the printing wheels 92 for subsequent printing of additional scores or ball results.

Reference is now directed to FIG. 11 wherein there is schematically illustrated a control circuit for the present printing apparatus. The motor means 216 of the first carriage means 98 has associated therewith a first set of cams 288 which serves to control the stopping and starting of the motor means 216 by way of a motor control circuit 290 and also the energization and deenergization of the first indexing solenoid 230. Similarly, the motor means 208 of the second carriage means 100 has associated therewith a second set of cams 300 which serves to control the stopping and starting of the motor means by way of a motor control circuit 302 and also the energization and deenergization of the second indexing solenoid 244.

Two computers 304, 306 are provided, one each for alley A and alley B, respectively. Computer 304 is connected to both of the sets of cams 288, 300; a pinfall detector 308 associated with alley A; and a print control circuit 310. Similarly, the computer 306 is connected to both of the sets of cams 288, 300; a pinfall detector 312 associated with alley B; and the print control circuit 310.

In order to simply the explanation of the operation of the present printing apparatus, it will be assumed that only one team is to play with each player bowling alternatively on alleys A and B and that the first player is about to bowl.

Referring now to FIGS. 2, 5, 6 and 11, the first player, prior to bowling, will depress the first one of the buttons 44 adjacent his name. This activates his circut in the computer 304 associated with alley A. After the first ball is delivered, the pinfall detector 308 signals the computer 304 whereupon the print control circuit 310 activates the drive mechanism 174. If, for example, three pins are knocked down, the drive mechanism 174 rotates the printing wheel 170 until the print character three is adjacent the sheet 50. Simultaneously, the second indexing solenoid 244 is energized to disengage the plunger 246 from the aperture 238 corresponding to the rest position 93 (see FIG. 2). Thereafter, the motor means 208 is activated whereby the second carriage 100 is moved to the right as viewed in FIG. 6. When the second carriage means 100 has moved through a distance determined by one of the cams 300, the motor means 208 and the second indexing solenoid 244 are deenergized. The plunger 246 will engage the aperture 248*b* of the first pair of apertures 248. The printing wheel 170 will now be positioned in printing relation with the first ball results box of the score sheet 48A. The solenoid 150 is sequentially energized whereby the printing wheels 92 are lowered, in a manner heretofore described, to print the ball results or printing character three on the sheet 50 and then deenergized whereby the printing wheels 92 are elevated to their normally raised positions.

After the second ball has been delivered, the ball results is printed in the second ball results box of the first frame of score sheet 48A by means of the printing wheel 172. If the remaining seven pins are knocked down, a spare mark is entered in the second ball results box. If, however, less than seven pins are knocked down, for example six, an "open frame" results. The print character six, first is printed in the second ball results box. Thereafter, the second carriage means 100 again is moved to the right, as viewed in FIG. 6, by the sequential energization of first the second indexing solenoid 244 and the motor means 208; and then the deenergization of the motor means 208 and the second indexing solenoid 244. The second distance through which the second carriage means 100 travels is determined by one of the cams 300. In this second position, the plunger 246 will be engaged in the aperture 248*a* of the first pair of apertures 248 in the indexing plate 234. The printing wheels 170 and 172 will be aligned in printing relation with the score spaces 56 of the first frame of score sheet 48A. Since a total of nine pins have been knocked down, the printing wheel 172 will have been rotated, during the movement of the second carriage means 100, whereby the printing character nine is adjacent the sheet 50. The score is then printed.

Having completed a printing cycle, the second carriage means 100 is moved to the left, as viewed in FIG. 6, until the printing wheels 92 are positioned in the rest position 93 (see FIG. 2). Hence, when only one team or single player is bowling, a "printing cycle" is defined as the movement of the printing wheels 92 from the rest postion 93 to the printing poition for each frame of each player and back to the rest position 93.

When all of the players have completed the first frame, the first indexing solenoid 230 is energized to disengage the plunger 232 from the first of the apertures 228 in the first indexing plate 244 (see FIG. 9). The motor means 216 is energized whereby the first carriage means 98 is moved to the right, as viewed in FIG. 5, through a distance determined by one of the cams 288. At this point, the motor means 216 and the first indexing solenoid 230 are deenergized. The plunger 232, thus, engages the second of the apertures 228 in first indexing plate 224. The printing wheels 92 are now aligned with the second frame of the score sheets 48A and 48B.

If desired, a "league play" switch (not shown) may be provided which permits each player to bowl alternately on alleys A and B. In this instance, the computer 304, for example, would be alternately connected with the pinfall detectors 308 and 312. It should be understood, that, for example, the computer 304 has the intelligence stored therein for directing each player to the proper alley and for aligning the printing wheels 92 with the proper player line, frame, and either the ball results boxes or score spaces of the frame being played for each player.

In the case of team play, that is, when two teams are playing and two players are bowling simultaneously, each player, prior to bowling, depresses the appropriate one of the buttons 44 or 46. After the first of the two players has delivered his bowling ball, the printing wheels 92 will be automatically positioned over his player line on, for example, score sheet 48A and aligned with the ball results box thereof to print the results of his first delivery. After the second of the two players has delivered his bowling ball, the printing wheels 92 will be automatically positioned over his player line on score sheet 48B and aligned with the ball results box thereof to print the result of his first delivery. After the first of the two players has delivered his second ball, assuming no mark has been made with the first ball, the printing wheels 92 will be automatically positioned over his player line on score sheet 48A and aligned with the ball results box thereof to print the result of his second delivery. Assuming a spare is made, a conventional mark is printed in the ball results box. After the second of the two players has delivered his second ball, the printing wheels 92 will be automatically positioned over his player line on score sheet 48A and aligned with the ball results box thereof to print the result of his second delivery. Assuming that a spare is not made, the number of pins knocked down by the second ball will be printed in the second ball results box whereupon the printing wheels 92 again will be moved so that they are positioned over the score spaces of his player line. The total number of pins knocked down will be printed in the score space since a mark has not been made in that frame. At this point, the printing wheels 92 will be moved to the rest position 93 (see FIG. 2).

It is important to note that during the playing of each frame, the printing wheels 92 are positioned to print the results of the balls in the order that they are bowled as described above. Hence, during team play, a "printing cycle" is defined as the movement of the printing wheels 92 from the rest position 93 to the printing positions for a predetermined frame on score sheets 48A, 48B, then back to the rest position 93.

Referring now to FIG. 14, there is illustrated a drive and indexing means 314 which, as will become apparent, comprises an alternative embodiment of the drive and indexing mechanisms already described. Accordingly, corresponding numerals will be employed to identify corresponding parts already described.

At the outset, it should be pointed out that although only one drive and indexing means 314 has been illustrated, it should be understood that each of the first and second carriage means 98 and 100 will be provided with one of the drive and indexing means 314. To this end, the drive and indexing means 314 has been illustrated as being mounted on the second carriage means 100 shown in phantom outline.

As can be seen, the drive and indexing means 314 comprises a pair of positioning rack members 316 which are secured to the bottom of the second carriage means 100 by any suitable means. The positioning rack members preferably extend beyond both sides of the second carriage means 100. Secured at a central location on the first carriage means 98 (not shown) is the drive motor 208 having a drive gear 318 secured to the drive shaft thereof. Journaled at a central location on the first carriage means 98 (not shown) is a shaft 320 which extends between the positioning rack members 316. The shaft 320 has secured to its ends pinion gears 322 both of which are engaged in driving relation with the positioning rack members 316 and one of which is engaged with the drive gear 318 of the motor 208.

As illustrated, the second carriage means 100 is so positioned whereby the printing wheels 92 are disposed in printing relation with the first layer line 52 of the score sheet 48A (see FIGS. 2 and 3). Hence, when the motor 208 is energized, the second carriage means 100 will be displaced toward the left as viewed in FIG. 14. By reversing the driving direction of the motor 208, the second carriage means 100 will be displaced toward the right as viewed in FIG. 14.

In order to accurately position the printing wheels 92 in printing relation with the player lines 52 of the score sheets 48A and 48B, an indexing means 324 is provided which comprises the solenoid 244 carried by the first carriage means 98, a shaft 326 also journaled to the first carriage means 98 by means of bearing blocks 327, and a pair of indexing rack segments 328. As can be seen, an arm 330 has one end secured to the shaft 326 and the other end pivotally secured to the plunger 246 of the solenoid 244. Further, arms 332 are provided each of which extend between and is rigidly secured at its ends to the indexing rack segment 328 and the shaft 326.

When the solenoid 244 is energized, the arm 330 will rotate the shaft 326 in a counterclockwise direction whereupon the indexing rack segments 328 are forced into engagement with the positioning rack members 316. Upon

deenergization of the solenoid 244, the indexing rack segments 328 will be disengaged from the positioning rack members 316 whereby the second carriage means 100 may be moved to a different position relative to the score sheets 48A and 48B.

As stated above, a similar drive and indexing means 314 will be provided for driving and positioning the first carriage means 98 relative to the score sheets 48A and 48B. In this instance, the motor 218 and the solenoid 230 (see FIG. 5) as well as the shaft 326 will be secured to the stationary frame means 96. Operation of this second drive and indexing means 314 will serve to position the printing wheels 92 in printing relation with the score spaces 56 and the ball results boxes 58 of the score sheets 48A and 48B as heretofore described.

It should be pointed out that the pitch of the positioning rack members 316 will be chosen so that engagement of the indexing rack segments will correspond to the spacing of the player lines and the score spaces and ball results boxes of the score sheets 48A and 48B.

Although the present invention has been disclosed and described 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. To this end, it should be evident that the overall height of the printing wheel positioning mechanism 94 may be reduced by eliminating the upper rod and track members of both the first and second carriage means. Further, the stationary frame need only comprise a support structure of sufficient strength and disposed below the first and second carriage means. Still further, it should be obvious that means other than the rod and track members illustrated in the accompanying drawings may be employed to guide the first and second carriage means.

I claim as my invention:

1. Apparatus for recording the frame-to-frame ball results and scores achieved in a bowling game on a sheet, comprising: stationary frame means; plate means disposed exteriorly of said stationary frame means and adapted to support said sheet; said plate means having ruled thereon a score sheet divided into player lines each of which is divided into frame spaces, said frame spaces being divided into score spaces and ball results boxes disposed directly above said score spaces; first carriage means slideably supported on said stationary frame means for reciprocal movement in a first direction; second carriage means slideably supported on said first carriage means for reciprocal movement in a second direction which is perpendicular to said first direction; said first and second directions being parallel to said player lines and the rows of frame spaces; movable frame means pivotally supported on and movable with said second carriage means; printing wheel drive means supported by said movable frame means; coaxially-aligned shaft means connected to said printing wheel drive means and extending therefrom in cantilever beam relation and adjacent to one face of said sheet; said frame means being pivotal about an axis extending transversely of said coaxially-aligned shaft means; three axially-aligned printing wheels connected to the free ends of said shaft means and disposed adjacent to said sheet; cooperating means associated with each of said first and second carriage means for positioning said printing wheels with respect to said score spaces and ball results boxes of said player lines; and means for moving said printing wheels into printing engagement with said sheet.

2. The apparatus of claim 1 wherein each of said cooperating means comprises motor means for moving each of said carriage means and solenoid means including plunger means adapted to engage a predetermined one of a plurality of stop means for stopping the movement of said carriage means whereby said printing wheels are positioned in a predetermined relation with respect to said sheet.

3. The apparatus of claim 1 wherein said cooperating means comprises positioning rack means associated with said carriage means, motor means engaged in driving relation with said positioning rack means, second rack means adapted to engage said positioning rack means at predetermined points along its length, and means for moving said second rack means into and out of engagement with said positioning rack means.

4. Apparatus for recording the frame-to-frame ball results and scores achieved in a bowling game on a score sheet, comprising: plate means adapted to support said score sheet; frame means disposed adjacent to said plate means; movable carriage means for supporting and positioning said frame means relative to said score sheet; printing wheel drive means supported by and movable with said frame means; axially-aligned printing wheels disposed adjacent to said support plate and exteriorly of said movable carriage means and said frame means; coaxial shaft means connecting said printing wheels to said printing wheel drive means; means associated with and for moving said movable carriage means whereby said printing wheels are positionable in printing relation with the score spaces and ball results boxes of said score sheet; pivot means connecting said frame means to said carriage means whereby said frame means is pivotal about an axis extending transversely of said coaxial shaft means; and means for pivoting said frame means about said axis whereby said printing wheels are brought into printing engagement with said score sheet.

5. Apparatus for recording the scores achieved in a bowling game on a bowling game score sheet, comprising stationary frame means, plate means disposed exteriorly of said stationary frame means and adapted to support a bowling game score sheet, first carriage means supported on said stationary frame means for reciprocal movement in a first direction, second carriage means supported on said first carriage means for reciprocal movement in a second direction which is perpendicular to said first direction, said first and second carriage means being movable in planes which are parallel to said score sheet, movable frame means pivotally supported on and movable with said second carriage means, printing wheel drive means supported by said movable frame means, printing wheel support means carried by said movable frame means and extending therefrom in cantilever beam relation and adjacent to one face of said score sheet, printing wheel means supported on the free end of said support means and operatively connected to said printing wheel drive means, cooperating means associated with each of said first and second carriage means for positioning said printing wheel means with respect to said score sheet, and means for selectively pivoting said movable frame means on the second carriage means to thereby move said printing wheel means carried on the support means into printing engagement with said score sheet.

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