April 29, 1969 D. D. MILLER 3,440,956

APPARATUS FOR SEQUENTIALLY PRINTING AND PROJECTING DATA SUCH AS GAME SCORES

Filed June 26, 1967 Sheet 1 of 4

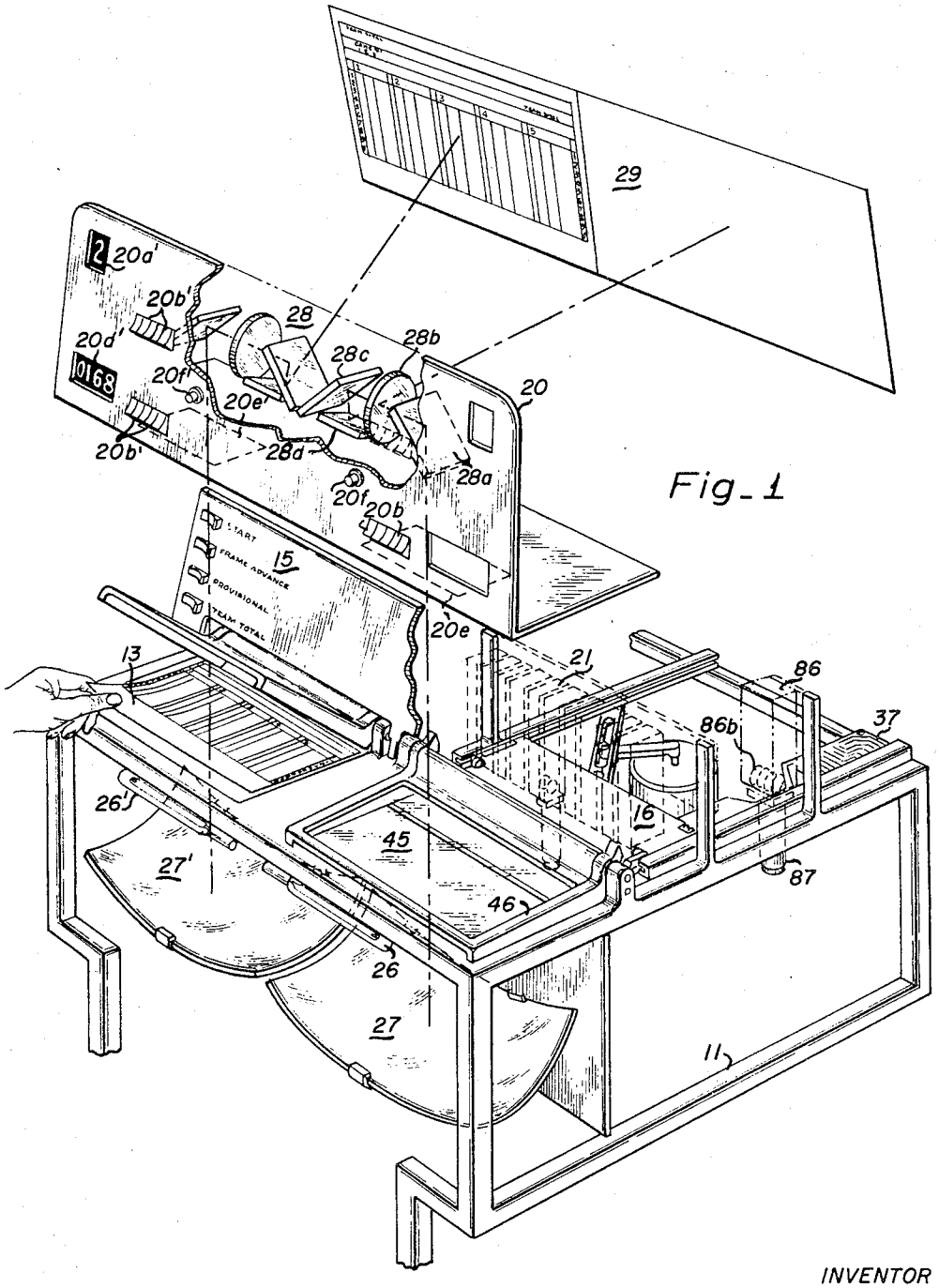


Fig_1

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APPARATUS FOR SEQUENTIALLY PRINTING AND PROJECTING DATA SUCH AS GAME SCORES

Filed June 26, 1967 Sheet 2 of 4

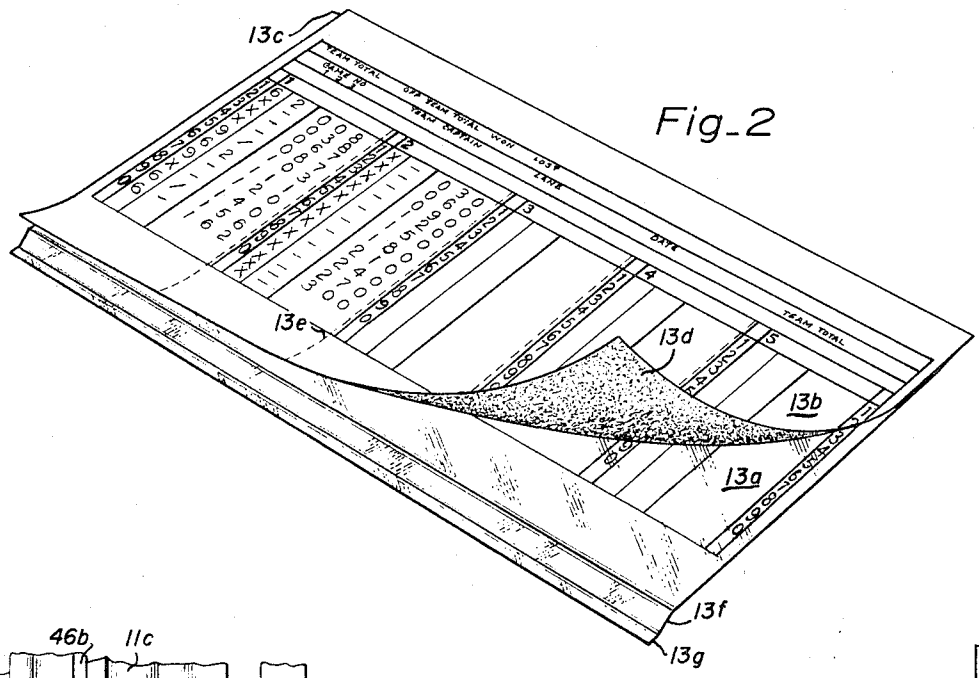


Fig_2

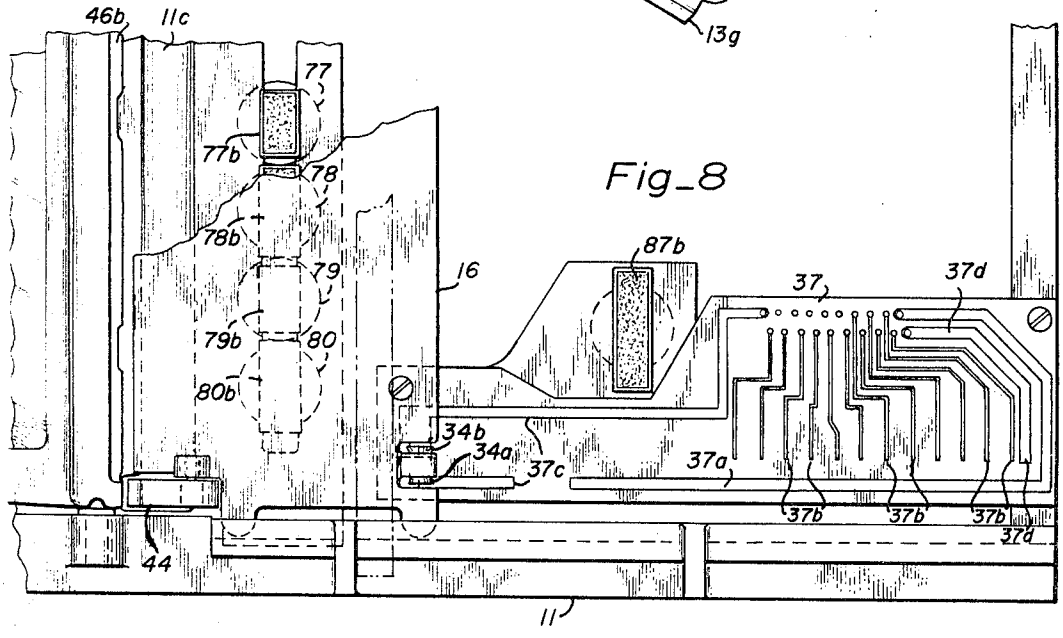


Fig_8

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APPARATUS FOR SEQUENTIALLY PRINTING AND PROJECTING DATA SUCH AS GAME SCORES

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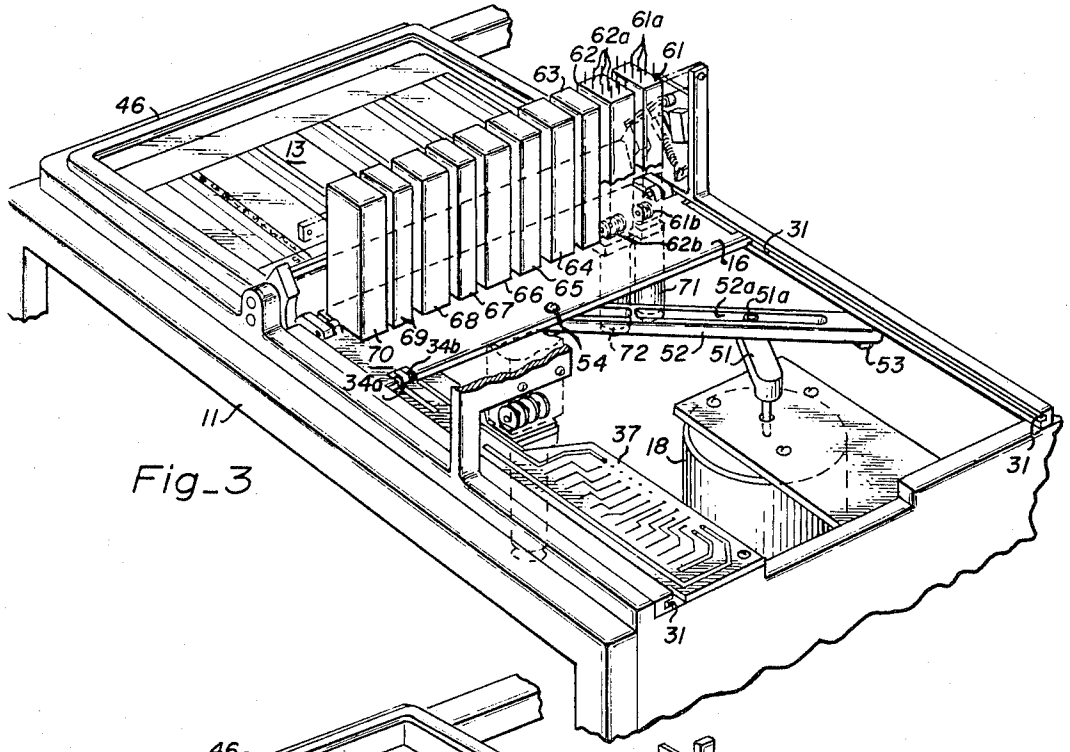


Fig_3

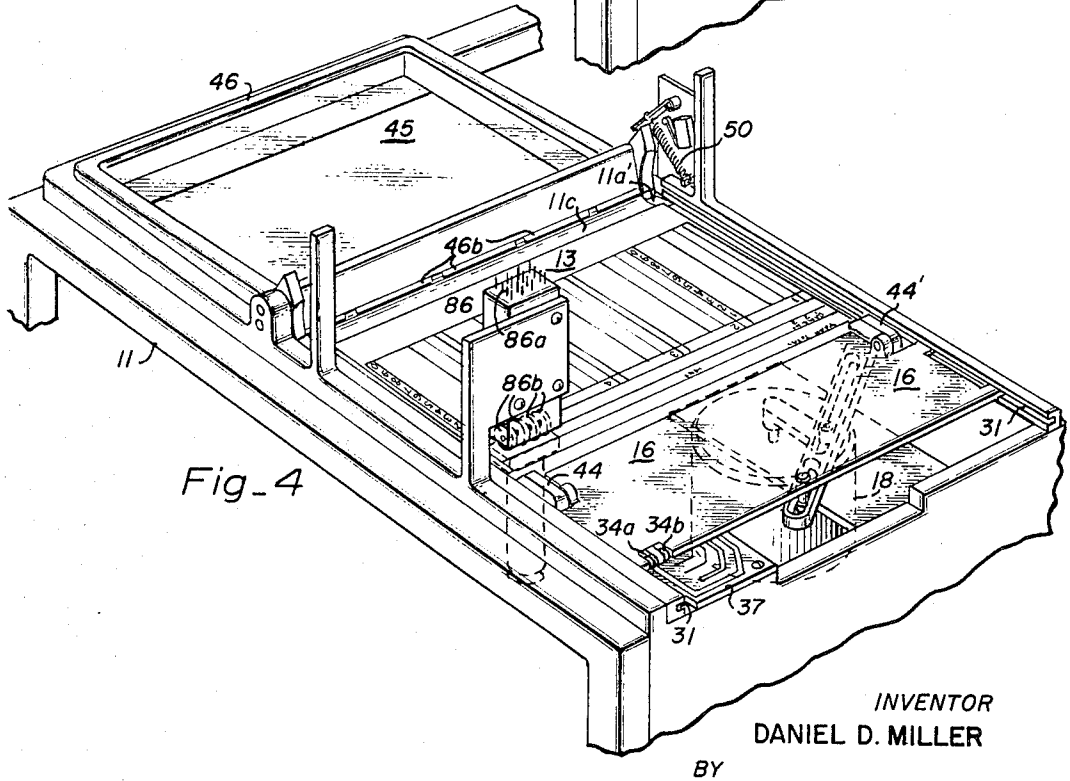


Fig_4

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April 29, 1969 D. D. MILLER 3,440,956

APPARATUS FOR SEQUENTIALLY PRINTING AND PROJECTING DATA SUCH AS GAME SCORES

Filed June 26, 1967 Sheet 4 of 4

Fig_5

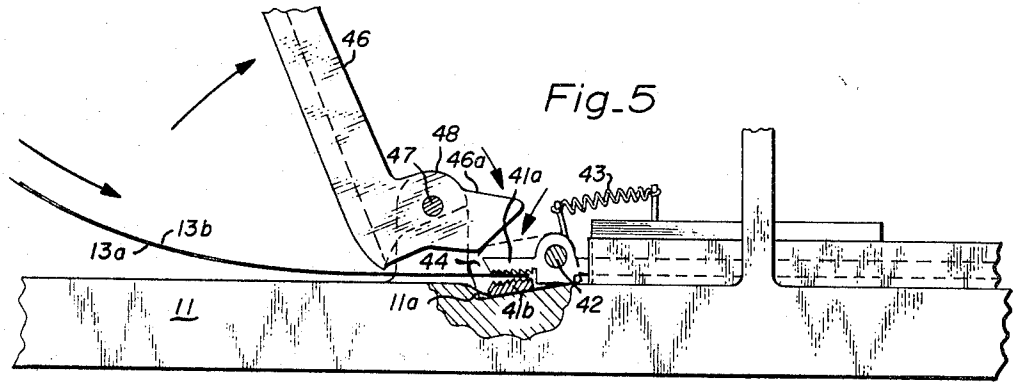


Fig_6

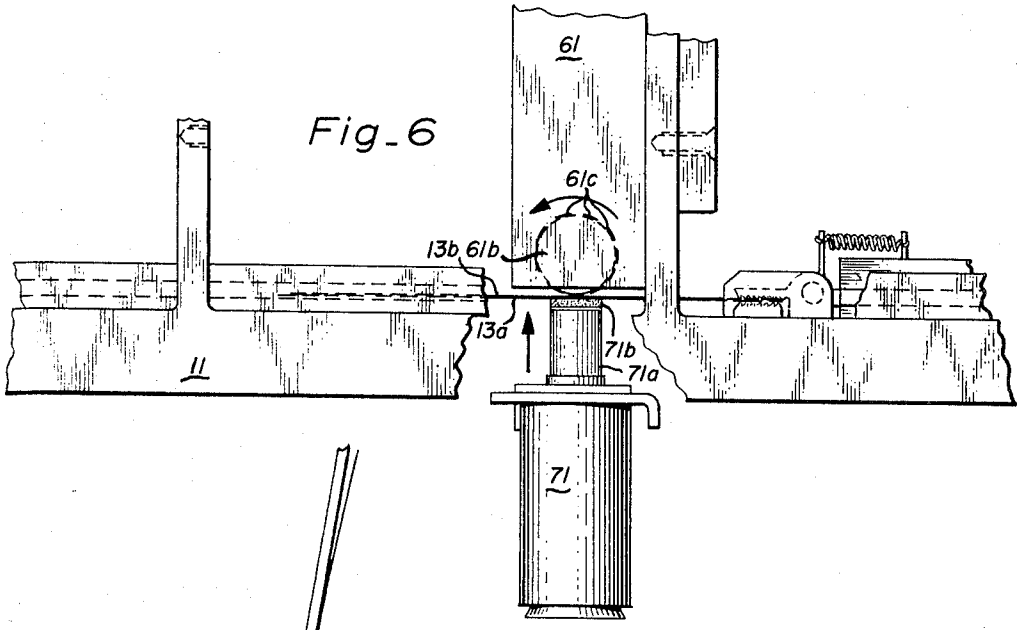
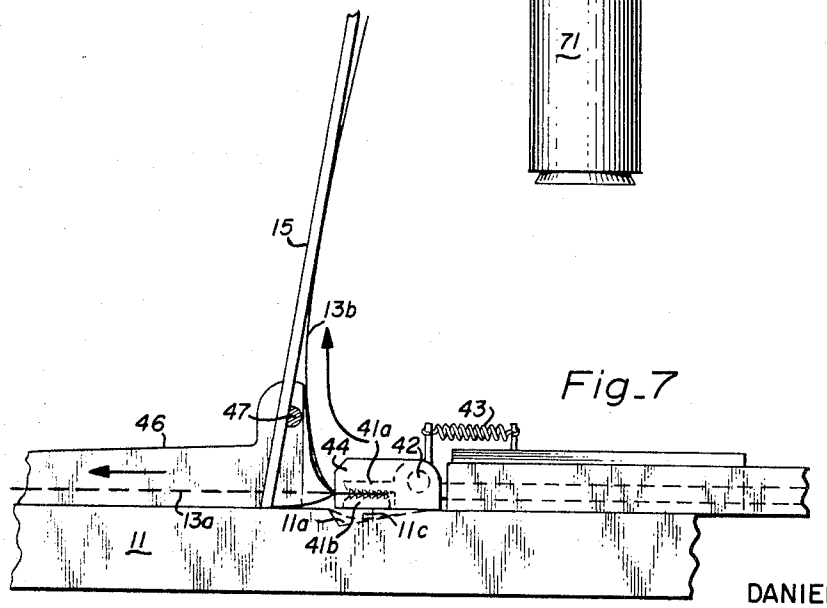


Fig_7



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United States Patent Office 3,440,956 Patented Apr. 29, 1969

3,440,956

APPARATUS FOR SEQUENTIALLY PRINTING AND PROJECTING DATA SUCH AS GAME SCORES

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Filed June 26, 1967, Ser. No. 648,863
Int. Cl. B41j 9/36
U.S. Cl. 101—93 10 Claims

ABSTRACT OF THE DISCLOSURE

A printing mechanism employs a movable shuttle mechanism which carries a form on which data may be printed. The form may be a multi-part form, one part of which is transparent for projecting an image of the printed data. At the printing position, all parts of the form receive printing from a common print mechanism, and as the shuttle moves to the projecting position, the non-projectable parts of the form are separated from the projectable part so that only the transparent part is carried to the projecting station. Printing is accomplished by placing the form adjacent printing wheels carrying the characters to be printed and forcing the form against the wheels by solenoid-operated print hammers.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates in general to printing and projecting mechanisms, and relates more particularly to such mechanisms for printing on a plurality of parts of a multi-part form and utilizing one of the form parts for projection while retaining another form part for record purposes.

Description of the prior art

In the field of bowling, there is a need for automatic scorekeeping equipment to keep pace with the advances contributed by automatic pinsetting machines. Such equipment is desirable both to speed up the play and to eliminate the costs and other problems associated with the use of human scorekeepers. In U.S. Patents 3,211,371 and 3,236,149, assigned to the same assignee as the present application, there is disclosed and claimed printing and projecting apparatus particularly adapted for use in bowling scoring. In that apparatus, signals are received from equipment which automatically senses and interprets the number of pins knocked down by each bowled ball, and these signals are utilized to control the setting of printing wheels to print this number of pins on the appropriate area of the score sheet. The score sheet comprises a translucent sheet which is first carried by a movable carriage to a printing position at which the printing is performed on the sheet by moving the printing wheels into contact with the sheet. The sheet then moves to a projecting position where light is projected through the sheet to form an enlarged image on a scoreboard for viewing.

This apparatus performs very satisfactorily to produce a projectable image of the individual scores as the bowling progresses, but there are a number of areas in which it can be improved. On the one hand, it is often desirable to have one or more printed copies of the completed bowling score in addition to the projectable image generated and used as the game progresses. These printed copies may be used for league record purposes or for retention by the bowling alley or the individual bowlers. Additionally, it is desirable in the printing mechanism to avoid having to move the print wheels into contact with the printing surface, since this places mechanical

strain on the printing elements and places limitations on their design.

SUMMARY OF THE INVENTION

In accordance with this invention, there is provided a printing mechanism which prints on one or more parts of a form sheet. In the preferred embodiment of the invention, the device is capable of simultaneously printing on a plurality of parts of a multi-part form, one of which parts is to be used to provide a projectable image and the other parts are used as permanent records. This mechanism employs a shuttle device which carries the form in a reciprocating motion between the projecting position toward the printing position. In response to a signal from the printer control mechanism, the shuttle mechanism is stopped at the proper position to locate the desired line under the printing means. The printing means includes printing units carrying printing wheels which can be indexed to locate the proper character or characters to be printed at the printing position facing the form. In response to a print signal, print hammer means comprising solenoid-operated printing anvils or hammers located on the side of the form opposite to the printing units are actuated to firmly press the form against the printing units, thus printing on all parts of the form that character or characters which were in printing position.

Upon completion of the printing, the shuttle continues to the end of its reciprocating travel and commences to return toward the projecting position. During this return, the parts of the form overlying the projectable part are peeled back therefrom and retained away from the projectable part. This separation of the parts of the form is facilitated by the configuration of the leading edge of the projectable form part which cooperates with a grooved portion of the device frame to initiate separation of the non-projectable form parts from the projectable part. The shuttle thus returns to the projecting position with only the projectable form part thereon, and this part is then in position for projection in enlarged form on a scoreboard. The position of the shuttle is controlled by a contact strip underlying the shuttle and having a plurality of electrical contacts corresponding to the different positions of the shuttle. These contacts are sequentially engaged by a contact member carried by the shuttle, and when the contact member reaches an energized contact, the shuttle is stopped for printing.

This action continues for each new item of scoring information to be printed, with the shuttle mechanism carrying both the projectable form part and the permanent part or parts to the printing position for printing on all parts of the form, and with the non-projectable parts of the form being separated from the projectable part as the shuttle returns to the projection position. Upon completion of the game, the complete form may be removed from the machine and the permanent parts thereof retained for whatever use is desired.

It is therefore an object of this invention to provide an improved device for printing on a sheet which is movable to position different parts thereof adjacent the printing means.

It is an additional object of the invention to provide a device for selectively positioning a movable member at any one of a number of discrete positions.

It is a further object of this invention to provide an improved device for sequentially printing and projecting data in one continuous operation.

It is a further object of the present invention to provide a device for simultaneously printing on each part of a multi-part form and then separating the parts to display one of them.

It is an additional object of this invention to provide

a device for printing on a multi-part form to produce a projectable image of the printing and at least one permanent copy of the printing.

It is a further object of the present invention to provide a device for printing on a multi-part form by moving the form to a printing position to place the form between a printing unit and a movable print hammer and then returning one of the parts of the form to a projection station for projecting the data printed on that one part.

It is an additional object of this invention to provide a device of the type described which is inexpensive, reliable and easy to maintain.

Objects and advantages other than those set forth above will be apparent from the following description when read in connection with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a device embodying two printing-projecting units of this invention, with portions thereof broken away for clarity;

FIG. 2 is a perspective view of the preferred form of a score sheet for use in this invention;

FIG. 3 is a perspective view of one of the printing-projecting units showing the shuttle and score sheet approaching the projecting position;

FIG. 4 is a perspective view of the unit of FIG. 3 showing the shuttle and score sheet at a printing position;

FIG. 5 is a fragmentary cross-sectional plan view, on an enlarged scale, showing the mechanism for securing the score sheet to the shuttle;

FIG. 6 is a fragmentary cross-sectional plan view, on an enlarged scale, illustrating the printing action;

FIG. 7 is a fragmentary cross-sectional plan view, on an enlarged scale, showing the separation of the non-projectable parts of the score sheet from the projectable part as the shuttle returns toward the projecting position; and

FIG. 8 is a fragmentary plan view, on an enlarged scale, showing the contact strip and print hammers of the device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the overall printing-projecting device is illustrated, and includes a frame member **11** on which is mounted equipment for printing and projecting the scores of two bowling teams. As is common in league bowling, two teams of five bowlers each generally bowl against each other using two adjacent alleys on which they alternate play. The illustrated embodiment of the invention operates to print and project the scores of the individual players of each of these two teams, with separate score sheets for each team. Thus, the device includes two symmetrical parts, each of which prints and projects data for one of the bowling teams. In the description, the reference numerals applied to the unit on the left side are given a prime to differentiate them from those applied to the right side unit.

Overall operation

Prior to describbting the details of the device, the following general description of its operation is presented to provide a better understanding of the overall device.

Referring to FIG. 1, the score sheet **13** is carried by a shuttle mechanism **16** which moves in a reciprocating motion behind a front plate **15** between a projecting position at the front of the unit and a printing position toward the rear of the unit. This motion is imparted to the shuttle mechanism by means of a motor **18** through a linkage mechanism which converts the unidirectional rotary motion of motor **18** to the desired reciprocating motion. The shuttle mechanism is stopped at a selectable point on its rearward movement for printing to take place. This stopping is controlled by signals from the pin sensing and scoring computer and serves to stop the shuttle mechanism so as to position the desired line of the score sheet under the stationary printing mechanism.

The printing mechanism **21** includes a plurality of individually controllable printing units, each of which contains one or more printing wheels which are indexable to position a given character or symbol at the print position. These printing units are controlled by signals from the sensing and scoring computer to position the desired symbol or symbols at the printing position after a ball has been bowled.

The printing mechanism also includes a plurality of printing hammers or anvils, one of which is shown in FIG. 1, which are actuated by "print" signals from the sensing and scoring computer to press score sheet **13** against those print characters of the printing units which are located in the printing position. This impact simultaneously produces a printing at the desired line on all parts of the multi-part score sheet.

After printing, motor **18** continues to drive the shuttle mechanism rearward until the end of travel is reached, at which time the shuttle motion is reversed and it returns in a forward direction until it stops at the projection position at the front of the unit. During this forward motion, the parts of the score sheet overlying the projectable part are peeled back from and retained away from the projectable part, so that the projectable part alone returns with the shuttle mechanism to the projection position.

At the projection position, light from a light source **26** is focussed by means of an elliptical mirror **27** and projected upwardly through the projectable form in the projectable position. This projected image is transmitted through an opening **20***e* in an upper front panel **20** to a lens and mirror arrangement generally identified at **28** in FIG. 1, to produce an enlarged image of the score sheet on a scoreboard **29**. This lens arrangement includes a first mirror **28***a* disposed at a 45-degree angle to reflect the projected image through a lens **28***b* to a second mirror **28***c*. From mirror **28***c*, the image is reflected to a mirror **28***d* and then to scoreboard **29**.

With the above description of the overall operation of the device in mind, the following more detailed description of the different components of the device will be clearer.

Multi-part score sheet

As shown in FIG. 2, the multi-part score sheet **13** includes a projectable part **13***a* and at least one non-projectable part **13***b*. The columns and legends on all parts of the form are identical and are aligned with each other when the parts of the score sheet are positioned adjacent each other (as they are at the printing position). Thus, the printing mechanism can simultaneously produce the desired printing on the same line of all parts of the score sheet. As shown, each sheet includes individual columns for the scores of the five individual members of the bowling team, as well as headings for team totals and other entries.

The different parts of the score sheet are joined together at the top thereof along the edge **13***c* so as to maintain the parts in registry during printing while permitting easy separation of non-projectable part **13***b* for a permanent record or other use after completion of the game.

Projectable part **13***a* may be of any suitable transparent material, such as Mylar or acetate, capable of receiving and retaining the impressions from the printing mechanism and having the column headings and lines and other fixed data printed or otherwise impressed thereon as opaque areas. The non-projectable part **13***b* of the form similarly may be of any suitable material capable of re-

ceiving and retaining the impression from the printing mechanism.

One particularly satisfactory construction of the score sheet is as follows. Non-projectable part **13***b* is of the so-called "carbonless" carbon paper type employing a coating of microcapsules on the top surface of the sheet. These microcapsules rupture upon impact with the printing mechanism to release a coloring material which produces a visible image on the top surface of part **13***b* in the areas struck by the printing mechanism. The bottom or back surface of part **13***b* carries a suitable marking material **13***d*, such as colored wax, carbon or the like, which is normally retained on this part, but which may be transferred to the face of the projectable part **13***a* when contacted by the printing mechanism. This marking material **13***d* may be either a coating on the back of part **13***b* or a separate transfer sheet interposed between parts **13***a*, **13***b*. Thus, contact of the printing mechanism with the score sheet simultaneously produces printing on both the non-projectable part **13***b* by selective rupturing of the microcapsule coating in the impact area, and on the projectable part **13***a* by transfer of the coating **13***d* from the back of part **13***b* to the face of projectable part **13***a* in the areas contacted by the printing mechanism.

If desired, the non-projectable part **13***b* may include perforations **13***e* which extend generally along the column lines separating the individual team members scores. Thus, upon completion of the game, non-projectable part **13***b* may be separated from projectable part **13***a* along edge **13***c* and then divided along perforations **13***e* to provide each individual bowler a printed and permanent copy of his score for that game.

The leading edge of projectable part **13***a* extends beyond the leading edge of part **13***b*, and is provided with a unique configuration to facilitate separation of the score sheet parts as the shuttle returns towards the projecting position. This configuration includes a first step portion **13***f* which is bent downwardly from the rest of part **13***a* and a second step portion **13***g* which is shorter than step portion **13***f* and is bent upwardly with respect thereto. These step portions of part **13***a* cooperate with a grooved portion of frame **11**, in a manner to be described below, to initiate separation of the score sheet parts as the shuttle returns toward the projecting position.

Shuttle mechanism

As best shown in FIGS. 3 and 4, the shuttle mechanism is in the form of a generally planar plate **16** for holding score sheet **13**. The outer edges of the shuttle mechanism slide in and are guided by guideways or guide grooves **31** provided in the sides of frame **11**. Shuttle **16** carries an electrical contact member in the form of a pair of conductive rollers **34***a*, **34***b* which sequentially make contact with a plurality of electrical contact areas disposed on a contact strip **37**. Contact strip **37** is mounted under shuttle **16** so that contact members **34***a*, **34***b* sweep across strip **37** as the shuttle is driven rearward. The details of the operation and structure of contacts **34***a*, **34***b* and contact strip **37** are given below, but, in general, those contact members are connected to controls for motor **18**, and by energizing a selected one of the areas of contact strip **37** in response to a signal from the sensing and scoring computer, when members **34***a*, **34***b* reach that selected contact in their rearward motion, motor **18** is stopped to thus stop the motion of shuttle **16** at that point. Printing then occurs and motor **18** is re-energized to drive shuttle **16** to the rearmost position and then forward to the projection position.

Score sheet **13** is retained on the shuttle by means of gripping jaws **41**. As best shown in FIGS. 5 and 7, these jaws comprise an upper jaw **41***a* and a lower jaw **41***b*, both of which are carried on a shaft **42**. Jaws **41***a*, **41***b* are normally urged toward each other by spring means **43** to grip the score sheet therebetween, as shown in FIG. 7.

To separate the jaws for insertion and removal of the score sheet, a separating block **44** is provided. This block is normally retained in the position shown in FIG. 7 by spring **43**, but is movable under the camming action produced by lifting of a cover **46** which normally overlies the score sheet in the projection position. Cover **46** is a generally open frame member, as shown in FIG. 1, and serves to hold the score sheet down on a glass sheet member **45** in the projecting position. Cover **46** may be manually raised to pivot it about a shaft **47** journalled in bearing supports **48** mounted on frame **11**. Cover **46** may be provided with an interlock switch **50** (FIG. 4) to prevent operation of motor **18** and shuttle **16** when the cover is raised.

Cover **46** is provided with a lug or ear portion **46***a* which extends rearwardly of the pivot on shaft **47**, so that as cover **46** is raised from the horizontal position, lug **46***a* moves downwardly to engage separating block **44**. As cover **46** continues upwardly about pivot **47**, lug **46***a* forces separating block **44** and lower jaw **41***b* downwardly into a recess **11***a* formed in frame **11** to separate jaw **41***b* from upper jaw **41***a*. With jaws **41***a*, **41***b* separated as shown in FIG. 5, score sheet **13** may be inserted therebetween or removed therefrom. When cover **46** is lowered from the raised position, lug **46***a* withdraws from separating block **44** so that spring **43** forces jaws **41***a*, **41***b* back together to firmly grip the score sheet.

Shuttle drive

As indicated above, shuttle **16** is driven by a motor **18** through a linkage which converts the unidirectional rotary motion of the motor to the desired reciprocating motion of the shuttle. Referring again to FIGS. 3 and 4, motor **18** carries a crank **51** which is driven by rotation of the motor through a gear reduction unit which may be built into the motor. Crank **51** has a stud **51***a* on the end thereof away from the motor which rides in a slot **52***a* in an arm **52**. Arm **52** is disposed in a plane parallel to the plane of shuttle **16** and has one end pivotally secured to frame **11** by a pivot pin **53** and has its other end pivotally secured to the rear of shuttle **16** in the center thereof by a pivot pin **54**.

As motor **18** rotates, the linkage mechanism operates in a well-known "figure eight" manner to move shuttle **16** in a reciprocating motion from the projecting position at the front of the unit toward the rear of the unit. Thus, when crank **51** is in a position pointing toward the front of the unit, shuttle **16** will be in its most forward position, corresponding to the projecting position. As crank **51** rotates counter-clockwise from this position, it pulls arm **52** with it to thereby move shuttle **16** rearwardly from the projection position. At some point in this rearward travel, the shuttle motion will be stopped for a printing operation (FIG. 4), as will be described in detail below, and the shuttle motion then continues rearwardly until crank **51** is pointing toward the rear of the unit. As crank **51** continues to rotate counter-clockwise from this position, it carries arm **52** and shuttle **16** forward again until the shuttle again reaches the projecting position, at which time motor **18** is de-energized to await a signal for another print operation from the computer. By connecting arm **52** to shuttle **16** at a point equidistant between guideways **31**, shuttle **16** is always properly centered in the guideways and does not stick or bind during its movement.

Shuttle motor control

The motion of shuttle **16** during a print operation is controlled by energizing the selected one of the contacts on contact strip **37** which corresponds to the location of the line on score sheet **13** at which printing is to occur. This selection of the desired line is under control of the pin sensing and score decoding computer, which energizes the appropriate one of the contacts at the start of the shuttle motion for printing. Such pin sensing and scoring equipment may be of any suitable type, such as that shown and

claimed in U.S. Patents 3,140,872 and 3,295,849, assigned to the same assignee as the present application.

As best seen in FIG. 8, the contact strip **37** may be a printed circuit board having a common conductor **37***a* and a plurality of contacts **37***b* corresponding to the different frames of a bowling game. Twelve such contacts **37***b* are provided corresponding to the ten frames of a bowling game and the two additional frames which may result. The contacts on strip **37** may be energized by the desired signals through connections made to the back of the strip, in accordance with techniques well-known in the printed circuit art. When shuttle motor **18** is energized, the computer will have energized the one of contacts **37***b* corresponding to the line on score sheet **13** to be printed. As shuttle **11** moves rearwardly, contact roller **34***a* will engage common conductor **37***a* and roller **34***b* will sequentially engage the different contacts **37***b* until it reaches the energized one. When the energized contact is reached by roller **34***b*, this action completes a circuit through the rollers and control circuitry (not shown) to stop motor **18** and thus stop shuttle **11**. Printing is then performed on the line of the score sheet positioned under the printing units at that time, and the motion of the shuttle is resumed. The shuttle continues rearwardly to the end of its travel and then moves forward to the projecting position. As the shuttle nears the limit of its forward travel, rollers **34***a*, **34***b* engage "home" position contacts **37***c*, and closure of these contacts de-energizes motor **18** to stop shuttle **11** at the "home" or projecting position.

An additional conductor **37***d* is provided on strip **37** for printing the total team score on score sheet **13** upon completion of the game. When the "team total" print switch on the front of the device is actuated upon completion of the game, motor **18** is energized to drive the shuttle, with roller **34***a* in contact with conductor **37***a*, until roller **34***b* engages conductor **37***d*. Conductor **37***d* is energized at this time, so that motor **18** and shuttle **11** stop at this point to position score sheet under a team total printer to be described below. After printing of the team total score, shuttle **11** returns to the "home" position and its motion is stopped by engagement of rollers **34***a*, **34***b* with the "home" contacts **37***c*.

Printing mechanism

The printing mechanism includes a plurality of printing units, as indicated above, which are operable to print selected characters or symbols on the different lines of the score sheet. In the illustrated embodiment, it is assumed that there are spaces for the scores of five players on sheet **13**. As shown in FIG. 2, each player's score area has three separate columns; a first column for a score for the first ball of each frame, a second column for the second ball score of each frame, and a larger third column for the player's accumulated score for each frame as the game progresses. Also, the first column may have therein a strike indication (×), while the second column may have an indication of a spare (/), and either the first or the second column may have an indication of a foul (F).

To accomplish this printing, the printing units preferably comprise a plurality of printing counters for each player's score. As shown in FIG. 3 for the first player, a first printing device **61** is provided having two individual printing units or counters therein for printing in the first two columns of the first player's score, and a second printing device **62** is provided having three individual printing units therein for printing the accumulated score for the first player. Similar sets of printing devices **63–64**, **65–66**, **67–68**, and **69–70** are provided for printing the scores of the other four players on the team.

Each of the printing counters in the printing units may be of any suitable type capable of receiving electrical signals, such as on the contract pins **61***a*, **62***a* illustrated for devices **61**, **62**, which operate to step or advance the printing wheels of the counters to position different characters or symbols on the wheels at the printing position. One of such printing wheels **61***b* is shown for device **61** in FIG. 6, and is illustrated having a plurality of raised characters **61***c* around the periphery of the wheel. The one of characters **61***c* which is located at the bottom of the wheel is at the printing position, and it will be clear that any one of different characters on the wheel may be positioned at the printing position by the appropriate rotation of wheel **61***b*. These printing counters may be of any suitable type, such as the count module manufactured by Practical Automation, Inc. under the type designation Model CM.

Each of the printing counters has associated therewith a print hammer or anvil which is movable to strike score sheet **13** against the character on the selected print wheel which is at the print position, to produce an impression of that character on all parts of the multi-part score sheet. Print hammers **71**, **72** associated with devices **61**, **62** are illustrated in FIG. 3, and similar hammers **73–80** (FIG. 8) are provided for the other printing devices **63–70**.

As best illustrated in FIG. 6 which shows print hammer **71** associated with one of the printing counters of device **61**, the hammers include a solenoid having an armature **71***a* which is movable upwardly in response to an electrical signal supplied to the solenoid winding to press score sheet **13** against the character on print wheel **61***b* which is located at the printing position. The face of armature **71***a* which strikes score sheet **13** is preferably provided with a pad of slightly resilient material **71***b* to insure uniform contact of the score sheet with the character on the print wheel. In the illustrated embodiment, print hammer **71** cooperates with the two printing counters of device **61**, while hammer **72** cooperates with the three printing counters of device **62**; a similar relationship prevails for the remainder of hammers **73–80** and counters **63–70**. This arrangement is utilized to permit separate printing of the characters on the printing mechanisms for each player. Thus, if a player achieves a strike, the strike symbol (×) is printed in the first column of that player's score, but no total score is printed until the results of the two bonus balls to which the player is entitled are known.

Separation of projectable form part

To separate the non-projectable parts of score sheet **13** from projectable part **13***a* as the shuttle returns toward the projecting position, knife edge portions **46***b* are provided on the back edge of cover **46**, as shown in FIG. 4. These knife edge portions engage the non-projectable part **13***b* of the score sheet and lift it off transparent part **13***a* as the shuttle returns. This lifting is greatly facilitated by the construction of part **13***a* and the design of a special groove in frame **11**.

This dished groove **11***c*, best seen in FIG. 4, extends across frame **11** between recesses **11***a* which receive lower gripping jaw **41***b*. Groove **11***c* is gently dished or concave and is located just back of knife edge portions **46***b*.

As indicated above, step portions **13***f*, **13***g* of projectable part **13***a* extend beyond the leading edge of part **13***b*. When these step portions encounter dished groove **11***c* in frame **11** as the shuttle is returning, they ride down into this groove and up again, and this motion serves to separate the leading edge of part **13***a* from the overlying part **13***b*, so that part **13***b* may be readily engaged by knife edges **46***b*. This separation is extremely important, because the static attraction between parts **13***a* and **13***b* is very high and these form parts are difficult to separate without this novel construction of part **13***a* and the dished groove **11***c*.

After this separation, shuttle **16** continues to carry part **13***a* forward to the projecting position, while part **13***b* is diverted by knife edges **46***b* and travels up the back of plate **15**, as shown in FIG. 7.

When shuttle **16** reaches the forward or projecting position, part **13***a* is positioned in the projecting position on

glass plate **45**, while part **13***b* is disposed behind plate **15** in the position shown in FIG. 7. For the next printing operation, as shuttle **16** moves rearwardly, part **13***b* will be drawn back down plate **15** and will again overlie part **13***a* when the printing position is reached. Part **13***b* thus does not interfere with the projection of the printed information on part **13***a*, but is still secured thereto and is carried with part **13***a* by shuttle **16** for each printing operation.

Team total printer

In addition to printing the scores of the individual players of the team, the device may also print the total team score at the completion of the game. This printing is accomplished by a team total printer unit **86** located rearwardly of the printing mechanism **21** and having four printing units with printing wheels **86***b* for printing the four digits of the total team score. This printer receives electrical signals on pins **86***a* from the sensing and scoring computer to index the print wheels to the desired positions. A print hammer **87** associated with printer **86** is operable upon command to move upwardly in a manner similar to that described above for hammer **71** to press score sheet **13** against print wheels **86***b* for printing. This printing is placed in the indicated space on the upper right hand corner of score sheet **13** (FIG. 2), and is performed after completion of the game under the control of a "team total print" signal. As indicated above, this signal causes shuttle **16** to be positioned at the proper location for printing this information on score sheet **13**.

Other controls and displays

In addition to the operations described above, additional controls and displays may be provided on the device for use in different phases of bowling. As shown in FIG. 1, the front panel **20** is preferably provided with an illuminated display in a window **20***a* indicating the number and color (red or white) of the player bowling on that team at that time. This information is provided by the player pushing his corresponding number button out of the five such buttons **20***b* for each color. The player pushes his button before each frame, and this serves to identify him to the computer so that the appropriate portion of the score sheet is addressed by the printing mechanism. Player "cancel" switches **20***f*, **20***f'* are provided to allow correction if a player inadvertently presses the wrong one of player buttons **20***b* or **20***b'*. Additionally, a display of the team total score is provided for each team in a window **20***d*, each window displaying the score for the "home" team for its associated alley.

In adidtion to a "Start" button on panel **15**, a "frame advance" switch may be provided to allow a player when is late to advance his scoring to the current frame being bowled, thus forfeiting any score for the missed frames.

A "provisional ball" switch is provided for use in the event of a dispute as to scoring on a given ball. When this switch is operated, the computer ignores the scoring on the next or provisional ball and a note is made of the provisional ball score for possible use in settling the dispute after the completion of the game.

A "team total" switch is provided to control the printing of the team total score on score sheet **13** upon completion of the game, as discussed above.

Summary

It will be seen that there is provided a novel and useful device for printing and projecting data. The printing portion of the device acts on a matrix basis to select a row on sheet **13** for printing in response to energization of the appropriate contact on strip **37**. The device then selects one or more columns within that row in response to energization of the appropriate one or ones of the print hammers **71–80** to produce printing on the selected row and column or columns.

Although the invention has been illustrated showing the use of a multi-part score sheet for printing and separation of these parts for projecting, it will be apparent that the invention is useful where only printing or only projecting is desired. Further, it will be seen that the motor control circuitry which is operable to control the positioning of a movable member at any one of a number of discrete positions, is useful in a number of applications other than the particular one illustrated and described. Also, it will be apparent that the invention is useful in a number of areas in addition to the illustrated application to bowling scoring device.

While the above detailed description has shown, described and pointed out the fundamental novel features of the invention as applied to various embodiments, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. A device for printing data on all parts of a multi-part form and subsequently projecting the data printed on one of the parts, the form including a projectable part and at least one non-projectable part, comprising:

shuttle means for holding said form with all parts thereof aligned with each other;

drive means for moving said shuttle means;

control means for controlling said drive means to move said shuttle means with said form to a printing position;

printing means actuable to strike said form for producing a visible impression of said data on all parts of said form when said form is at said printing position;

said control means being operable after actuation of said printing means to cause said drive means to move said shuttle means toward a projecting position;

separating means for separating said non-projectable part of said form from said projectable part as said shuttle means moves toward said projecting position; and

projecting means at said projecting position for projecting an image of the data on said projectable part of said form.

2. Apparatus in accordance with claim **1** in which said shuttle means has a plurality of discrete positions at which printing may occur.

3. Apparatus in accordance with claim **1**, in which said separating means includes knife edge means for lifting said non-projectable parts of said form from said projectable part of said form as said shuttle moves toward said projecting position.

4. Apparatus in accordance with claim **3** in which said projectable part comprises a transparent sheet whose leading edge is provided with a downwardly extending portion defining a step portion.

5. Apparatus in accordance with claim **4** in which said separating means includes a groove in which said step portion of said projectable part rides as said shuttle means moves toward said projecting position, to facilitate separation of said non-projectable part from said projectable part.

6. Apparatus in accordance with claim **1** in which said non-projectable part of said form overlies said projectable part and said non-projectable part comprises a sheet having a first coating on the front surface thereof and a second coating on the back surface thereof adjacent said projectable part, said first coating forming a visible impression on said front surface in response to said printing means, and portions of said second coating being transferrable to said projectable part in response to said printing means to form a visible impression on said projectable part.

7. Apparatus in accordance with claim **6** in which said projectable part of said form comprises a plurality of different portions joined together by perforated sections.

8. A device for printing data on a sheet, comprising:
shuttle means for holding said sheet;
drive means for moving said shuttle means, said shuttle means including:
a unidirectional electric motor;
an arm lying in a plane parallel to the plane of said shuttle means, said arm having a slot therein and having one end pivotally connected to said shuttle means and having its other end pivotally connected to a frame member; and
a crank driven by said motor and oscillatable in said slot to drive said shuttle means in a reciprocating motion in response to rotation of said motor;
control means for controlling said drive means to move said shuttle means with said sheet to any one of a plurality of discrete positions; and
printing means disposed adjacent the path of movement of said sheet, said printing means comprising a plurality of stationary printing units disposed on one side of said sheet and a plurality of movable print hammer means disposed in registry with said printing units on the other side of said sheet;
each of said printing units having print characters thereon which are selectively positionable in a spaced apart printing position facing said sheet;
said plurality of print hammer means being selectively actuable to strike said sheet against selected ones of said printing units to produce an impression on said sheet of the print characters facing said sheet.

9. A device in accordance with claim 8 in which said control means includes:
a contact strip having a plurality of electrical contact means thereon corresponding to the different positions of the shuttle means, said contact strip being

positioned adjacent the path of movement of said shuttle means; and
electrical roller means on said shuttle means for engaging said contact means as said shuttle means is driven in said reciprocating motion, whereby said drive means is stopped when said roller means engages a selected one of said contact means, to stop said shuttle means at the desired printing position.

10. A device in accordance with claim 8 in which said frame member is provided with guideways in which said shuttle means rides; and
said one end of said arm is connected to said shuttle means equidistant between said guideways to prevent binding of said shuttle means in said guideways.

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