This invention relates to automatic golf ball teeing machines for use in practice driving ranges, and its principal object is to provide an automatic teeing machine which is simpler, yet more durable and reliable than those previously used. A further object of the invention is to reduce considerably the cost of manufacture and maintenance of such machines.

Herefore, automatic teeing machines relied generally for their operation upon electric motors or similar power means, and more or less complex mechanism to solenoid control, the operation being accomplished by the motor into the desired deliberate reciprocative movement of a teeing arm or plunger operative intermittently as necessary to tee the ball. If the motor ran continuously, as is done in many similar machines, a waste of mechanical power to one or more of such machines, there was a considerable wastage of electric power, and clutching mechanism was necessary. On the other hand, where each machine was driven directly by an electric motor unit, the starting and stopping of the motor for each teeing operation was relatively slow and entailed excessive wear on the motor mechanism. Their initial manufacturing cost was consequently high, and it was generally required to maintain them in satisfactory operating condition.

In accordance with the present invention, such prior disadvantages as the large number of moving parts, their complexity, the electric power expended in operating the machine, and the costs of manufacture and maintenance are greatly minimized, and at the same time an increase in reliability of operation is realized. A feature of such a machine resides in a teeing element guided for movement between teeing and ball reloading positions which is held normally in teeing position, such as by a spring, and moved from the teeing position by solenoid or electromagnet means energized selectively and automatically by suitable control means. The control means may be of the type responsive to the removal of a golf ball from the tee, a switch controlled either photoelectrically by the restoration of a beam of light interrupted by a teed golf ball, or by movement of the tee member upon bearing of the weight of the golf ball as the ball is driven from the tee.

Another feature of the invention relates to the golf ball reloading means coacting with the downward movement of the teeing means, and coordinated in its operation with the solenoid control means. Preferably the teeing means comprises a plunger depressed magnetically by controlled energization of the solenoid, at which time another plunger is depressed in the tee and the solenoid de-energized, whereupon expansion of a compression spring elevates the reloaded plunger into teeing position.

Various other features, operations, and advantages of the invention will become more fully apparent from the following description considered with the accompanying drawings.

Figure 1 is a vertical sectional view through my improved teeing mechanism, shown in golf ball teed position, and in a similar view of the same mechanism with its parts positioned for reloading the tee.

Figure 3 is a detail side elevation view of an element of the teeing plunger actuating mechanism shown in Figures 1 and 2, with parts broken away to show damping or cushioning means operable to prevent the teeing element, lifted by the action of the plunger elevating spring, from being stopped so abruptly at its elevated position as to toss the golf ball from the tee into the air.

Figure 4 is a plan view of the mechanism of Figures 1 and 2, showing solenoid control switching means.

Figure 5 is an elevation view, with parts broken away, of a modification of the mechanism of Figures 1 and 2 taken at right angles to these figures.

Figure 6 is a schematic diagram showing a control circuit for the machine of Figures 1, 2 and 4.

Figure 7 is a side elevation view of a modified form of the machine, with parts broken away, in which the cooperating means between the reloading means and the teeing plunger, and the reloading means itself, are largely mechanical, and Figure 8 is a schematic diagram of such a machine.

Figure 9 is a schematic diagram of a golf ball teeing machine of the type illustrated structurally in Figure 5, in which the control is primarily photoelectric.

Figure 10 is a vertical sectional view of an alternative form of solenoid controlled teeing mechanism embodying features of the invention.

For purposes of this description it will be expedient to refer first to the details of construction of the solenoid-actuated golf ball teeing mechanism which is common to all of the illustrated forms of the invention, in conjunction with a selected reloading mechanism thereafter subse- quently digress to the particular forms of control and other modifications of the illustrated embodiments of the invention.

The teeing mechanism appears most clearly in Figures 1 and 2 wherein certain of the components and arrangements of such components shown are illustrative only. The machine, shown generally in Figures 1 and 2, is housed within a box or cabinet 10 which is set into the floor or platform on which the practicing player stands, with its top generally flush with the level of the floor. The top itself may be sufficiently sturdy to form a continuation of the floor and to support the weight of a person standing on it. A suitable driving mat 12 may be laid over the machine, with an aperture at 14 through which a golf ball 15 may be elevated by the machine from beneath the level of the floor into teed position above the level of the mat. Such aperture 14 preferably is located directly over the opening of a vertical golf ball guide tube 16 supported at its opposite ends by the top and bottom, respectively, of the housing 10. The lower end of the tee guide tube fits in the annular shoulder of a base plate 22, the inner surface of which forms an annular guide for the tee.

The tee guide tube 16 serves to encase and guide for vertical reciprocation the golf ball teeing plunger 18 which is formed of tubing 20 held spaced concentrically inwardly from the outer surface of tee 16 by the teed golf ball. The plunger is secured to the top of tube 20 and slidable engaging the inner wall of guide tube 16. A pneumatic-密封 cap 24 closes the lower end of sleeve 20. The head 22 carries a tabular rubber tee 28, which is secured by a screw 30 threaded axially directly into the tee head, as shown in Figure 5, or into the upper end of pin 26. Such pin is slidable mounted in the tee head as shown in Figure 1, for a reason to be described hereafter. The head of the screw is accessible at the bottom of the upwardly opening recess in the tee.

A piston 34 is received in the tubular section 20 of the teeing plunger and is supported therein by a stationary piston rod 36, having its lower end anchored in the base 32 of the teeing mechanism, projecting upwardly within the tube 16, and passing through an aperture in the cap 24 closing the lower end of the teeing plunger. In the construction shown in Figure 1 the piston and the upper end of rod 36 are recessed at 25, as shown in the detail of Figure 3, to receive the tee-supporting pin 26 when the plunger is in the depressed position shown in Figure 2. Where no tee-supporting pin is used, as in the construction shown in Figure 5, no recess in the piston and its rod is required.

The aperture of cap 24 should fit the rod 36 sufficiently snugly to afford an effective guide for the lower end of the teeing plunger 18 as it moves vertically, without being so snug as to cause any appreciable binding during such movement. Suitable play is provided, however, to make the fit reasonably airtight. Engage-
ment of the cap 24 with the piston 34 when the plunger 18 has reached its uppermost position as shown in Figure 1 will serve to limit the upward movement of the plunger, such elements cooperating to constitute stop means. When the piston 34 has a further function of snubbing upward movement of the plunger as will be explained later in greater detail.

The preferred driving mechanism for raising the tee-in the head and the plunger coming within the guide tube 16 and encircling the plunger, the upper end of which bears against the lower side of the plunger head 22 and the lower end of which bears against the spring 33, must be sufficiently strong to raise the teeing plunger reasonably rapidly while carrying a golf ball 15, yet it should be no stronger than necessary to result so that the force required to compress the spring in order to lower the plunger into a position for receiving another golf ball will be minimized as far as possible. When the tee has been raised by the spring 38 such spring will, of course, act to hold the plunger 18 in its uppermost position.

To apply to the plunger 18 the force required to depress it into reloading position a solenoid 40 is employed which, when energized, produces a force which will attract magnetically the plunger tube 18, of magnetic material, and draw the plunger downward axially of the coil 40. The core of the coil 40 for the solenoid, and the magnetic force which must be exerted upon this plunger in order to move it sufficiently far downward against the lifting force produced by spring 33, is directly in the number of ampere-turns required for the solenoid.

The structure of the solenoid coil 40 may be conventional and may include a number of coil layers wound around the lower end of the guide tube 16, which should be of nonmagnetic material, and the periphery of the coil may be enclosed by a tubular jacket 42 encircling the ribs of the upper end of the guide tube 16, and the terminal plug 44 may be closed by an annular plug 44 inserted between the casing tube 42 and the teeing tube outer wall. This plug, the casing tube 42, and the base plate 32 may be of ferromagnetic material, and the jacket 42, the annular plug 44, and the coil 40, which circuit is completed through the space within teeing tube 16 containing the teeing plunger armature. The magnetic field created by the solenoid is intensified by the high-permeability path thus provided for the external flux, to render the interior flux passing through the body of the plunger, at least a part of which is of ferromagnetic material, of maximum effectiveness and capable of producing sufficient retractive force to draw the plunger downwardly to the bottom of the teeing tube 16 against the progressively increasing resistance of the spring 38.

Full depression of the plunger is made possible by the teeing plunger being sufficiently long that in its lowered position its effective magnetic center is still sufficiently above the tee, so that a suitable magnetic force for the purpose is still exerted on the plunger. Because the teeing tube 16 is of nonmagnetic (palladium or nonferromagnetic material) it cannot by-pass the magnetic field around the plunger effectively to shield it. The pneumatic piston 34 and piston shaft 36 may or may not be of magnetic material.

When the teeing plunger is lowered by energizing the solenoid, the top of the tee 28 is below the level of the discharge end of the golf ball delivery chute 46 affixed to the side of the teeing tube, as shown in Figure 2. Golf ball 15 in the chute may then be introduced through the teeing tube through an opening 48 by the reloading plunger 52 which may be reciprocated lengthwise by a solenoid 50. The plunger pushes the golf ball up through the top of the inner track 47 of the delivery chute along which the ball rolls to the tee tube aperture. After the ball rests on the tee the plunger-depressing solenoid 40 is deenergized, and the teeing plunger with the ball is raised by extension of the spring 38.

To insure that the spring 38 has sufficient power to enable it to resist the resulting abrupt impact of the plunger upon arrival there would dislodge the ball from the tee. Such a contingency is prevented by the pneumatic retracting action of piston 34 coacting with the tee 28 and the large, hollow plunger 34 having a relatively small aperture 53 extending through it between its upper and lower surfaces, and a similar, relatively large aperture 54 having its lower end bored to receive a ball valve 56. The ball is pressed against the base of the counter-bore to close off the aperture 54, by a light valve spring 58. The ball is retained in the counter-bore by a threaded plug 60 which is also apertured from the upper surface.

On the downward movement of the teeing plunger 18 the column of air in its tubular section 20 above piston 34, under compression at that time between the plunger head 22 and the piston 18, escapes freely through the aperture 54 because a slight accumulated air pressure above the ball valve 56 opens it. During upward movement of the teeing plunger, however, the column of air in the tube 20 is compressed so that when the teeing plunger is in its lowered position the small tube 20 is closed and the aperture 54 in the piston, thus materially retarding the movement of the teeing plunger and causing the tee to be eased gently into ball-teeing position. Since the retardation takes place only on the upward movement of the teeing plunger, rapidity of reloading the machine is not hampered. The increasing compression of the spring 38 prevents excessive shock at the bottom of the down stroke of the tee-in. Keeping in view the general purposes, construction and operation of the ball tee-in mechanism proper just described, while the armature principal exception of the particular tee reloading means, are common to several herein illustrated forms of my improved teeing machine, the particular forms of automatic control for such mechanism can now more readily be included, in order of their description, first the form shown in Figure 6, next that of Figure 8, and finally that of Figure 9.

Two principal types of systems for controlling energization of the golf ball-teeing mechanism are illustrated in the several modifications of devices shown in the drawings. In the device of Figures 1, 2 and 6, the control mechanism for the solenoid 40 is actuated by light reception of the tee member 28 relative to the plunger 18, resulting from the force produced in a downward direction on the weight of the ball 15, and in the upper direction by the pressure of spring 27 when the tee member is relieved from the weight of the ball. In the golf ball teeing machine shown in Figures 1, 2 and 6, the solenoid control switch actuated by this relative movement of the golf tee and plunger is a stationary switch mounted independently of the plunger 18, whereas in the form of device shown in Figures 7 and 8 such control switch is carried by the plunger.

The second type of control mechanism for the-tee-operating solenoid is illustrated in the device shown in Figure 9, and utilizes a photosensitive device.

In the type of control mechanism shown in Figures 1, 2 and 6, the control switch 112, being mounted stationarily, is less vulnerable to the shock of so that a subsequent magnetic force for the purpose is still exerted on the plunger. Because the teeing tube 16 is of nonmagnetic (palladium or nonferromagnetic material) it cannot by-pass the magnetic field around the plunger effectively to shield it. The pneumatic piston 34 and piston shaft 36 may or may not be of magnetic material.

When the teeing plunger is lowered by energizing the solenoid, the top of the tee 28 is below the level of the discharge end of the golf ball delivery chute 46 affixed to the side of the teeing tube, as shown in Figure 2. Golf ball 15 in the chute may then be introduced through the teeing tube through an opening 48 by the reloading plunger 52 which may be reciprocated lengthwise by a solenoid 50. The plunger pushes the golf ball up through the top of the inner track 47 of the delivery chute along which the ball rolls to the tee tube aperture. After the ball rests on the tee the plunger-depressing solenoid 40 is deenergized, and the teeing plunger with the ball is raised by extension of the spring 38.

As shown in Figures 1 and 2, switch 112 is mounted outside the teeing tube near the base of the tee element 28 in its elevated position, and may be of the micro type which is opened or closed by the short movements of its actuating member, although usually such member is capable of considerable additional movement. In this instance for example, because it is in its uppermost position, to which it is raised by spring 27 when the plunger 18 has been raised to its uppermost position and the ball 15 has been removed from the tee. Spring 27 must be light enough so that the weight of a ball upon the tee will depress it relative to the plunger head 22 sufficiently against the force of the spring to move or hold arm 114 down below switch-closing position when the teeing plunger is fully raised. The tee is guided for
such movement, of course, by pin 26 which is slidable through head 22 of the plunger.

As shown in the wiring diagram of Figure 6, closing of switch 112 effected by arm 114, as the tee 28 is moved upward by spring 27 upon removal of a golf ball from the tee, as the plunger 18 is moved toward the uppermost position, energizes the solenoid 40 which, as previously explained, will attract and draw downward plunger 18 for reloading of the tee. Because switch 112 will open automatically as arm 114 is withdrawn from it by downward movement of the plunger, a holding relay 116 is incorporated in the solenoid circuit to maintain the solenoid 40 energized after its energization has been initiated by closing switch 112 and this switch will again operate following retraction of arm 114 because of the self-opening character of the switch.

It will therefore be evident that the tee plunger depressing solenoid 40 would remain energized indefinitely through the action of the holding solenoid 116 unless supplementary control mechanism were provided to interrupt the circuit through this relay. The tee plunger is depressed, of course, for the purpose of supplying another ball to the tee, whereupon the solenoid can be deenergized to enable spring 38 to raise the tee plunger again to ball teeing position. It is convenient, therefore, to provide relay deenergizing means which is actuated by the ball supply mechanism.

Ball loading mechanism for supplying balls to the tee 28 wherein its lower position is actuated by a reciprocable plunger, 52 in the device of Figure 1 and 64 in the device of Figure 7, operable to drive the lower golf ball in a ball-supply chute 46 from such chute into the teeing tube 18. The movement of the plunger is coordinated with the downward movement of the ball teeing plunger 18 effected by energization of solenoid 40, but the ball loading plunger may be operated either by separate solenoid 50, as shown in Figures 1 and 2, or purely mechanically by a mechanism such as shown in Figure 7. In either event recirculation of the ball-loading plunger inward to feed a golf ball onto the tee may be arranged to open a normally closed switch 118, shown in Figure 6, for the purpose of deenergizing the holding relay 116 to interrupt the flow of current through the solenoid 40 to maintain it in a position to enable the tee plunger to be raised by its spring.

In its normal position the ball loading plunger is withdrawn, with its enlarged end received, clear of the golf ball chute, in a recess formed in a bushing 66 mounted in the wall of the delivery chute, held there by a lock nut 68, and apertured to receive the plunger 52 or 64 and to guide it for reciprocation. The threaded plug 66 projects outwardly from the delivery chute and has a reduced portion encircled by a plunger-retracting compression spring 70 (Figures 4 and 7). This spring reacts between the shoulder of the plug 66 and a washer 72 secured on the plug rod by a cotter pin 74. In Figure 7 the plunger appears in its ball delivering position projecting well into the delivery chute, whereas in Figures 1, 2 and 4 the plunger is shown retracted.

To effect coordination between downward reciprocation of the ball-teeing plunger 18 and the ball-feeding mechanism where the ball-feeding plunger 52 is moved inward by a solenoid 50, a loading switch 104, as shown in Figures 1, 2 and 6, is actuated by the descending ball-teeing plunger 20 to energize relay 50. The loading switch comprises a stationary contact 106 and a movable contact 108 which may be pressed downward by reciprocation of a slide pin 110. This slide pin is guided for reciprocation in a hole in the base 32 of the device, and is shifted downward upon being engaged by the downwardly moving tee plunger. In this fashion the switch 104 is closed as soon as the ball-teeing plunger reaches its fully-depressed ball-receiving position, so that when the solenoid 50 is energized immediately to reciprocate plunger 52 in the ball-feeding direction. When this plunger has completed its ball-feeding movement, washer 72 will engage switch 118 to open it, which deenergizes both the circuit supplying solenoid 50, itself, so that the plunger may be returned by its spring 70, and thus through the holding relay 116 so that the solenoid 40 will be deenergized to enable the tee plunger to be raised by its spring 38.

Following an operating cycle of this mechanism, beginning with the operation of this circuit, assuming the golf ball in teed position, all of the switches including the holding relay 116 are open, except release switch 118 which is then closed. The moment the golf ball is driven from the tee, the plunger 18 descends and engages the instant switch 112, and immediately thereafter the holding relay 116 closes and so remains. The instant switch 112 is closed, and during the continuing energization and closing of the holding relay 116, the solenoid 40 actuates the plunger 18, drawing the teeing plunger downward. When the teeing plunger descends to its reloading position, it closes loading switch 104, which energizes the loading relay 50 by current flowing through a circuit including release switch 118 and the supply leads 120.

As the loading solenoid plunger 52 pushes a ball into the teeing tube for forming a chute, arm 72 of the plunger engages and opens release switch 118, which opens the entire circuit, deenergizing both solenoids, 40 and 50, and the newly loaded golf ball plunger is lifted by spring 38 into teed position. If for any reason the tee is not loaded, such as when the delivery chute is emptied, the teeing plunger will continue to rise and fall until more balls are supplied or a master switch 123, controlling the power supply, is opened.

In the device of Figure 7, the control for which is shown in Figure 8, the operation is more fully mechanical in nature, as distinguished from electrical, than in the other forms, particularly with respect to the means for loading the ball onto the tee, and coordinating such loading with movement of the teeing plunger.

Figure 1, plunger 64 is reciprocated inwardly by a bell crank 76 supported on a post 78 carried in a mounting bracket 80 at the base of the machine. The machine base is slotted at 82 to accommodate the lower and shorter crank arm 64, which is generally horizontal, for swinging in a vertical plane. The upper end of the arm 86 of the bell crank carries an abutment for contacting plunger 64, preferably in the form of an adjustable screw 88 threaded through the end of the arm and locked in its desired adjusted position by the force nut 90. The end of the lower arm 84 is flat and lies beneath a vertical pin 92 slidable received in an aperture in the base plate 92. This pin extends upward to engage a portion of the teeing tube 16 for engagement by the lower end of the teeing plunger 18 as the latter is depressed to its lowermost position, as shown in Figure 7. The lower end of this pin bears against arm 94.

When the teeing plunger is raised, the upright arm 86 of the bell crank is held away from the ball support tube by the expanded return springs 70 reacting against the washer 72 on the plunger 64. Slide pin 92 is consequently raised to project well up into the bottom of the teeing tube. However, upon energization of the plunger-depressing solenoid, the descending teeing plunger engages the pin 92 and presses it downward into the bell crank in a counterclockwise direction, as viewed in Figure 7, by pressure of the pin on the lever 84 of the bell crank to swing the upright lever 86 toward the ball supply tube 46. The upper end of the bell crank is pressed against the loading plunger 64 and reciprocates it to deliver another golf ball into the teeing tube 16 and onto the then empty tee 28 ready for teeing.

While reloading of the teeing plunger as described occurs directly as a result of its movement in the teeing tube, such movement is itself determined by controlling energization and deenergization of solenoid 40. The solenoid circuit, as shown in Figure 8, includes current supply leads 102 and a control switch 94 adapted to interrupt the circuit to deenergize the solenoid. This switch, unlike the switch 112 shown in Figure 1 and described above, is mounted on an arm 98 carried by the plunger 18, so that it rises and falls with the plunger. The switch-supporting arm extends through a suitable vertical slot in the side of the teeing tube, as shown schematically in Figure 8.

The switch contacts are closed whenever there is no golf ball resting on the tee 28 by a switch-actuating arm 100, carried by the top of the tee arm 114 rises, closing the same slot in the wall of tee-guide tube 16 as arm 98. The spring 27, as has been explained previously in connection with the structure shown in Figure 1, raises the tee member 28 relative to plunger 18 when relieved of the weight of the golf ball, and with no arm 114 rise, ball is resting on the tee, however, the tee is depressed relative to plunger 18 sufficiently to move the arm 100 out
of contact with the arm of switch 94 to enable it to open, such switch being of the normally open type.

The switch 94 is closed by upward movement of tee 28 relative to plunger 18 when the ball is driven from the tee, solenoid 40 is energized and depresses the teeing plunger 18. Because tee 28 remains extended along its downward movement, so that arm 100 holds switch 94 closed, solenoid 40 remains energized as long as another golf ball is not delivered to the tee.

Because, coincidentally with downward movement of the teeing plunger, the bell crank 76 will be rocked for delivering another ball to the tee, as has been explained above, the solenoid 40 normally will be deenergized very soon after a ball has been dropped or released. The weight of the golf ball delivered to the tee will move it downwardly relative to plunger 18 against the force of spring 27, thus lowering switch-actuating arm 100 to enable switch 94 to open and deenergize the solenoid.

The plunger 18, being thus released, will be raised again to teeing position by spring 38 while bell crank 76 will be returned in a clockwise direction, as seen in Figure 7, by spring 70 which moves plunger 64 to the right, since the pressure of the teeing plunger on pin 92 has been removed by upward movement of such plunger. If there is no ball in the delivery chute 46 to be pushed onto the tee, the plunger remains in a depressed condition, so that open position of switch 94, of course, and the solenoid 40 will remain energized until a fresh charge of balls has been supplied.

In the third illustrated form of the invention (Figure 9) the solenoid is controlled photoelectrically and the timing of the re-operations of the machine is controlled differently than in the forms discussed above, the interval during which the teeing plunger remains depressed by continued energization of the solenoid 40 being determined by a special timing network in the photoelectric control circuit, which, except for its initiation, functions independently of the physical movements of any of the machine parts. The mechanically simplified machine of Figure 5 is preferred for use with this form of control.

If the Figures 5 and 9 and forming the teed golf ball 15 intercepts a beam of light formed by a light source 124 and lens 124', which would otherwise be received by a photo-electric cell 126 through a condensing lens 126'. When the golf ball is driven from the tee the light beam is restored, resulting in the generation of an electrical signal by the photoelectric cell, which is applied as a positive bias to a photocell amplifier circuit including the amplifier of Figure 129. The resulting anode current of the tube flows through the winding of a solenoid relay 130, closing an energizing circuit for the plunger-depressing solenoid 40. Both the amplifier and solenoid circuit are supplied with power from the secondary winding of transformer 132, the primary of which is connected to the supply lines 134 through a master control switch 136.

The energization of the solenoid energizing circuit just referred to, the photocell circuit controlling conduction in amplifier 128 is connected directly across supply leads 134 on the primary side of the power transformer 132. The photocell circuit includes the field coil of relay 130 by-passed by filter condenser 137, the series condenser 138 by-passed by resistor 140, the photoelectric cell 126, resistor 141 connected between control grid and cathode of tube 128, and the normal or potentialimeter winding 142 between the potentialmeter tan 144 and the end of such winding remote from the cathode of tube 128.

With the reception of a light signal by the photoelectric cell 126, there will be an increase in the voltage drop in resistor 141 which is applied with positive polarity to the control grid of amplifier tube 128. Driven positively and amplified by tube 128 becomes conductive, generating an energizing current to flow in the field coil of relay 130 to close its switch 131 in the circuit of solenoid 40. By this means the solenoid is energized to retract the teeing plunger 18, the toggle plunger can again be elevated by its spring, the solenoid 40 in this instance remains energized for a period of time which is determined by timing characteristics of the photoelectric amplifier circuit, and the time delay mechanism for switch 131. Thus, when the light beam is first restored to the photoelectric cell a comparatively large current flows initially in the photocell circuit, through series condenser 138, when the current continues to flow, such condenser gradually charges, increasingly blocking such flow, until finally positive grid voltage applied to the amplifier 126 is reduced to the point where the amplifier current is no longer sufficient to hold relay 130 closed. At such time the solenoid 40 is deenergized and the teeing plunger can rise to the tee ball. In the ensuing charge of the condenser 138 the photocell circuit is prepared for a subsequent cycle of operation when the teed golf ball is struck from the tee.

If at any time the tee does not carry a ball as it rises, the device can be made to reoperate to load a ball simply by obstructing the light beam with the head of a golf club for a short while, with condenser 138 discharges, or the master switch 136 could be re operated, or a manually operable switch in parallel with switch 131 may be provided. Alternatively condenser 138 could be by-passed by a push-botton switch to discharge it instantly by pressing such switch, thus removing all potential of the photocell current would render amplifier 128 again conductive. Any of these expedients could be employed to initiate energization of solenoid 40. It has been left standing for some time with the light beam turned on and no teed golf ball or other light obstructing means present.

The alternative form of teeing mechanism of Figure 10, designed to employ photoelectric control mechanism of the type shown in Figure 9, and ball reloading mechanism of the type shown in Figure 7, differs principally from the mechanism described previously with reference to the construction of the teeing plunger and coacting pneumatic Retarding means for preventing the teeing plunger from rising too rapidly and hence to overcome as to throw the ball from the tee. Here the teeing plunger tube 150 comprises an inverted cylindrical cup. The tee 28 is mounted centrally on the closed end of the plunger cup by a screw, and the plunger sides are guided for vertical reciprocation of the plunger within teeing tube 16. A plate 152 stationary during upward movement of the plunger to seal the lower end of the chamber within the plunger 150, is positioned over the lower teeing opening, but is movable as a valve to uncover such opening partially as the plunger moves downward for venting the air rapidly from the interior of the plunger.

The valve plate 152 is normally urged upwardly against the end of the teeing tube to close off such tube by the lifting arm 44', which is the equivalent of the lower bell crank arm 44 of Figure 7, being urged against the lift of the valve 152 by a spring 70 of the golf ball loading mechanism. In the closed position of the valve plate the teeing plunger is extended upwardly in teeing position by a coiled spring 38 which retracts upwardly from the closed position of the valve when the plunger is received in the teeing tube 16 and is closely encircled by the inner peripheral wall of the teeing plunger 150 against the closed end of which it bears to lift the plunger. The plate 152 is carried at the lower end of a tube 156, extending upwardly into the hollow of spring 38, the spring serving as a guide for the tube.

When the solenoid 40 is finally energized to effect reloading of the tee, the valve plate 152 is held against the bottom of tee tube 16 by the arm 44', which is urged upwardly by the force of the spring 70. As the magnetic field of the solenoid passes through the walls of the tube 156, extending downwardly in the tube, there are two increasing forces on the valve plate 152 which tend to press it downward out of contact with the teeing tube against the resistance presented by arm 44'. At the end of the stroke of the forces is the progressive force of compression of the spring 38 between the valve plate and the teeing plunger 150. This force alone, however, even in the extreme depressed position of the teeing plunger, as shown in Figure 10, preferably is not of itself sufficient to overcome the inherent stiffness of spring 38 as applied through the arm 44'. The second of the two forces mentioned, however, is that which is produced by compression of the column of trapped air contained in the space between such plate, and the bottom of the teeing plunger. The combination of these
forces is sufficient to depress the valve plate downward out of contact with the bottom of the teeing tube a short but sufficient distance to permit said cap of the teeing tube to snap against the spring permitting rapid descent of said teeing plunger when the valve plate is energized. Otherwise, when the plunger approaches its fully depressed position, it strikes the valve plate, hence swings the arm 84 downward through an appreciable angle and thereby actuates the loading plunger 64. It will be seen, therefore, that the loading operation which is initiated by energization of the solenoid is executed rapidly.

When the solenoid is deenergized, the spring 38 is permitted to expand, and thereby elevate the teeing plunger 150 into ball-teed position, and no retarding force was applied to the teeing plunger during its upward movement effected by recoil of the spring, it would reach its elevated position quickly and without any abruptness that a golf ball on the tee 28 would be set down on a flat surface. To order to avoid excessive deceleration of the teeing plunger, at the end of its upward movement, use is made of a return spring as a valve which closes off the bottom of the teeing tube 150 when the solenoid is deenergized, such closure being accomplished by spring 70 through the arm 84. As the plunger 150 rises under expansion of spring 85, the plunger plate 152 closes off the bottom of the teeing tube 16, the column of air between the plunger and the plate expands. As this air expands, the air pressure against the bottom side of the teeing plunger 150 decreases. According to the law 38 works against a progressively increasing component of atmospheric pressure acting on the top side of the plunger 150 and thereby prevents it from deceleration by this pneumatic action to the plunger 150, which prevents it from deceleration too rapidly and stopping with excessive abruptness in its elevated position to unseat a golf ball on the tee 28.

A vertical air jet through the plate 152 permits escape of air from the space between plunger 150 and the plate 152 rapidly enough that the time required for the teeing plunger to move from elevated position under force of spring 38 is not unduly prolonged.

I claim as my invention:

1. A golf ball teeing machine, comprising a teeing plunger, a tee carried thereby, an upright teeing tube operable to guide said teeing plunger downwardly, a vertical tube, a plunger guided to reciprocate therein between elevated ball teeing and depressed ball reloading positions, a ball receiving opening in the side of said closed tube operable to guide the ball through chute and radially of said upright teeing tube toward said tube operable means enclosing within said tube a ball in said chute to push it therefrom through said tube opening into said tube and then retract, lever means operable to guide the ball through a semi-circular arc in said tube, a return spring means operable to guide the ball through said tube means enclosing said upright teeing tube operable means enclosing within said tube operable means operable to guide the ball in the chute to push it therefrom through said tube, and then retract, lever means operable to guide the ball through said tube and return spring means operable to return the plunger to its fully depressed position and swing the ball crank opposite upon ascent of the teeing plunger in the teeing tube to release the slide pin thereby.

2. In a golf ball teeing machine, the combination comprising a vertical tube, a plunger guided to reciprocate vertically in such tube and having a tubular depending portion, a tee carried by said plunger, a return spring within said tube, an upright teeing tube engaging upwardly on such plunger from the base of such tube, and pneumatic dash pot means comprising a piston member projecting upward from the base of said tube and into cooperative engagement with a said tubular depending portion as a pneumatic cylinder, and means closing said tubular depending portion above and below said piston member against ready escape of air from said tubular depending portion to thereby maintain said plunger relative to said tube, said dash pot means further comprising relief valve means operable to limit said tubular depending portion automatically in response to initiation of downward movement of said plunger thereby to minimize retardation of such movement imposed by said pneumatic dash pot means.

3. A golf ball teeing machine comprising an upright guide tube, an elongated plunger operable to guide a ball through said guide tube for upward movement into ball teeing position and downward movement from said guide tube for ball reloading position, a golf ball carrier carried by said plunger, a rotating horizontal spring member, means guiding said ball carrier for movement upward through said guide tube and return vertically to said guide tube, and means enclosing said guide tube, said plunger, and ball carrier, said means enclosing said guide tube operable to guide the ball carrier vertically from said guide tube, and means enclosing said plunger operable to guide said plunger to and from said guide tube.

4. A golf ball teeing machine comprising an upright guide tube, an elongated plunger operable to guide a ball through said guide tube for upward movement into ball teeing position and downward movement from said guide tube for ball reloading position, a golf ball carrier carried by said plunger, a rotating horizontal spring member, means guiding said ball carrier for movement upward through said guide tube and return vertically to said guide tube, and means enclosing said guide tube, said plunger, and ball carrier, said means enclosing said guide tube operable to guide the ball carrier vertically from said guide tube, and means enclosing said plunger operable to guide said plunger to and from said guide tube.

5. A golf ball teeing machine comprising an upright guide tube, an elongated plunger operable to guide a ball through said guide tube for upward movement into ball teeing position and downward movement from said guide tube for ball reloading position, a golf ball carrier carried by said plunger, a rotating horizontal spring member, means guiding said ball carrier for movement upward through said guide tube and return vertically to said guide tube, and means enclosing said guide tube, said plunger, and ball carrier, said means enclosing said guide tube operable to guide the ball carrier vertically from said guide tube, and means enclosing said plunger operable to guide said plunger to and from said guide tube.
into engagement with a ball in said chute to push it there-from onto said tee and then retract, means operable thus to move said ball striker, spring means operable to urge said tee plunger into ball reloading position, solenoid means for energizing said tee plunger, and mechanism for moving said ball striker movement means for pushing a ball from said chute onto said tee, and means operable thereafter to deenergize said solenoid and thereby release said tee plunger to be struck by means.

8. A golf ball teeing machine, comprising a tee plunger and a tee carried thereby, an upright teeing tube operable to guide said tee plunger for vertical reciprocation therein between engaged ball tee and depressed ball reloading positions, a ball receiving opening in the side of said tube adjacent to said tee plunger in ball reloading position thereof, a ball delivery chute extending alongside and substantially tangential to the side of said teeing tube having the ball-receiving opening therein, for delivery of golf balls into loading position immediately adjacent to said tee plunger, a ball striker, means guiding said ball striker for movement through said chute transversely of the chute and radially of said upright tee plunger tube toward said tube opening and into engagement with a ball said to be pushed forward said tube opening into said tube and then retract, drive means operable to move said ball striker, means operable to move ball plunger between ball tee positioning and ball reloading position, and means operable by said tee plunger moving into ball reloading position to actuate said drive means to move said ball striker for pushing a ball from said chute through said tube opening.

9. A golf ball teeing machine, comprising a tee plunger and a tee carried thereby, an upright teeing tube operable to guide said tee plunger for vertical reciprocation therein between engaged ball tee and depressed ball reloading positions, a ball receiving opening in the side of said tube adjacent to said tee plunger, a ball delivery chute extending alongside and substantially tangential to the side of said teeing tube having the ball-receiving opening therein, for delivery of golf balls into loading position immediately adjacent to said opening, a ball striker, means guiding said ball striker for movement through said chute transversely of the chute and radially of said upright tee plunger tube toward said tube opening and into engagement with a ball said to be pushed forward said tube opening into said tube and then retract, means operable to move said tee plunger between ball tee positioning and ball reloading position, a pin projecting upward into said tee plunger tube from the base thereof in position to be struck automatically by said tee plunger moving into ball reloading position, and a ball retaining arm engaged with said ball striker to reciprocate the same and having a generally horizontal arm arranged below the tee plunger tube and engageable with said slide arm as it moves downward to depress said horizontal arm and thereby swing said upright tee arm toward the tee tube opening to actuate said ball striker for pushing a ball from said chute through said tube opening into said tube.

10. In a golf ball teeing machine, the combination comprising an upright tube, a plunger tube armature guided to reciprocate vertically in said upright tube, a tee carried by said plunger tube armature having a closed end defining one end of an air-filled daphstochpeter, and a closure member defining the opposite end of such daphstochpeter and having thereon the bleed port for slow flow of air therethrough as the volume of such daphstochpeter is changed progressively by upward movement of said plunger tube armature to intake an upward spring-urged movement of said plunger tube armature relative to said upright tube, and a solenoid encircling said upright tube at a location substantially below the force of operable to attract magnetically and thereby drive downward said plunger tube armature.

11. In a golf ball teeing machine, the combination comprising a vertical tube, a plunger guided to reciprocate vertically in such tube and having a tubular depending portion, a tee carried by said plunger, a return spring within said tube, concentric with and actuated on said plunger, a piston member projecting upward from the base of said tube and into cooperative engagement with the inside of said tubular depending portion, a moveable member disposed in position to be struck automatically by said plunger member moving into ball reloading position, and means operable thereby to deenergize said solenoid and thereby release said tee plunger to be struck by means.

12. The golf ball teeing machine defined in claim 10, in which the closure member defining the opposite end of the daphstochpeter is a moveable cover member disposed over the lower end of the upright tube and the upper end of the plunger tube armature is the closed end, an air spring means urging said cover member upward toward closed position to close lower end of the upright tube, the spring within the upright tube bearing upon and reacting upwardly from said cover member and, by its compression resulting in upward movement of the plunger tube armature, tending to move said cover member downward from the lower end of the tube to actuate the bleed port of air from the daphstochpeter.

13. The golf ball teeing machine of defined in claim 4, a ball delivery chute adjacent to the golf ball tee in ball reloading position, a loading member operable to effect movement of a golf ball from said tube chute onto the tee in ball reloading position, and switch means operable with said loading member to effect deenergization of the solenoid means by ball loading movement of said loading member to enable the member to raise the loaded golf ball tee into ball teeing position.

14. The golf ball teeing machine defined in claim 8, in which the ball striker drive means includes loading solenoid means operable to move ball striker movement thereof through the chute, the means operable automatically by the tee plunger moving into ball reloading position including loading solenoid means energizing switch means closed by movement of the teeing plunger into ball reloading position.

15. A golf ball teeing machine, comprising a teeing plunger and a tee carried thereby, an upright teeing tube operable to guide said teeing plunger for vertical reciprocation therein between engaged ball tee and depressed ball reloading positions, a ball receiving opening in the side of said tube adjacent to said teeing plunger, a ball delivery chute extending alongside and substantially tangential to the side of said teeing tube having the ball-receiving opening therein, for delivery of golf balls into loading position immediately adjacent to said opening, a ball striker, means guiding said ball striker for movement through said chute transversely of the chute and radially of said upright tee plunger tube toward said tube opening and into engagement with a ball said to be pushed forward said tube opening into said tube and then retract, drive means operable to move said ball striker, means operable to move ball plunger between ball tee positioning and ball reloading position, and means operable by said teeing plunger moving into ball reloading position to actuate said drive means to move said ball striker for pushing a ball from said chute through said tube opening.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,858,256</td>
<td>Baumgartner</td>
<td>Nov. 22, 1932</td>
</tr>
<tr>
<td>2,051,253</td>
<td>Goebl et al.</td>
<td>Aug. 18, 1938</td>
</tr>
<tr>
<td>2,127,283</td>
<td>Beckett</td>
<td>Apr. 25, 1938</td>
</tr>
<tr>
<td>2,152,650</td>
<td>Blaski</td>
<td>Apr. 29, 1939</td>
</tr>
<tr>
<td>2,199,009</td>
<td>Perryman</td>
<td>Apr. 30, 1940</td>
</tr>
<tr>
<td>2,295,599</td>
<td>Moxel</td>
<td>Sept. 15, 1941</td>
</tr>
<tr>
<td>2,335,280</td>
<td>Hogeberg</td>
<td>Mar. 30, 1943</td>
</tr>
<tr>
<td>2,450,206</td>
<td>House</td>
<td>Sept. 28, 1940</td>
</tr>
</tbody>
</table>