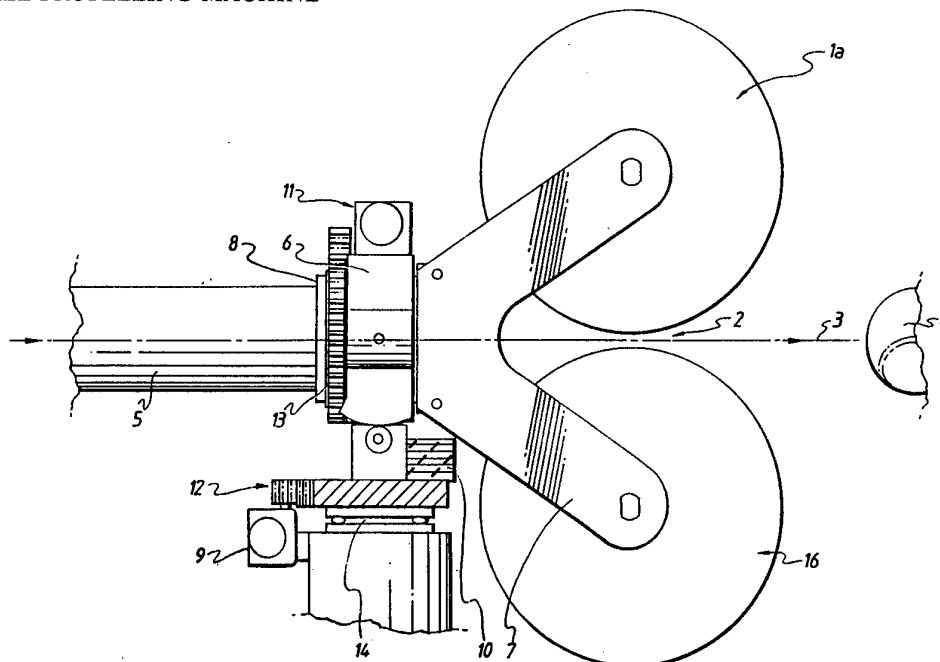




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : A63B 69/40	A1	(11) International Publication Number: WO 94/11069 (43) International Publication Date: 26 May 1994 (26.05.94)
(21) International Application Number: PCT/GB92/02107 (22) International Filing Date: 13 November 1992 (13.11.92) (71) Applicant (for GB only): KOSMIN, Gerald, Emmanuel [GB/GB]; 7 Lapstone Gardens, Kenton, Harrow HA3 0DZ (GB). (71) Applicant (for all designated States except US): ROBO SPORTS TECHNOLOGIES PTY. LIMITED [AU/AU]; 5 Park Drive, Dandenong South, VIC 3175 (AU). (72) Inventor; and (75) Inventor/Applicant (for US only) : ELBAUM, Daniel [IL/AU]; 5 Park Drive, Dandenong South, VIC 3175 (AU). (74) Common Representative: KOSMIN, Gerald, Emmanuel; Kosmin Associates, 7 Lapstone Gardens, Kenton, Harrow HA3 0DZ (GB).		(81) Designated States: AU, CA, GB, JP, KR, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE). Published <i>With international search report.</i>

(54) Title: BALL PROPELLING MACHINE**(57) Abstract**

A machine which can be used by a player practising a ball game such as tennis or badminton has an ejection mechanism comprising a pair of revolving discs (1a, 1b) spaced apart by a gap (2) through which can be drawn a ball (4) for ejection in a direction (3) which can be determined by appropriate adjustment of the vertical and horizontal positioning of the revolving discs by means of inclination drive (10) and sweep gear (12). Side spin or slice can be imparted to the ball by rotation of the revolving discs about an axis lying in the direction (3) of the ball ejection, whilst top spin or under spin can be imparted to the ball by varying the angular velocity of the discs (1a, 1b) by causing them to rotate at differing speeds. The ejection mechanism may be mounted on a height adjusting mechanism in order to vary the height at which the ball is ejected. The machine can be controlled by a microprocessor-based system which may be pre-programmed or operated by remote control.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgyzstan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CS	Czechoslovakia	LV	Latvia	TG	Togo
CZ	Czech Republic	MC	Monaco	TJ	Tajikistan
DE	Germany	MD	Republic of Moldova	TT	Trinidad and Tobago
DK	Denmark	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	US	United States of America
FI	Finland	MN	Mongolia	UZ	Uzbekistan
FR	France			VN	Viet Nam
GA	Gabon				

BALL PROPELLING MACHINE

This invention relates to ball games, in particular but not exclusively racket games such as tennis and badminton, and is concerned with machines which can be used to assist players in practising for such games, e.g. the strokes employed in such racket games.

Known tennis ball propelling machines use pressurised air current to force the ball under compression out of an elongate tube, or operate by squeezing a ball between a pair of high speed rotating wheels so that the ball is propelled out of the gap between the wheels. While all such machines have means of adjusting the inclination and direction of the ball ejection and the wheel type machines allow variation of the wheels' angular velocity to impart a degree of spinning to the ball in a vertical plane, resulting in pure top spin or under spin, there is no provision for controlling other characteristics of the ball subject to manipulation by the average tennis player, such as the height at which the ball is propelled, or characteristics mastered only by top grade tennis players, such as various side spins or "slice" at controllable angles.

The term "programmable" when used in connection with existing propelling machines is misleading in the sense that no programming option is available in the prior art machines other than manual adjustment of one or more of a limited number of parameters.

Other machines allow for a "random" mode, whereby the machine is set by means of a mechanical switch to deliver a series of balls with varying parameters at random.

While several known machines claim to have programming capability, this is limited to a small number of pre-

determined settings that are being performed repeatedly with no provision for adjustment to the ball trajectories by the user.

- 5 It is a further disadvantage of the prior art machines that while known machines do have means for remote control operation, those do not provide complete control over the full range of ball characteristics, propelling heights and ball trajectory types.

10

Tennis ball propelling machines thus suffer from the disadvantages of:

- (a) not providing for a ball service that is truly realistic;
- 15 (b) not providing for variable imparting height;
- (c) propelling balls with only a restricted range of characteristics that is not satisfactory for efficient training; and
- 20 (d) severely damaging the balls within a small number of shots.

It is an object of the invention to provide a ball propelling machine which obviates the disadvantages of
25 the known machines.

Thus the present invention provides a mechanical and electronic apparatus and method for the control, adjustment, and manoeuvring of various types of
30 propelling mechanism to be used for sport and recreational games such as tennis, badminton, volley-ball and the like.

In accordance with the invention, there is provided a
35 machine suitable for propelling a ball in the general direction of a player practising a game involving the use of such a ball, comprising in combination:

a pair of substantially coplanar spaced revoluble discs having concave rims which are adjacent so as to form therebetween a gap;

driving means capable of causing the discs to revolve in opposite directions when in use;

feeding means capable of delivering a ball or the like into one end of said gap so that, in use, it is drawn through the gap by the adjacent rims of the revolving discs and ejected from the other end of the gap; and
means for varying the horizontal and vertical positions of the discs and for rotating the discs about an axis which defines the direction of the ejected ball or the like;

the arrangement being such that in use the player can obtain the desired ball characteristics by appropriate adjustment of the position of the pair of revolving discs in the vertical and horizontal planes respectively and by rotation of the discs about said axis.

In a preferred embodiment of the invention, the operation of the machine is governed by a microprocessor-based system, which monitors and controls the operation either in accordance with the predetermined setup, or by responding to the player's requests. The microprocessor can be pre-programmed to control several mechanical motions, and utilize those motions to emulate a player in action. The microprocessor enables separate as well as combined actuation of any of said motions for adjustment of the machine to the required parameters for a single shot as well as to complete game patterns of varied shot and ball characteristics. The machine of the invention allows for retaining pre-programmed game patterns and customised characteristics and recording actual game patterns or shot characteristics. Thus full games be simulated in whole or in part.

In a preferred embodiment, the player is equipped with a remote control, which allows for full operation of all machine features under real game conditions.

- 5 The machine of the present invention is capable in a preferred embodiment, of providing the following ball characteristics:
- (a) Ball speed - controlled by adjustment of the speed of revolution of the discs;
 - 10 (b) Ball spin (top spin or under spin) - controlled by adjustment of the relative revolution speeds of the discs;
 - (c) Side spin or "slice" (swivelling) - controlled by radially altering the orientation of the revolving discs relative to an axis lying in the direction of the ball ejection;
 - 15 (d) Imparting height - controlled by a height adjustment mechanism positioning the revolving discs at various heights above ground level;
 - 20 (e) Sweep (side angle) - controlled by adjustment of the horizontal position of the revolving discs; and
 - (f) Inclination angle - controlled by adjustment of the vertical position of the revolving discs.
- 25 It will be appreciated that by controlling the above enumerated characteristics, a control of the ball trajectory is achieved. Thus for instance a curved trajectory is obtained by combining speed and spin adjustment with side spin (swivel), sweep, and height
- 30 positioning.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying

35 drawings, in which:

Figure 1 is a right side elevation of a ball propelling machine;

Figure 2 is a rear view of the machine of Figure 1;

5

Figure 3 is a vertical section through the machine of Figure 1;

Figure 4 is a left side partial sectional view of the machine of Figure 1;

10

Figure 5 is a left side elevation of a height adjustment mechanism for the machine showing different positions a, b and c;

15

Figure 6 is a right side elevation of another height adjustment mechanism for the machine showing different positions a, b and c;

Figure 7 is a schematic view of a part of a tennis court; and

20

Figure 8 is a front view of the machine of Figure 1 showing different positions A and B.

Referring now to the drawings, in Figures 1 and 2 there is shown a preferred ball propelling machine in accordance with the invention, which comprises a pair of revolvable discs 1a,1b having a gap 2 therebetween. Each disc has a concave rim 15a,15b (see Figure 2). The discs 1a,1b are mounted on a V-shaped support 7 attached to a yoke 6 which surrounds a rotatable sleeve 8, into which is fitted a feeding tube 5 through which a ball 4 can be fed into the gap 2 and ejected therefrom in ball propelling direction 3. A side angle (sweep) drive mechanism 9 can operate a sweep gear 12 in conjunction with sweep bearing 14 so as to vary the horizontal position of the discs 1a,1b and an inclination drive mechanism 10 can operate so as to vary the vertical

25

30

35

position of the discs 1a,1b. Likewise a swivel (spin angle) drive mechanism 11 can operate a swivel gear 13 so as to vary the orientation of the discs 1a,1b relative to direction 3. This assembly is mounted on a rotatable base 16 (see Figure 2).

Figure 3 shows the individual electric motors 20 which drive the revolvable discs 1a,1b and which can be operated at different speeds so as to control the ball spin of the ejected ball.

Figure 4 shows a casing 17 and a hopper 18 having a ball feeding disc which is formed with grooves and revolves within the hopper 18 so as to feed a series of balls into the ball feeding tube 5.

One form of height adjustment mechanism for the ball propelling machine is shown in Figure 5 and comprises a two segment arm which can be adjusted to various heights, examples of which are shown in a, b and c. The arm may optionally be fitted with a swivel joint 19 which can be used to vary the horizontal (side angle) position of the rotatable discs 1a,1b.

An alternative form of height adjustment mechanism is shown in Figure 6 and comprises an extendible scissor-type mechanism which can be adjusted to various heights, examples of which are shown in a, b, and c.

In Figure 7 there is shown a schematic representation of a tennis court showing an inclination angle α between horizontal plane c, b and ball direction a, and side angle β between plane a,b and straight line c aimed directly across the court.

In Figure 8 there is shown a front view of the two discs 1a,1b having concave rims with the gap 2 therebetween,

the discs being mounted on the support 7 affixed to the rotatable base 16. In position A, no side spin would be imparted to the tennis ball, whereas in position B, the ball is ejected with a side spin.

5

Ejecting Mechanism

As shown in Figure 1, revolvable discs 1a,1b are disposed on double support 7 mounted in a rotating sleeve 8, with
10 rotating sleeve 8 encircling the opening of a feeding tube 5 and they are rotatable in unison around axis 3 which defines the direction of ejected ball 4, while the position of the discs 1a,1b defines the degree of side spin or "slice" imparted to said ball.

15

The relative angular velocity of discs 1a,1b may be varied to impart top or under spin to ball 4. Each of the discs 1a,1b has a rim presenting a concave surface to the ball, as shown in Figure 2 at 15a,15b. The concave
20 surface radius and the size of gap 2 between the discs determine the ranges over which the characteristics of the ball can be varied. The discs 1a,1b may be made, for example, with a concave section of radius 50mm and a gap of 38mm between the deepest surface points of the rims of
25 the two discs.

In a preferred embodiment the revolvable discs are directly mounted on and driven by stationary shaft revolving case DC motors shown at 20 in Figure 3. In an
30 alternative embodiment, the discs are driven by two standard high speed DC motors with either direct, gear, chain or belt drive.

A variety of speed and spin amplitudes may be implemented
35 by forming the concave sections 15a,15b of the discs with any radius in the range from 38 to 68mm, and any gap in the range from 28 to 48mm, while the capability of

emulating with precision the ball characteristics as produced by a human player is maintained throughout.

Individual motor speeds are electronically controlled,
5 allowing for speed and spin adjustment to either pre-set or programmable shots, or a combination of both.

According to a further aspect of the invention motor speeds are remotely controllable for customised setting
10 of ball characteristics.

Ball Feeding Mechanism

The ball feeding mechanism, shown in Figure 4, comprises a hopper 18 and a rotating disc (not shown).
15

Upon rotation of the disc, balls from the hopper are led to meet opening of the feeding channel one at a time. The feeding channel then diverts the ball through the
20 external envelope of the ball container (hopper) 18, and into the feeding tube 5.

The preferred embodiment, the rotating disc is driven by a stepping mechanism.

25 The feeding tube 5 is positioned within the ball propelling head, to lead the ball in the direction of the gap 2 between the discs 1a,1b, where it is drawn into said gap 2 to be ejected therefrom in accordance with ejection data input.

30

The rotating feeding disc is disposed in a vertical position within the hopper 18, collecting the balls and delivering them into the feeding channel as it rotates around its axis. In an alternative embodiment the
35 rotating feeding disc is mounted horizontally at the base of the hopper. According to a further embodiment the rotating feeding disc comprises several engraved grooves

for leading the balls and avoiding ball jamming.

The ball is fed into the ejecting mechanism at the centre of the gap 2 between the rotating discs 1a,1b by the
5 force of gravity or by a small propulsion device.

Swivelling or Spin Angle Mechanism

The swivelling mechanism provides means for continuous adjustment of the spin angle or "slice", said spin angle
10 being the angle between the horizon and spin axis.

Adjustment of the spin angle enables emulation of any mode of side spinning the ball, as may be produced by a left-handed or right-handed player playing fore-hand or back-hand at any height, direction, speed and degree of
15 spinning. A 180 degree range of swivelling is provided (90 degrees to each side) to allow for any possible type of side spinning produced by an actual player.

In the preferred embodiment, swivelling is performed by
20 adjustment of the discs 1a,1b, said discs being rotatable around an axis 3 shown in Figure 1, which defines the direction of ejection of the ball 4 through the centre of the gap 2 between said rotating discs 1a,1b. Swivelling (spin angle) range is 90 degrees to each side.

25 Adjustment of rotating discs 1a,1b is effected by them being mounted on double frame 7 which protrudes from rotating sleeve 8, said rotating sleeve 8 enclosing the feeding tube 5 while being held and rotated inside the
30 yoke 6. Rotating is driven by swivel drive 11, utilizing a stepping mechanism and gear 13 to position rotating discs 1a,1b at an angle which may be pre-set, and is programmable and adjustable. The driving mechanism is a worm-wheel mechanism, the wheel being mounted on the
35 rotating sleeve 8.

Figure 8 shows by way example two different positions of

the ejecting means. In the drawing generally designated A the discs are in a perpendicular position resulting in zero spin, whereas in the drawing generally designated B the discs have been rotated to assume a diagonal position whereby a side spin of controllable velocity is obtained.

Side Spin Velocity Control Mechanism

Either of the two rotating discs 1a, 1b may be selected to rotate at a higher relative speed than the other whereby in combination with swivelling at $\pm 90^\circ$ any kind of side spin may be emulated.

Inclination Mechanism

The inclination angle is defined as the angle α between imparted ball direction a and the horizontal plane bc as shown in Figure 7.

The inclination mechanism provides means for continuous adjustment of the inclination angle, thereby enabling a variation of trajectories at a given speed and ejection height. It will be appreciated that the inclination angle may be positioned above the horizon as in Figure 7 creating a look up angle, or below it, creating a look down angle, not shown. Angles are fully adjustable and programmable, and may also be pre-set in the machine.

Controlling the inclination angle allows for emulation of a full range of shots from service height down to ground level, including emulation of a player hitting down to ground level, as well as emulation of a player hitting a ball from various heights at different distances from the net. Range of inclination angle is from 15 degrees down and up to 45 degrees up.

As shown in Figure 1, feeding tube 5 is mounted in a yoke 6 subject to inclination in a vertical plane, allowing modification of the inclination angle.

Inclination is driven by inclination drive 10 utilizing a stepping mechanism comprising a gear 13 with a worm-wheel, mounted on the yoke 6.

5 Sweeping or Side Angle Mechanism

The sweeping mechanism provides means for continuous adjustment of the horizontal angle at which the ball is ejected from the propelling machine.

10 The side angle β shown in Figure 7, is defined as the deviation of the direction a of the imparted ball from the vertical plane containing straight line c which is aimed directly across the court. It will be appreciated that deviation may be directed to the opposite side of line c.

15

Controlling the said horizontal angle enables the production of varies trajectories aimed at diverse locations on the court, whereby emulation of a full range of shots targeted to any point between the base line and
20 the net and across the width of the court is enabled. Due to the above described control mechanism the apparatus of the invention provides for serving more than one player by means of a simple machine. Range of sweeping (side) angle is from 45 degrees to the left to 45 degrees to the
25 right.

In the preferred embodiment, the propelling mechanism is supported on rotating base 16 which sweeps from right to left, driven by sweep drive 9 utilising a stepping
30 mechanism and gear 12, as shown in Figure 1.

In an alternative embodiment, the driving mechanism may be any type of motor, pneumatic or hydraulic device utilising gearing, and may also be applied at ground
35 level or close to ground level as shown in Figure 5 at 19, allowing for sweeping the height control mechanism in toto with the ejecting mechanism on top.

Elevation or Height Control Mechanism

The height control mechanism provides means for continuous adjustment of the height at which the ball is ejected from the ejecting mechanism, whereby a variety of trajectories aimed at various heights are produced to emulate a player at varying distances from the net hitting the ball at varying heights. The range of elevation is from 0.3 metres up to 2.75 metres above ground level.

In the preferred embodiment, the elevation mechanism consists of a scissor mechanism, shown in Figure 6.

In an alternative embodiment, shown by way of example in Figure 5, a two, three or four segment arm may be used for lifting the ejecting mechanism. Springs or gas filled struts may be used for minimising the force required to raise the mechanism.

Visual Indication of Ball Trajectory

In accordance with a feature of the preferred embodiment, actual movements are visibly performed by the ejecting head of the apparatus whereby a visual indication to the player is enabled of the direction, inclination, height and side-spin at which the ball is to be ejected. This feature is extremely important while performing a complete training session or a full game.

Ball Damage Prevention

In accordance with a further aspect of the invention, the concave surface of the rims of the rotating discs as well as the surface material and texture are designed to provide a firm and stable grip of the tennis ball, accelerating it until ejection at the desired speed and spin with minimal damage to the ball, where damage is defined as loss of fibres on the ball surface, "shaving"

or cutting of the ball. The present invention minimises the damage to the ball which is substantially less than effected by any other machine or professional player.

5 In the preferred embodiment, the surface material is a synthetic plastics material, such as polyurethane, with smooth, minimally textured surface.

In an alternative embodiment, the surface material may be any derivative of urethane or other material with similar
10 characteristics, such as thermoplastics, thermosetting plastics, elastomers, or alloy-plastic material, any reactive plastic material or naturally occurring coating materials.

15 Landing Point Control and Propelling Point Emulation

The mechanical components, drives, and electronics of the apparatus of the invention provide means for very accurate control of ball characteristics, allowing a ball to be ejected and landed within 15cm of the desired
20 location, provided the apparatus is positioned at a predetermined point on the court for calibration.

Actual location of the apparatus notwithstanding, training with the ball coming from various locations may be emulated by adjusting the ball characteristics,
25 trajectory and propelling height to produce a trajectory that simulates a shot coming from a desired location.

In the preferred embodiment, two means are available to accurately design and adjust the trajectory and landing
30 spot:

- (a) clear marks on the machine base for precise positioning at the centre of the base line, using the common lines marked on every tennis court, and
- 35 (b) calibration and adjustment. Known shots can be used for calibration, the calibrating shots being straight shots from maximum service height aimed

toward the opposite base-line at (1) the centre,
and (2) to the right corner of the base-line. The
machine can then be adjusted digitally to any
location by specifying coordination of the
5 desired new location.

Independent Movement Around the Court

In accordance with a further aspect of the present
invention, the ball propelling apparatus is capable of
10 independently moving around the court. This feature
allows for perfect visual emulation of a complete game as
well as training the player with various ball
characteristics driven from different locations on the
court.

15

The machine is equipped with sensors which identify its
location by means of infra-red or ultra-sonic
transceivers or both on the machine and at the sides of
the court. The same system provides the necessary means
20 for adjusting the machine to face a predetermined
direction such as straight facing the net.

Power Source

The apparatus of the invention may be connected to any
25 mains power source and it may be made with an alternative
power source such as a rechargeable sealed lead acid
battery for backup. The battery may be charged utilising
a solar charging system, with an alternative quick
charging from the main power line.

30

Microprocessor-based System

Operation of the apparatus of the invention is wholly
controlled by a microprocessor-based sub-system wherein
the microprocessor is embedded in an electronic board.
35 The said electronic board provides means for receiving
instructions either by a wire connected personal computer
or from a remote control apparatus allowing for

individual determination of shot characteristics as well as customised adjustment of programs and training session design.

Pre-programmed and customised parameters may be stored in the processor memory to (a) create a combination of desired ball characteristics, (b) create game patterns, (c) perform safety measures prior to ball ejection, (d) record, retrieve, display and/or print, ball characteristics, series of ball characteristics and evaluation of player responses to shots.

It will be appreciated that various types of electronic circuits using different kinds of processors may be used to operate the apparatus of the invention. Thus for example the number of I/O lines may differ according to the features and capabilities of various models whereas external memory may be implemented by a variety of means utilising floppy discs or CMOS memory cards with the appropriate drives.

Remote Control

The remote control system of the apparatus is used as a remote console of the microprocessor, allowing the user a determination of shot characteristics as well as choice of customised programs and pre-designed training sessions.

In the preferred embodiment a communication protocol is utilised in order to determine the said parameters. According to another aspect of the preferred embodiment the man-machine interface enables the use of menu driven options to simplify the determination process.

In accordance with a further embodiment of the invention the remote control receives feedback information from the

apparatus and is capable of displaying data on a remote display station, operating as a transceiver and a console in one.

5 Training Sessions

The electronic sub-system of the apparatus of the invention is capable of storing a large database of shots of varied characteristics. The said pre-stored shots can be used consecutively in any sequence or with
10 repetitions, to form a training program. Shots may be ejected at a time upon player request, or successively, in accordance with a predetermined pattern. The time elapsed between each shot may be predetermined, adjusted by the player or randomly selected if the player so
15 desires.

The said electronic sub-system further enables recording new customised training sessions, and updating existing sessions.

20 Sessions may be stored in the processor memory or in external memory for fast retrieval or future use.

Game Simulation

The said electronic sub-system is capable of storing a
25 database of numerous games. Each game may simulate a real game or it may be designed to suit preferences of the player. The electronic sub-system allows for customising and recording new games, as well as utilising new update games provided by means of external memory device.

30

Printing Games and Training Sessions

The electronic sub-system of the apparatus further provides means for printing designed or actual games and training sessions via a printer. In the preferred
35 embodiment the data is presented in the form of ball characteristics of each shot. Recording and printing may be used by coaches for assistance in training schedule

planning.

Return-Shot Evaluation, Recording and Printing

5 In accordance with a further aspect of the invention,
coaches or players may record selected shots with an
evaluation of the student's response to each shot. In the
preferred embodiment, the coach selects his evaluation
on a scale of "a" to "n", "a" being excellent and "n"
being poor response, and records the ball characteristics
10 with the student return evaluation. The coach and the
student may then print the evaluated shots, analyse them
and plan the student's next training session accordingly.

CLAIMS:

1. A machine suitable for propelling a ball in the
general direction of a player practising a game
5 involving the use of such a ball, comprising in
combination:
a pair of substantially coplanar spaced
revolvable discs having concave rims which are
adjacent so as to form therebetween a gap;
10 driving means capable of causing the discs to
revolve in opposite directions in use;
feeding means capable of delivering a ball or the
like into one end of said gap so that, in use, it
is drawn through the gap by the adjacent rims of
15 the revolving discs and ejected from the other
end of the gap; and
means for varying the horizontal and vertical
positions of the discs and for rotating the discs
about an axis which defines the direction of the
20 ejected ball or the like;
the arrangement being such that in use the player
can obtain the desired ball characteristics by
appropriate adjustment of the position of the
pair of revolving discs in the vertical and
25 horizontal planes respectively and by rotation of
the discs about said axis.
2. A machine as claimed in Claim 1, wherein said
driving means comprises individual separately
30 controllable motors for the revolvable discs,
whereby in use the speed and spin of the ejected
ball can be controlled by appropriate adjustment
of the motor of each disc.
- 35 3. A machine as claimed in Claim 1 or 2, wherein
said feeding means comprises a tube having one
end positioned adjacent said one end of the gap

and communicating at its other end with a storage hopper containing means for introducing balls or the like stored in the hopper into said other end of the tube.

5

4. A machine as claimed in Claim 1, 2 or 3, wherein the concave rims of the revolvable discs are coated with a synthetic plastics material.

- 10 5. A machine as claimed in Claim 4, wherein the rims are coated with polyurethane.

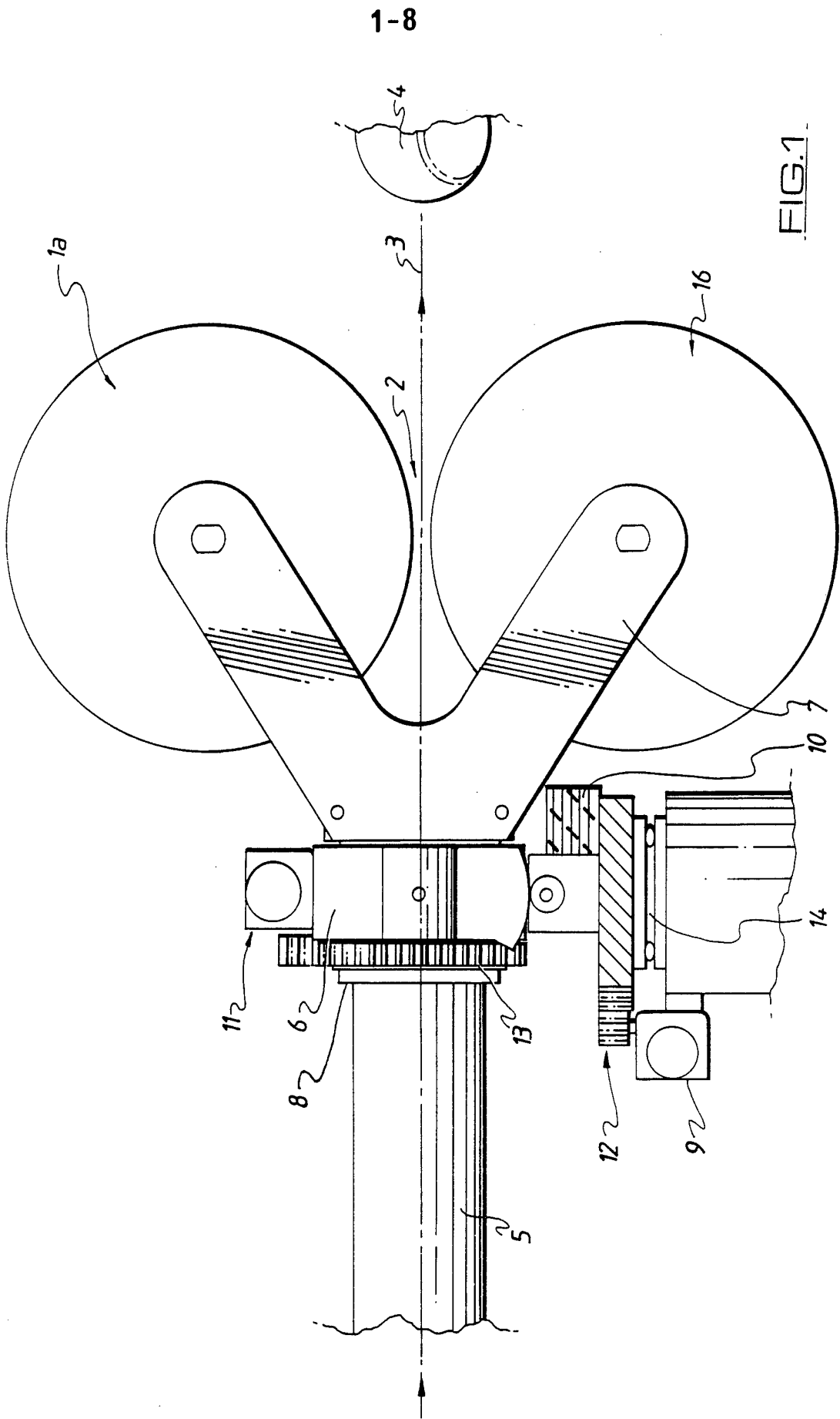
6. A machine as claimed in Claim 1, 2, 3, 4 or 5, wherein the desired characteristics are obtained
15 by means of electric motors which are capable of actuating the adjustment and/or rotation of the discs, and wherein means are provided to control the operation of the electric motors.

- 20 7. A machine as claimed in Claim 6, wherein said means for controlling the operation of said electric motors is a microprocessor.

8. A machine as claimed in Claim 7, wherein said
25 microprocessor is programmed to receive signals emitted from a remote control device, enabling the player to determine shot characteristics or choose from a repertory of customised shots and training programs stored in the microprocessor
30 memory or in any external memory.

9. A machine as claimed in Claim 8, wherein said
35 microprocessor is adapted to communicate with a personal computer allowing for programming, retaining, recording and recalling of single shot or full game characteristics.

10. A machine as claimed in Claim 9, wherein means
are provided for printing out single shot
characteristics, games, training sessions and
return shot evaluations.
- 5 11. A machine as claimed in Claim 10, wherein means
are provided for recording game evaluation input.
- 10 12. A machine as claimed in Claim 8, 9, 10 or 11,
wherein said remote control device receives
feedback information from said machine.
- 15 13. A machine as claimed in any one of Claims 7 to 12
and further comprising sensors for the reception
of signals from emitters positioned around the
court which signals are processed by said
microprocessor to define the location of said
machine within the court.
- 20 14. A modification of the machine claimed in Claim
13, wherein the sensors are positioned around the
court and the emitters are mounted on the
machine.
- 25 15. A machine as claimed in Claim 13 or 14, wherein
said sensors are receptors of infra-red
radiation, or receptors of ultra-sonic signals.
- 30 16. A machine as claimed in Claim 13, 14 or 15,
wherein the microprocessor is programmed to
calculate the ball characteristics in accordance
with said location of the machine.



2-8

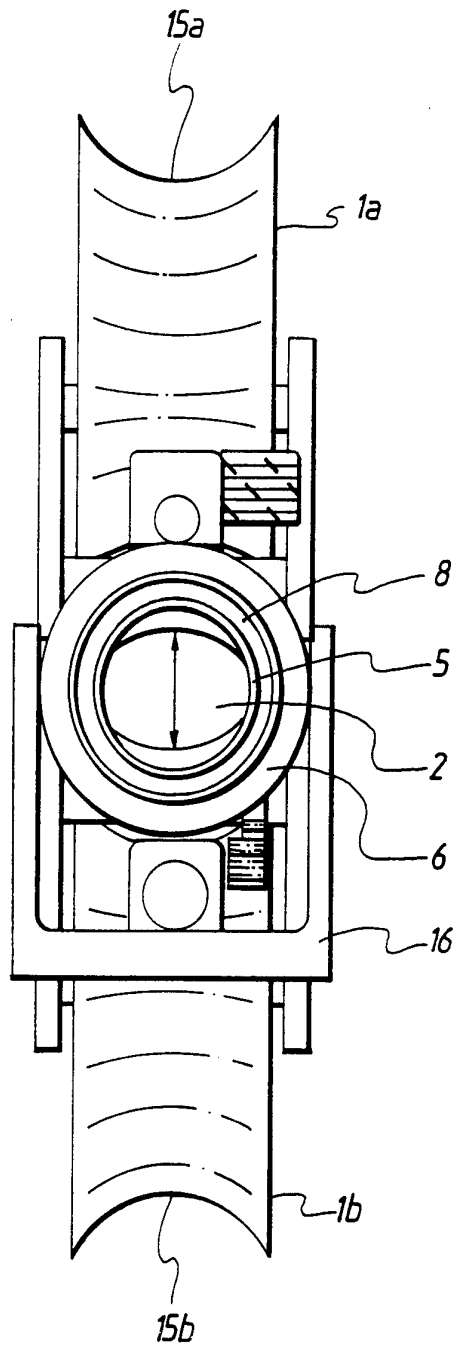


FIG.2

3-8

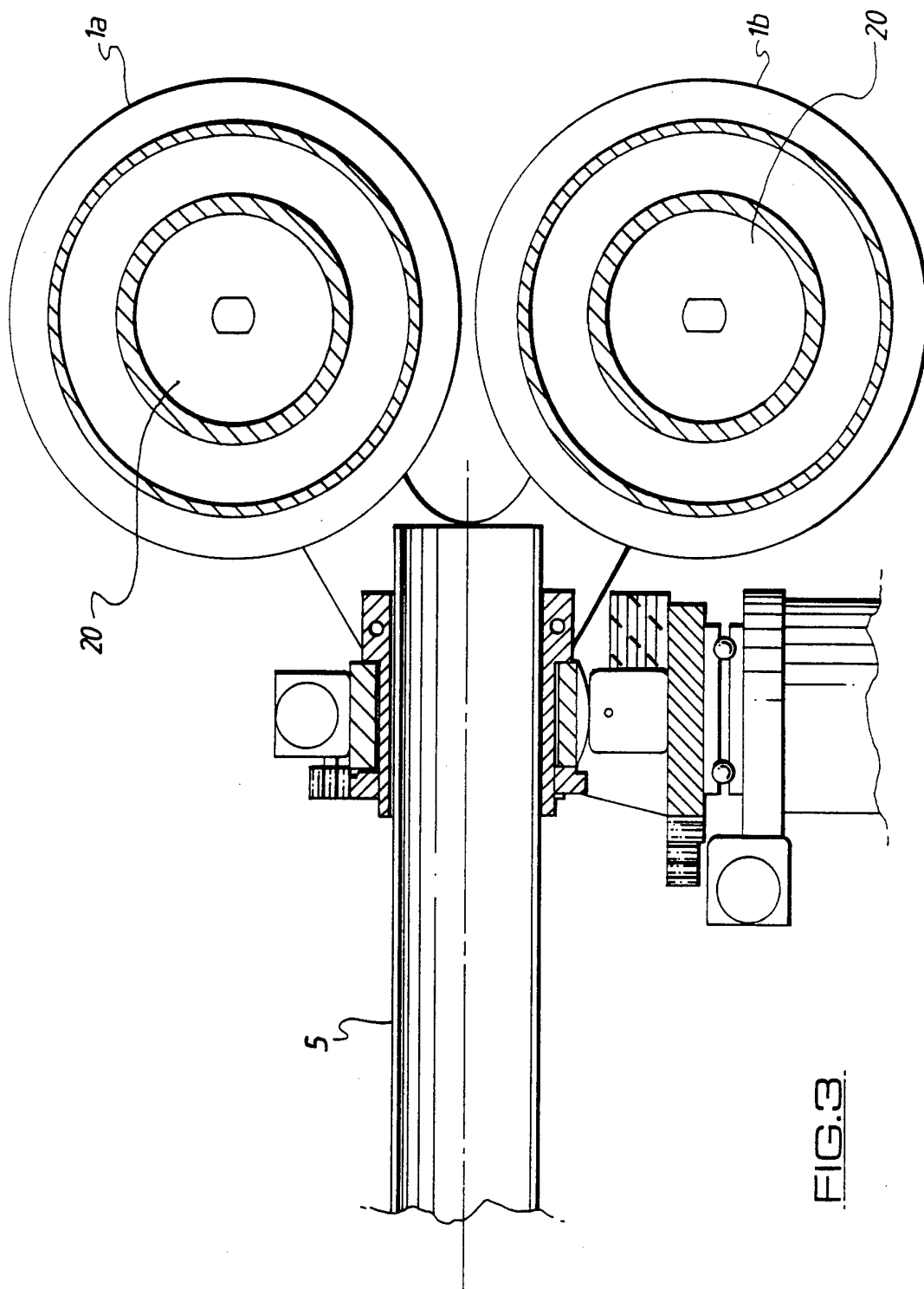
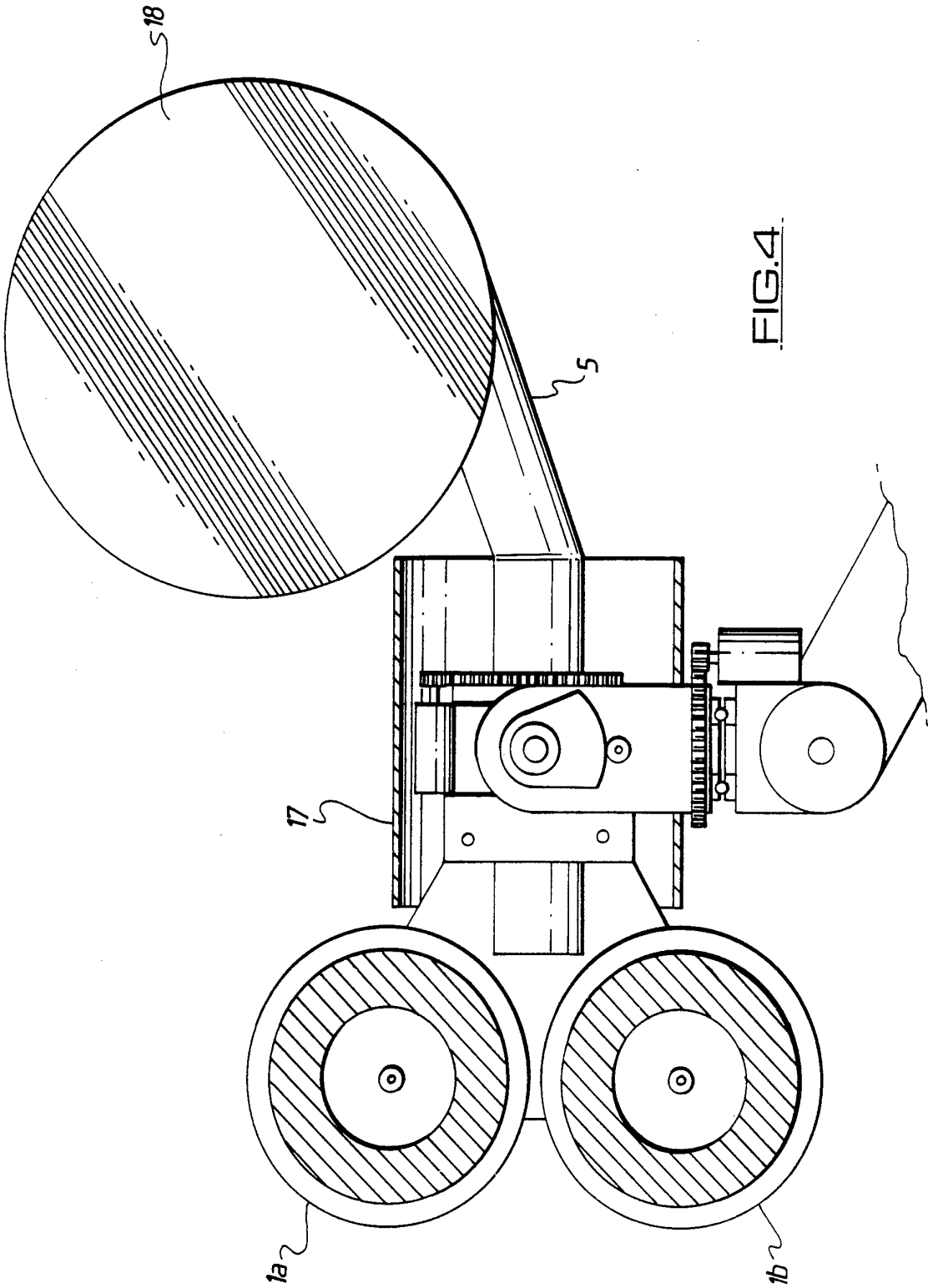


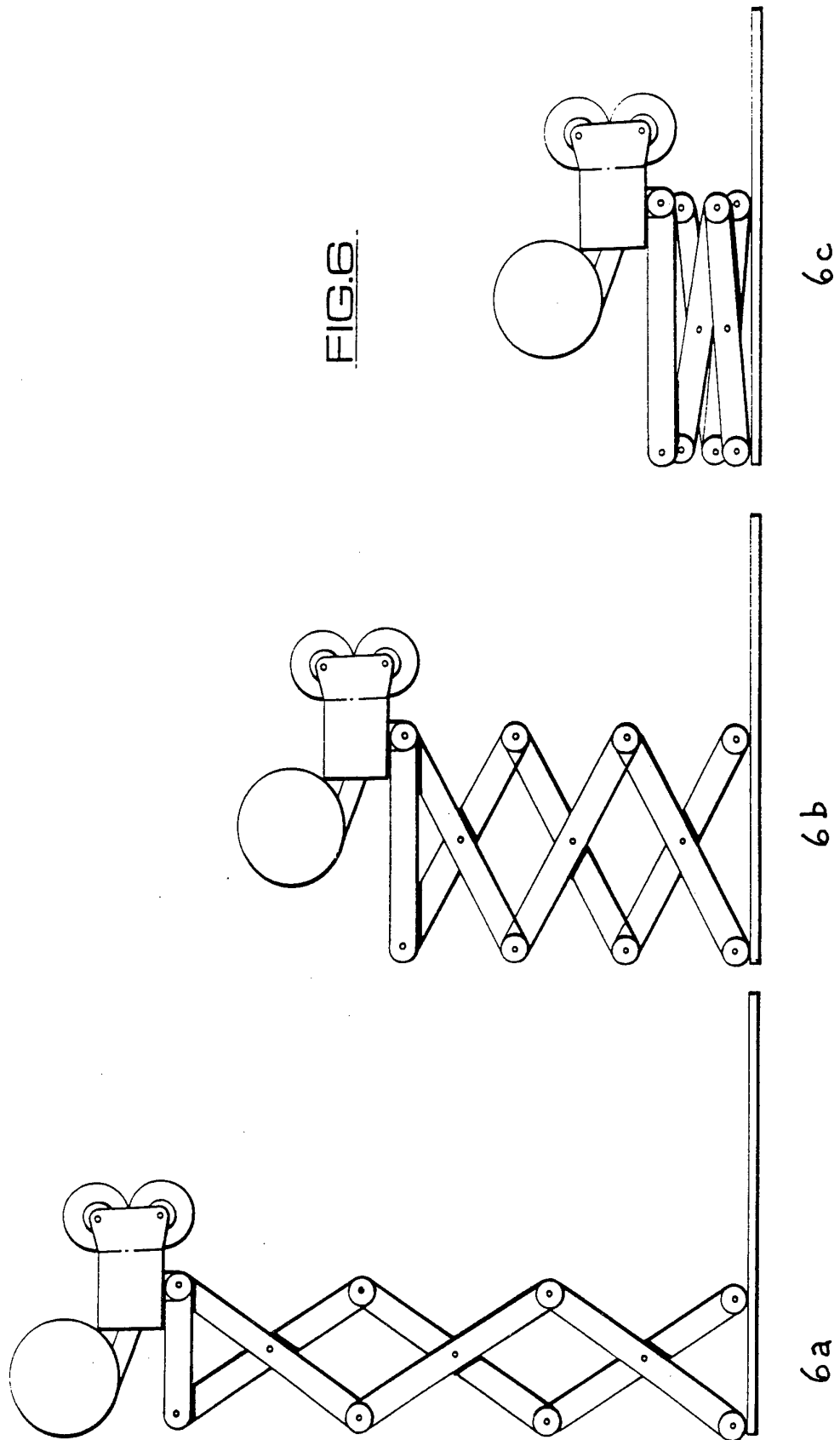
FIG. 3

4-8



6-8

FIG. 6



7-8

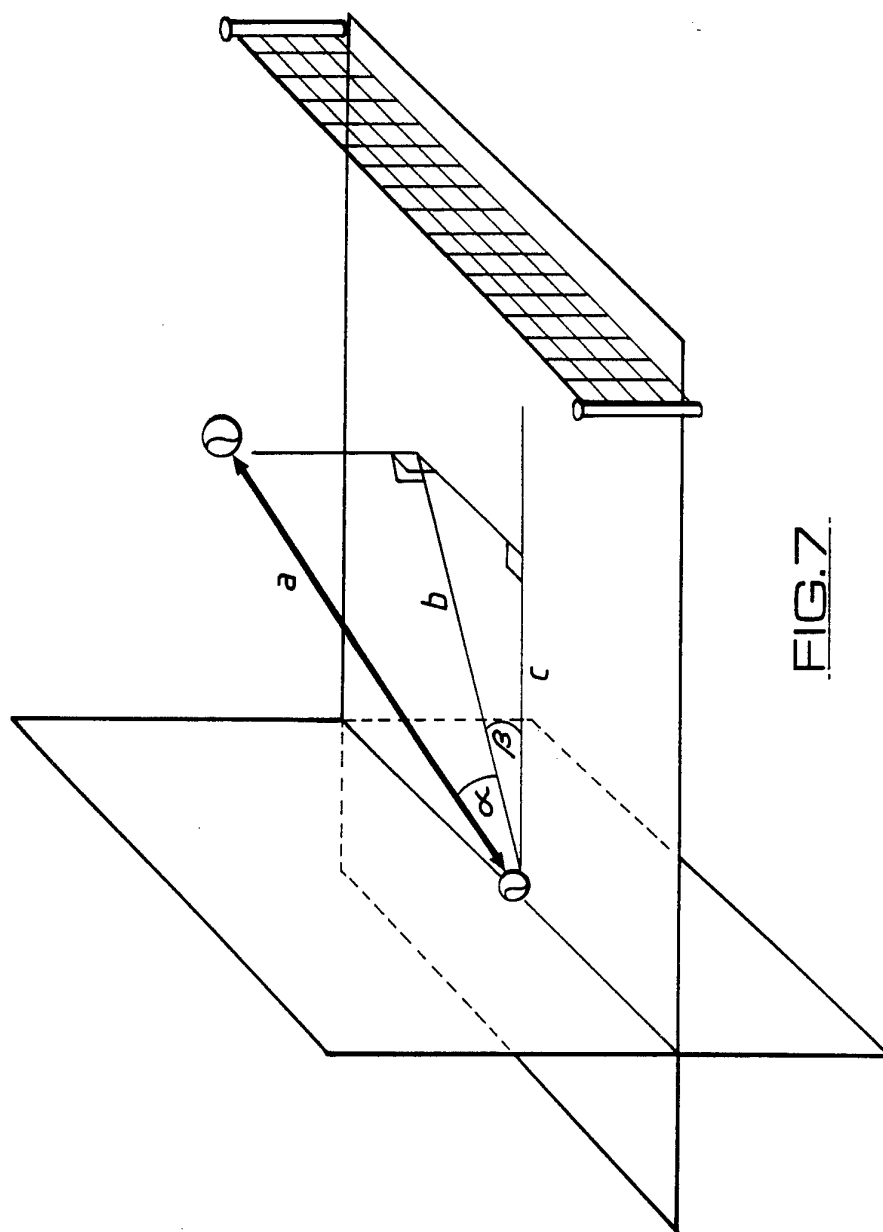
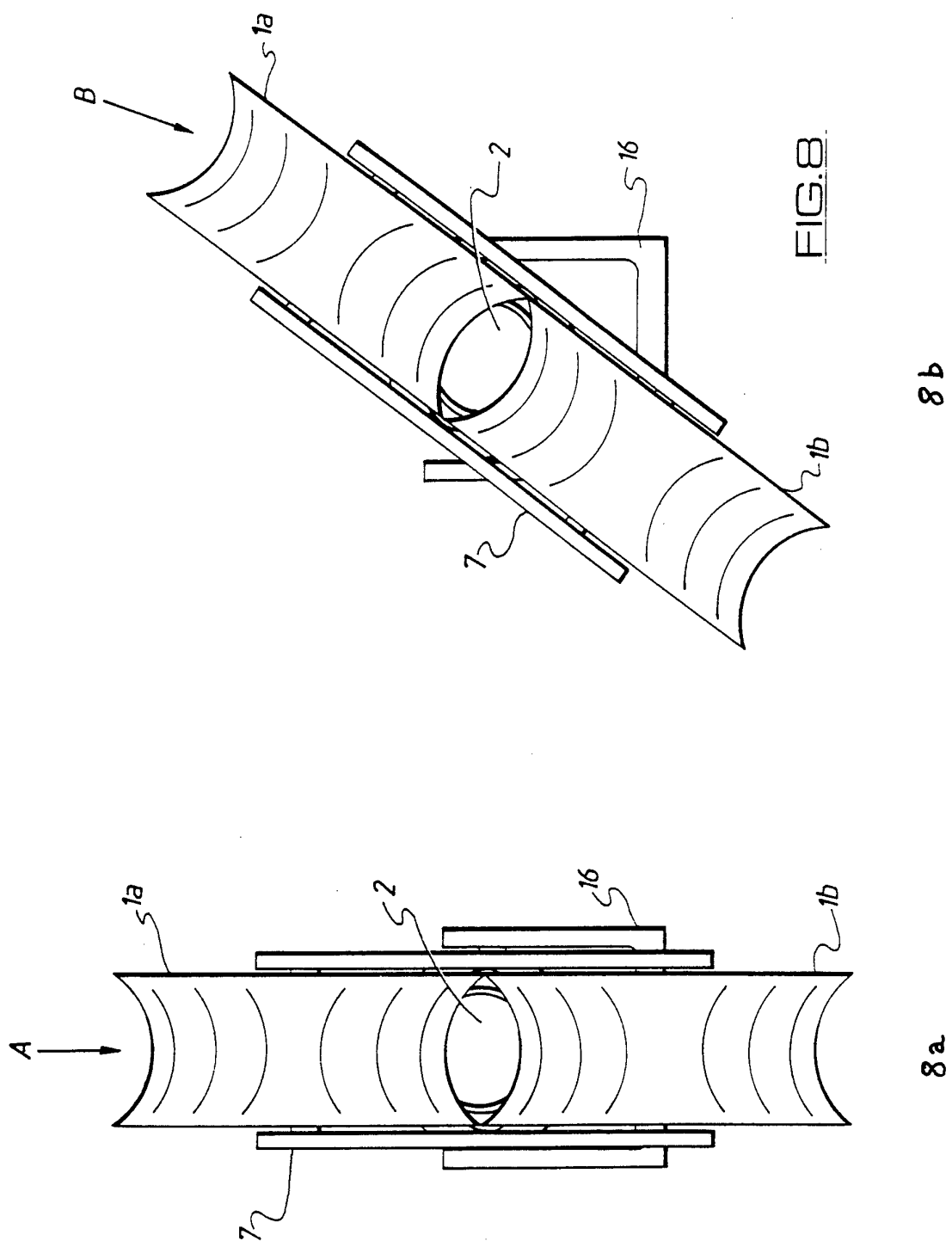


FIG. 7

8-8



INTERNATIONAL SEARCH REPORT

PCT/GB 92/02107

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 A63B69/40		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	A63B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ^o	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US,A,4 712 534 (F NOZATO) 15 December 1987 see column 1, line 48 - column 2, line 12 see column 2, line 51 - line 53 see column 3, line 25 - line 28 see column 4, line 35 - line 55 see figures ---	1-5
X	WO,A,8 801 188 (F KOVACS) 25 February 1988 see page 7, line 9 - line 21 see page 8, line 9 - page 9, line 5 see page 12, line 3 - line 25 see page 13, line 21 - line 26 see figures 1,2,4,5 --- -/--	1-3,6-11
^o Special categories of cited documents : ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "I" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
07 JULY 1993	07.07.93	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	VEREECKE A.	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	EP,A,0 400 325 (H REENTS) 5 December 1990 see column 6, line 54 - column 7 see column 7, line 52 - column 8, line 24 ---	1,3,6-9
A	US,A,4 922 885 (S IWABUCHI) 8 May 1990 see column 3, line 28 - line 46 see column 6, line 9 - line 11 see figures ---	1-5
A	US,A,4 325 351 (S YUASA) 20 April 1982 see column 2, line 9 - column 3, line 8 see figures -----	1-3,6

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

GB 9202107
SA 66538

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

07/07/93

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4712534	15-12-87	JP-B- 4027874 JP-A- 61263469	12-05-92 21-11-86
WO-A-8801188	25-02-88	AU-A- 7803787 US-A- 5125653	08-03-88 30-06-92
EP-A-0400325	05-12-90	DE-A- 3914017	31-10-90
US-A-4922885	08-05-90	US-A- 5044350	03-09-91
US-A-4325351	20-04-82	None	