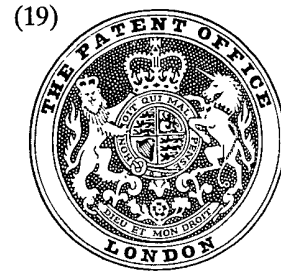


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(54) DISK CARTRIDGE RECORD/PLAYBACK APPARATUS

(71) We, INTERNATIONAL BUSINESS MACHINE CORPORATION, a Corporation organized and existing under the laws of the State of New York in the United States of America, of Armonk, New York 10504, United States of America do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The invention relates to disk cartridge record/playback apparatus.

Random access disk stores used in data processing systems often employ a disk assembly of one or more rigid magnetically coated disks which can be mounted on or in disk record playback apparatus for recording and playback of data from the disk surfaces. Often the disks are contained within a cartridge to facilitate handling and storage and to protect the surfaces of the disks during installation and removal from the apparatus. Such cartridges are designed to prevent human contact with the disk surfaces and to seal the disk assembly from airborne contaminants. Provision is made to allow the necessary connections to be made with the record playback apparatus including the introduction of one or more transducers into close proximity to the disk surfaces and the attachment of the disk hub assembly within the cartridge to a drive motor for rotation of the disk or disks.

Development of flexible recording material has lead to the development of flexible disk cartridges for installation on record/playback apparatus containing appropriate disk drive motor and head actuator mechanism. An advantage of using flexible disks is that in operation, the disk flies over the head supported on an air bearing generated as a result of the relative motion therebetween, in contrast to the reverse as is the case with rigid disks. Accordingly, a simple

non-compliant head assembly is all that is required in the disk drive in place of the complex and relatively expensive suspension unit required for rigid disks.

The present invention is concerned with apparatus for receiving such interchangeable cartridges. The apparatus should be simple to operate yet ensure that cartridges are located with precision within the apparatus so that the required head to disk relationship is established to enable successful record/playback operations to be performed.

According to the invention, a disk cartridge record/playback apparatus comprises a housing containing a rotatable disk drive member, a receptacle for receiving a disk cartridge containing a rotatable record/playback disk, the receptacle being movable between a cartridge loading position spaced from the disk drive member and a cartridge record/playback position adjacent the disk drive member, retaining means associated with said receptacle for engaging and retaining a cartridge inserted therein, locating means in said housing adapted to engage a cartridge contained within said receptacle as it is moved towards said record/playback position in order to position and support said cartridge at a record/playback station with its contained disk connected for rotation to said drive member, means attached to said receptacle arranged, as a result of further movement of said receptacle towards said record/playback position, to contact and clamp a cartridge contained therein on said locating means at said record/playback station, and bias means operable to urge said receptacle towards said record/playback position in order to maintain a cartridge supported on said locating means at said record/playback station.

In order that the invention may be fully understood, a preferred embodiment thereof will now be described, by way of exam-

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ple. with reference to the accompanying drawings. In the drawings:

5 *Figure 1* is a perspective view from the side of one form of disk cartridge record/playback apparatus according to the invention;

10 *Figure 2* is a transverse sectional view of the apparatus in its 'open' condition ready to receive a disk cartridge;

15 *Figure 3* is a transverse sectional view of the apparatus in its 'closed' position with a loaded cartridge enclosed located at a record/playback station within the apparatus;

20 *Figure 4* shows an over-centre toggle mechanism maintaining the apparatus at its open position as shown in *Figure 2*; and

25 *Figure 5* shows the over-centre toggle mechanism maintaining the apparatus at its closed position as shown in *Figure 3*.

30 Referring to the figures, cartridge record/playback apparatus according to the invention generally comprises a housing, part of which is shown as base plate 1 and front panel 2, containing a cartridge receptacle 3. The receptacle is hinged within the housing at its rear end to be movable from a cartridge loading position, shown in *Figure 1* and *Figure 2*, to a cartridge record/playback position shown in *Figure 3*. A horizontal slot 4 is provided in the front panel 2 to permit insertion of a disk cartridge 5 into the receptacle 3. A latch mechanism 6 carried by the receptacle is positioned to engage a cartridge 5 inserted into the receptacle and retains it therein against spring pressure until it is subsequently released. An operating lever 7 projects from the front of the receptacle through a vertical slot 8' in the front panel 2 to enable an operator to move the receptacle 3 up and down about its rear hinge between the loading and the record/playback positions.

35 A disk drive magnetic chuck 8 and a record playback head assembly 9 are supported above the base plate 1 in the vicinity of the record/playback position. Locating pins 10 extend from the base plate 1 into the receptacle 3 and are positioned to enter correspondingly positioned apertures in the base of the cartridge as it is moved by an operator towards the record/playback position. The pins and cartridge apertures are arranged so as to support and accurately position the cartridge at a record/playback station where the enclosed disk is connected for rotation to the drive chuck 8, and a record playback head 11 (*Figure 2*) carried by the assembly 9 projects through an aperture in the cartridge in order to access the enclosed disk. The receptacle 3 continues its movement towards its record/playback position leaving the cartridge held supported and accurately positioned on the pins 10 at the record/playback station. The

receptacle movement ceases when a projection carried by the upper part of the receptacle contacts the upper surface of the cartridge and firmly clamps it on the pins 10 at the record/playback station. Since the cartridge is now independently supported on the locating pins 10 at the record/playback station, it is buffered to a large extent from mechanical shocks and disturbances received by the cartridge receptacle 3 which could lead to record or playback errors. A door or shield, carried by the cartridge receptacle covers the slot when the receptacle is in the record/playback position as shown in *Figure 3*.

40 An over-centre toggle-action spring mechanism 12, to be described fully later with reference to *Figure 4* and *Figure 5*, connects the receptacle 3 to the base plate 1. The mechanism is constructed so that, when in one of its bistable states (*Figure 4*) it biases the receptacle towards the loading position shown in *Figure 2*, and when in the other of its bistable states (*Figure 5*) it biases the receptacle towards the record/playback position shown in *Figure 3*. The force exerted by the mechanism when the receptacle is in the record/playback position contributes towards the clamping force holding the cartridge located at the record/playback station.

45 Stops 13 are provided adjacent, but just beyond, the cartridge loading position on the side remote from the record/playback position. The arrangement is such that a small upward movement of the cartridge receptacle from the loading position causes the stops 13 to contact and disengage the latching mechanism 6 from the cartridge whereupon the cartridge is automatically ejected, or partially ejected, from the slot by spring pressure.

50 In summary therefore, an operator wishing to load a cartridge into the apparatus, first moves the operating lever 7 to the load position shown in *Figure 2* to open the door of slot 4 and inserts the cartridge through the slot 4 into the receptacle 3. When the cartridge is fully inserted it is retained by the cartridge latch mechanism 6. To remove the cartridge, the operator merely raises the operating lever from the loading position, pushing the latch mechanism 6 against the stops 13 causing the cartridge to be ejected under spring pressure.

55 To locate a cartridge at the record/playback station, the operator inserts the cartridge and moves the operating lever 7 to its lower position. At some point during the downward movement of the receptacle, the toggle mechanism 12 snaps from one state (*Figure 4*) to the other (*Figure 5*) and urges the receptacle towards the record/playback position and clamps it firmly in place.

60 At the end of the record/playback opera- 130

tion, the cartridge is unloaded by returning the lever 7 to the original loading position. At some point during the upward movement, the toggle-action mechanism snaps back to its original state (Figure 4) and thereafter urges the cartridge receptacle upwards towards the loading position. The combination of the operator pressure raising the lever 7 and the bias exerted by the toggle-action mechanism 13 usually results in the receptacle over-shooting the loading position with spontaneous release and ejection of the cartridge. Upon release of the lever, the receptacle moves to its stable loading position ready for another cartridge to be inserted.

Before describing the construction and operation of the apparatus in more detail, it is appropriate to give some details of the construction of a cartridge suitable for use with the apparatus.

Such a cartridge consists of a slim disk enclosure suitably dimensioned for insertion through the slot 4 into the receptacle 3. The cartridge contains a record disk provided with a central hub. An aperture through the cartridge is required to permit attachment of the disk hub to the motor chuck at the record/playback station in order to rotate the disk. A head aperture is also required to permit insertion of a data record/playback head at the record/playback station into the cartridge in order to perform data transducing operations on the disk. With the particular head assembly 9 used in the apparatus, the head aperture needs to be located through a major surface of the cartridge. Other head assemblies are, of course, available which would require the aperture to be located elsewhere. For example, with cartridges containing rigid disks it may be desirable to access both sides of the disk simultaneously in which case record/playback heads may be introduced into the cartridge when attached to the drive via a slot in the side of the cartridge. A detent slot is required in the cartridge to engage with the latching mechanism in the apparatus. Apertures are also required in the lower surface of the cartridge to locate on pins 10 as the cartridge is moved to the record/playback station. These holes in the cartridge are preferably shaped so as to pick up the pins 10 even though the cartridge may be slightly misaligned in the receptacle. The shape of the holes and pins are such that the cartridge is pressed in place by the receptacle as it moves to its record/playback position until it is precisely positioned and clamped at the record playback station.

One form of cartridge which is particularly suitable for use in the apparatus subject of the present invention is described and claimed in our copending UK Application for Letters Patent No. 2712477 (Serial No.

1525849). The cartridge described in this application contains a flexible record disk which in use is rotated supported by an air bearing above a stabilizing Bernoulli backing plate. The cartridge is provided with an internal spring-loaded shutter which serves to close at least the head aperture when the cartridge is not in use. A small hole in the leading edge of the cartridge, with respect to the intended direction of insertion into the record/playback apparatus, permits insertion of a pin therethrough to engage the shutter and move it against the spring action to its open position. It has been found convenient in practice to mount the pin within the cartridge record/playback apparatus itself positioned so as to enter the aperture and to progressively open the shutter as the cartridge is inserted by an operator into the apparatus.

The following more detailed description of the component parts of the apparatus subject of the invention will make its operation clear. The receptacle 3 is in the form of a tray having a rectangular base 14 and raised side portions 15. The base 14 is apertured to permit access of the chuck 8 and head 11 at the record/playback station. The tray is hinged along its rear end by means of a rod 16 extending outwardly from each of the two side portions 15 and through the ends of a U-shaped bracket 17 attached to the base plate 1. Springs 18 carried by rod 16 each have their free ends attached between the tray and bracket 17 respectively to exert a force in a direction to counter-balance the weight of the cartridge receptacle.

The cartridge latch mechanism 6 consists of a multi-limbed lever 19 mounted between the sides 15 of the receptacle tray by means of pivots 20. A centrally disposed limb of the lever extends on one side of the pivotal axis and is provided with a downward projecting detent 21 at its free end. Two side limbs extending co-parallel to and co-planar with said centrally disposed limb extend on the other side of the pivotal axis and have sideways projecting lugs 22 which themselves extend into apertures 23 in the sides 15 of the receptacle tray. The dimensions of the apertures 23 are selected to maintain the extent of rocking movement of the lever 19 about its pivotal axis within pre-selected limits. Springs 24 connected between the lever 19 and trays sides 15 bias the lever in a clockwise direction continuously urging the detent towards the cartridge receptacle 3. The two stops 13 referred to previously are conveniently provided as hooked ends of a U-shaped bracket 25 attached to the base plate 1. The dimensions of the bracket 25 are such that the hooked ends, acting as the two stops 13, contact the upper surfaces of the extending lugs 22 when the cartridge

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receptacle tray is in its loading position.

5 Since, in this particular example, the cartridge to be received by the apparatus is of the type containing a spring-loaded head aperture shutter, as described in our afore-  
 10 said co-pending Application No. 27124/77 (Serial No. 1525849), a pin 26 is provided towards the back of the receptacle 3, positioned to enter the cartridge during  
 15 insertion thereof and to open the head aperture. The pin 26 has a shoulder which acts as a stop for the cartridge when it is fully inserted. With alternative cartridges not having such a spring loaded shutter, the  
 20 pin 26 is replaced by a separate spring located towards the back of the receptacle to provide the resilient bias against cartridge insertion. A separate stop for the cartridge is also provided. Since this alternative arrangement is quite clear it is not shown in the drawings.

25 As the cartridge is inserted into the receptacle tray 3, it contacts and lifts detent 21, rotating the latch lever 19 against the action of springs 24. The detent 21 slides along the top of the cartridge 5 in a groove 27 as the cartridge is inserted further into the receptacle guided by side walls 15. The cartridge is aligned sufficiently accurately by its close fit between walls 15 to pick up  
 30 shutter pin 26. Further insertion of the cartridge causes the shutter pin to open the spring loaded shutter in the cartridge. This, because of its spring loading, acts against the pin to produce a resilient bias in a direction opposite to that of cartridge insertion. When the cartridge is fully inserted in the receptacle 3, the latch detent 21 drops into a corresponding detent slot 28 in the top of the cartridge retaining it within the  
 35 receptacle against the resilient bias from the spring-loaded shutter.

40 To unload the cartridge the lever 7 is raised as previously described whereupon the stops 13 bearing on lugs 22 cause the latch lever 19 to be rotated in an anti-clockwise direction lifting the detent 21 from the cartridge detent slot 28. The cartridge is ejected under action of the resilient bias from the spring-loaded shutter acting against the pin 26. On release of the operating lever 7, the receptacle tray returns to its loading position with the lugs 22 of the spring-loaded latch lever 19 contacting the two stops 13.

45 The toggle action spring mechanism connecting the receptacle tray 3 to the base plate 1 is shown in detail in Figure 4 and Figure 5. The mechanism shown in these  
 50 figures consists of an arm 29 connected at one end to a bracket 30 extending from the underside of the base plate 1 by a pivot pin 31. The arm 29 is further connected to a bracket 32 extending from the underside of the base 14 of the receptacle tray 3 by a  
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pivot pin 33 passing through a longitudinal slot 34 in the other end of arm 29. A coil spring 35 is attached at one end to the bracket 30 and at the other end to the slotted end of arm 29.

60 In Figure 2, and in detail of Figure 4, it is seen that the spring 35 acts so as to apply a clockwise moment to the arm 29 about pivot pin 31 thus supplying an upwards bias to the receptacle 3 to hold it in its loading position against stops 13.

65 In Figure 3, and in detail in Figure 5, the spring 35 acts to apply an anti-clockwise moment to the arm 29 about pivot 31 biasing the tray towards its lower record/playback position. In this position, an elongated projecting bar 36 provided integral with, and directly under the pivotal axis of, the latching lever 19 contacts the upper surface of the cartridge now precisely supported on the locating pins 10 and presses it in place to clamp it at the record/playback station.

70 The magnetic chuck 8 which engages the disk hub in the cartridge as it moves into the record/playback station is mounted on a spindle 37 extending through the base plate 1 and driven by a disk drive motor 38. The motor is itself mounted to the underside of the base plate 1. The record/playback head assembly 9 is of the pivoted type having a support arm 39 mounted for arcuate movement about an arm spindle 40 extending through the base plate 1. The actuator arm 39 is driven by a motor 41 mounted to the underside of the base plate 1. The record/playback head 11 mounted on the free end of the arm is positioned to project into the head aperture of a cartridge when it is located at the record/playback station. The actuator assembly is positioned so that the arcuate movement of the head is in a substantially radial direction with respect to a disk at the record/playback station in order to perform data transducing operations thereon.

WHAT WE CLAIM IS:-

75 1. Disk cartridge record/playback apparatus comprising a housing containing a rotatable disk drive member, a receptacle for receiving a disk cartridge containing a rotatable record/playback disk, the receptacle being movable between a cartridge loading position spaced from the disk drive member and a cartridge record/playback position adjacent the disk drive member, retaining means associated with said receptacle for engaging and retaining a cartridge inserted therein, locating means in said housing adapted to engage a cartridge contained within said receptacle as it is moved towards said record/playback position in order to position and support said cartridge at a record/playback station with its contained disk connected for rotation to said drive member, means attached to said re-  
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ceptacle arranged, as a result of further movement of said receptacle towards said record/playback position, to contact and clamp a cartridge contained therein on said locating means at said record/playback station, and bias means operable to urge said receptacle towards said record/playback position in order to maintain a cartridge supported on said locating means at said record/playback station.

2. Disk cartridge record/playback apparatus as claimed in claim 1, in which said bias means includes a bistable device operable in one mode to continuously urge said receptacle towards said record/playback position and operable in another mode to continuously urge said receptacle away from said record/playback position.

3. Disk cartridge record/playback apparatus as claimed in claim 2, in which said bistable device comprises an over-centre toggle-action spring loaded mechanism connected between said receptacle and said housing, the mechanism being arranged to switch its stable state as said receptacle moves through a predetermined intermediate portion of its path of movement between said loading and said record/playback position.

4. Disk cartridge record/playback apparatus as claimed in any one of the preceding claims, in which said locating means are pins mounted within the housing adjacent said record/playback station positioned so as to enter corresponding holes in a cartridge retained in said receptacle as it is moved towards said record/playback station.

5. Disk cartridge record/playback apparatus as claimed in any one of the preceding claims, in which the housing includes a slot located at one end of said receptacle to permit insertion of a cartridge therethrough into said receptacle, and means attached to said receptacle for moving it between the loading and the record/playback position.

6. Disk cartridge record/playback apparatus as claimed in claim 5, including a shield carried by the receptacle arranged to cover said slot to prevent insertion of a cartridge therethrough when the receptacle is in the record playback position.

7. Disk cartridge record/playback apparatus as claimed in any one of the preceding claims, further comprising means for releasing a cartridge from said retaining means, operable in response to movement to said receptacle from said loading position in a direction away from said record/playback position.

8. Disk cartridge record/playback apparatus as claimed in any one of the preceding claims, further including means within the receptacle for co-acting with said

cartridge, or parts within said cartridge, to produce on insertion of said cartridge into said receptacle a resilient bias action acting in a direction opposite to that of cartridge insertion.

9. Disk cartridge record/playback apparatus as claimed in claim 8, in which said means within the receptacle is a pin extending parallel to the direction of insertion of said cartridge into the receptacle, said cartridge having an aperture located to receive said pin therein as said cartridge is inserted into the receptacle and including a spring mechanism positioned within the cartridge to contact and exert a resilient bias against said pin on insertion into the receptacle.

10. Disk cartridge record/playback apparatus as claimed in claim 8, in which said means within the receptacle is a spring device mounted to contact said cartridge on insertion thereof into said receptacle and to exert a resilient bias against said cartridge on insertion into the receptacle.

11. Disk cartridge record/playback apparatus as claimed in claim 8, claim 9 or claim 10, in which said resilient bias is of sufficient strength such that, on release of said cartridge from said retaining means, said cartridge is ejected or partially ejected from said receptacle.

12. Disk cartridge record/playback apparatus as claimed in any one of the preceding claims, in which the retaining means is a spring loaded latching mechanism.

13. Disk cartridge record/playback apparatus as claimed in claim 12, in which the latching mechanism is a spring loaded pivoted arm having a detent at one end arranged to enter a corresponding detent slot provided in a cartridge on insertion of said cartridge into said receptacle.

14. Disk cartridge record/playback apparatus as claimed in claim 13 and claim 11, in which a cartridge retained within the receptacle is released therefrom by means operable in response to movement of said receptacle from said loading position in a direction away from said record/playback position to engage said pivoted arm and rotate it against the spring loading to lift the detent from the corresponding detent slot in said cartridge whereupon said cartridge is ejected or partially ejected from said receptacle by said resilient bias means.

15. Disk cartridge record/playback apparatus as claimed in claim 12, in which said latching mechanism includes an arm mounted for rocking motion towards and away from said receptacle about a pivot positioned at or near the centre of the arm, a spring connected to the arm so as to bias one end of the arm towards the receptacle, a detent on said one end for entering a

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corresponding detent slot in a cartridge on insertion of said cartridge into the receptacle and for retaining such inserted cartridge within the receptacle.

5 16. Disk cartridge record/playback apparatus as claimed in claim 15, further including a stop positioned adjacent the other end of said arm to limit the rotational movement of the arm about the pivot  
10 towards the receptacle, the stop being positioned with respect to the arm such that any movement of the receptacle past said loading position in a direction away from the record/playback position causes the arm to  
15 engage the stop and rotate the arm in a direction to disengage said detent from the corresponding detent slot in a cartridge retained in said receptacle to release said cartridge.

20 17. Disk cartridge record/playback apparatus as claimed in any one of the preceding claims, in which said receptacle is a rectangular tray having a flat base portion, the tray being adapted to slidably receive a  
25 cartridge onto said flat base portion from one edge thereof, and being supported within the enclosure by means of a hinge connected between the housing and the opposite edge of the tray whereby said  
30 receptacle may be rotated about said hinge between said record playback position and a position beyond the loading position in a direction away from the record/playback position.

35 18. Disk cartridge record/playback apparatus as claimed in any one of the preceding claims, including an arm attached to said receptacle and extending to the exterior of said housing by means of which  
40 the receptacle may be moved by an operator between the loading and record/playback positions.

45 19. Disk cartridge record/playback apparatus as claimed in any one of the preceding claims, including a stop located within said receptacle against which a cartridge inserted into said receptacle is held  
50 when said cartridge is at said record/playback station.

55 20. Disk cartridge record/playback apparatus as claimed in any one of the preceding claims, further including a record/playback head assembly positioned adjacent the record/playback station so as to enter an  
60 aperture in a cartridge retained in said receptacle as said cartridge is moved towards the record/playback station, the record/playback head assembly being positioned with respect to a cartridge located at the record/playback station so as to be  
65 capable, in use, of performing transducing operations on the record disk contained within said cartridge.

21. Disk cartridge record/playback apparatus substantially as hereinbefore de-

scribed with reference to, and as illustrated in, the accompanying drawings.

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Agent for the Applicants

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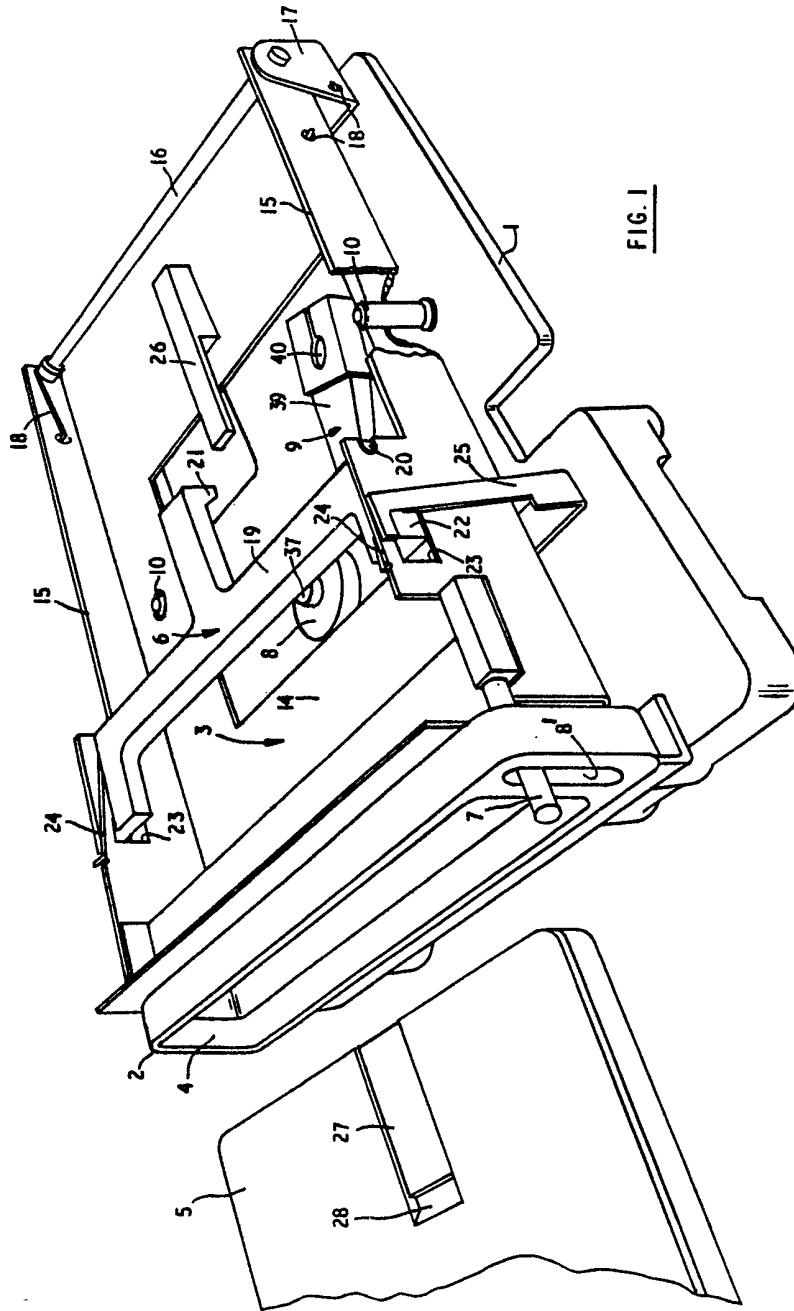


FIG. 1

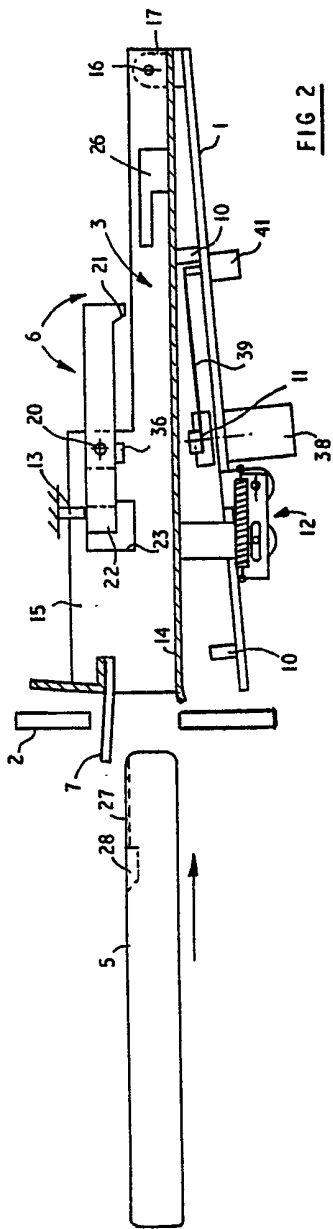


FIG. 2

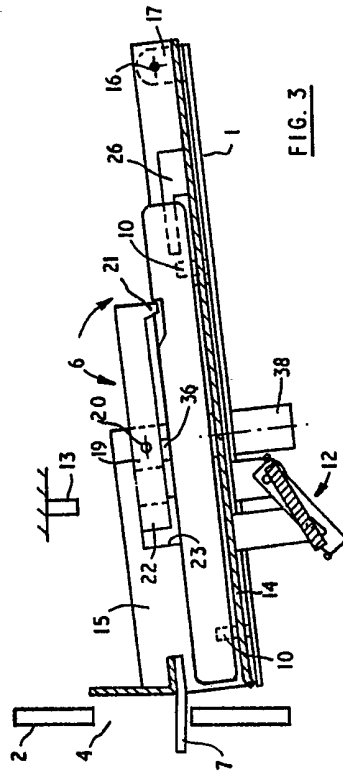


FIG. 3



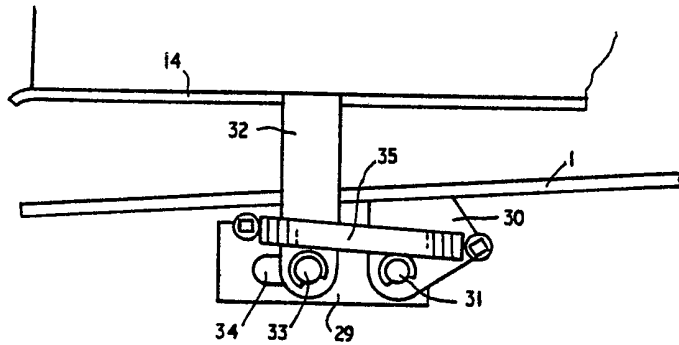


FIG. 4.

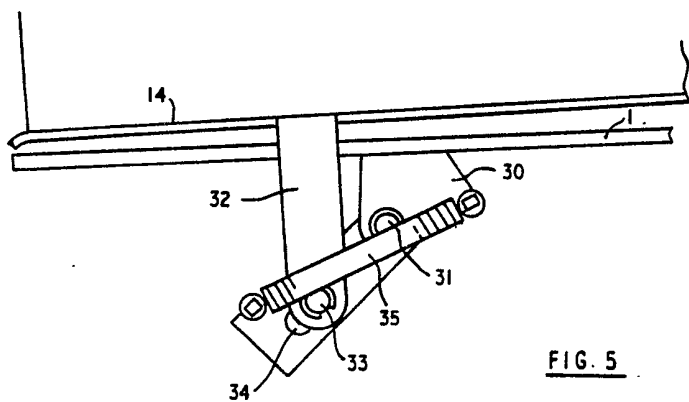


FIG. 5.