(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 July 2003 (24.07.2003)

PCT

(10) International Publication Number
WO 03/060872 A2

(51) International Patent Classification[7]: G10D 3/00

(21) International Application Number: PCT/GB03/00121

(22) International Filing Date: 15 January 2003 (15.01.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0200785.4 15 January 2002 (15.01.2002) GB

(71) Applicant and
(72) Inventor: **SMITH, Geoffrey, Michael** [GB/GB]; Top Flat, 73 Hollingbury Park Avenue, Brighton, East Sussex BN1 7JQ (GB).

(74) Agent: **FRANK B. DEHN & CO.**; 179 Queen Victoria Street, London EC4V 4EL (GB).

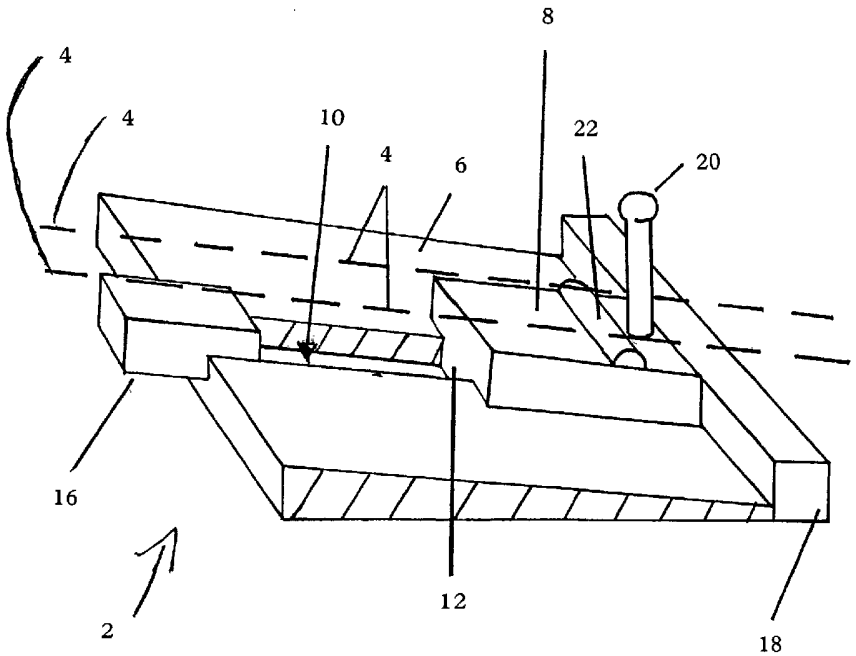
(81) Designated States *(national)*: AE, AG, AL, AM, AT (utility model), AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ (utility model), CZ, DE (utility model), DE, DK (utility model), DK, DM, DZ, EC, EE (utility model), EE, ES, FI (utility model), FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK (utility model), SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: TUNING MECHANISM



(57) Abstract: A tuning mechanism for altering the tuning of the strings (4) of a stringed instrument such as piano or hammered dulcimer comprises a plurality of sliding bridges (8; 36) mounted for sliding relative to the strings (4) over a predetermined travel. The bridges (8; 36) are in contact with the strings during at least a part of their travel, thereby allowing micro-tonal and semi-tonal interval changes in tuning to be effected. The predetermined travels of the sliding bridges are different to one another. Also disclosed is an instrument incorporating such a tuning mechanism and a mechanism which may be retro-fitted to an existing instrument.

WO 03/060872 A2

TUNING MECHANISM

This invention relates to a tuning mechanism for stringed instruments, particularly, although not exclusively, instruments in which the strings are struck by a hammer or the like to produce a sound.

Conventionally, the notes of indigenous hammered dulcimers and European or Western concert pianos and other related keyboard instruments have fixed tuning layouts. For example, the keys on a piano keyboard activate particular notes and each key will continue to activate the same note unless its corresponding string is retuned.

The European or Western acoustic piano is a standardised musical instrument which is generally tuned to the Western 12 note (i.e. 12 semi-tones) chromatic octave using the principle of equal temperament. It is possible to re-tune such instruments manually to create different tuning layouts, for example, using a tuning key, although this is a laborious process and it is not practicable to carry it out regularly.

Such Western or standardised acoustic instruments do not generally have the ability to play microtones since these are not commonly used in Western "traditional", "classical" or "popular" musical genres. By contrast, microtones are commonly used in the "Traditional" and "Classical" music of various Middle-Eastern and Eastern cultures. Numerous indigenous acoustic instruments from "Middle-Eastern" and "Eastern" cultures allow microtones to be played. In general however, these instruments also employ predominant, fixed tuning layouts.

Microtones have only been used to a limited extent in Western musical genres - it is, for example, possible for an accomplished violinist to play quarter-tones on a

violin due to the design of this instrument. Furthermore, quarter-tone keyboards and pianos have been produced, but these are simply an expansion of the normal fixed tuning layout requiring additional keys.

It will be seen therefore, that for example both the hammered dulcimer and the piano as well as other instruments are restricted to and by predominant fixed tuning layouts.

It is an object of the present invention to provide an improvement on this and when viewed from a first aspect the present invention provides a tuning mechanism for altering the tuning of the strings of a stringed instrument, the mechanism comprising a plurality of sliding bridges, each mounted for sliding relative to one or more of the strings over a predetermined travel and in contact with the one or more strings during at least a part of said travel, thereby allowing micro-tonal and semi-tonal interval changes in the tuning of said strings to be effected; wherein the lengths of the respective predetermined travels of the bridges are different to one another.

Thus it will be seen by those skilled in the art that the present invention provides a way of effecting precise micro-tonal changes in a particular string or strings of an instrument such as a piano or hammered dulcimer, which in turn allows a tuning layout which may be easily and frequently changed. In contrast to the prior art, therefore, a practical and convenient means may be provided by which to create and explore either different indigenous tuning layouts or generally to experiment with tuning and tuning temperaments.

The inventor has appreciated that the physical distance which a siding bridge must move to effect a given interval change - e.g. a semi-tonal interval - will depend upon the position of the base note in the octave. The sliding bridges therefore have different travel lengths to allow precise micro-tonal changes to

be achieved in the tuning of each string or set of strings. Most conveniently the differing travel lengths are such as to allow each bridge to provide the same interval change, although this is not essential.

The invention also extends to a stringed musical instrument comprising a plurality of strings, each string having associated therewith a sliding bridge mounted so as to be able to slide relative to the string over a predetermined travel and in contact with the string during at least part of said travel, thereby allowing micro-tonal and semi-tonal interval changes in said string to be effected; wherein the lengths of the respective predetermined travels of the bridges are different to one another.

In general the sliding bridges in accordance with the invention may act on just a single string, but in many preferred embodiments the bridges act on groups of strings. For example, in a hammered dulcimer each bridge may act on a pair of strings or four strings; in a piano there may be three strings to every bridge. Of course it is not essential that all the sliding bridges in a particular instrument have the same number of strings. Conversely, it is not essential that all of the strings in an instrument are associated with a sliding bridge.

The sliding bridges may be adapted to move into two or more discrete fixed positions in their predetermined travels to allow fixed micro-tonal changes, but preferably their position is continuously variable within their predetermined travel. This correspondingly allows the tuning of the strings to be varied continuously. Preferably means are provided to fix the bridge in a desired position. Such means could be provided integrally with the bridge, or on a base, or a combination of the two.

Preferably a calibrated scale is provided to allow a user to know by how much to move the bridges to attain

a desired interval change.

The travels of the sliding bridges may be arranged to effect any desired range of interval change in the string. In one preferred example the travels correspond to a semi-tonal change. Thus, movement through the entire travel will give a semi-tonal change, whereas a smaller movement will give a sub-semi-tonal or micro-tonal change. In another embodiment, a full tone interval change may be achieved.

The bridges may be arranged to be in contact with the strings throughout all of their travel, or alternatively may only engage the strings during a portion thereof, thereby allowing the strings to be sounded unmodified by the mechanism set out herein.

It is envisaged that the sliding bridges could move obliquely to the strings, but preferably they are arranged to move parallel thereto.

The sliding bridges could be made to move indirectly. For example, an appropriate mechanical linkage could be provided. Alternatively, a remotely operated actuator could be provided - e.g. controlled electronically by a microprocessor or the like. Indeed in some embodiments the tension in the strings may be so high as to preclude direct manual movement of the bridges, or mechanically assisted actuation may be preferred for other reasons. For example operation from a piano keyboard may be desired. In presently preferred embodiments however, the sliding bridges are each provided with a handle for facilitating direct movement thereof.

Any suitable means may be provided for permitting the required movement over the predetermined travel. For example, the sliding bridges may each be provided with or mounted to one or more rails, guides or the like provided on a base, fixed relative to the string. It is presently preferred however, that the sliding bridges are arranged to move along respective channels or

grooves provided in such a base.

The predetermined travels may be delimited by any suitable means. In the preferred embodiment, they are delimited by the lengths of the channels in which the bridges are allowed to slide. It is particularly preferred that one end of each predetermined travel is delimited by a stop which can be placed at a desired position along the corresponding channel or groove. This allows the differing travel lengths to be easily accommodated.

More generally the predetermined travels may be delimited by respective stops which are placed at different positions for each bridge. These need not necessarily be associated with grooves or channels. In one embodiment envisaged, similar adjustable stops are associated with each bridge. The desired travel lengths may then be attained simply by differing degrees of adjustment of the adjustable stop for each bridge. In another alternative the adjustable stops may instead be provided on the bridges.

The stops are preferably removable to permit easy dismantling of the mechanism e.g. for cleaning or maintenance.

Contact between the sliding bridges and the base might be provided by one or more of wheels, rollers, bearings or the like. Preferably, however, a simple, frictional sliding interface is provided.

The invention extends to musical instruments incorporating the tuning mechanism set out herein e.g. harps or acoustic keyboard instruments such as the harpsichord, or early piano but most preferably mechanism is applied to a piano, hammered dulcimer or the like.

Although it is of course expected that musical instruments incorporating the tuning mechanism of the present invention will be designed and fabricated, it is also envisaged that the mechanism may be retro-fitted to

existing instruments. Thus when viewed from a further aspect the invention provides a tuning mechanism for altering the tuning of one or more strings of a stringed instrument in use, said assembly comprising a plurality of sliding bridges and means for mounting said sliding bridges to said instrument so as to permit each bridge to slide relative to one or more strings over a predetermined travel and in contact with the string(s) during at least part of said travel, thereby allowing micro-tonal and semi-tonal interval changes in the tuning of the string(s) to be effected; wherein the lengths of the respective predetermined travels of the bridges are different to one another.

As mentioned above, the invention allows precise microtonal changes. The precision of the interval changes which may be set will depend upon the particular application but preferred embodiments allow a eighth-tone or approximately 10 cent tone intervals to be set.

Certain preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is an elevation of an embodiment of the tuning mechanism of the present invention;

Figure 2 is an enlarged elevation of the sliding bridge of the mechanism of Figure 1;

Figure 3 is a side elevation of a piano with a retro-fitted tuning mechanism in accordance with the invention; and

Figure 4 is a plan elevation of the mechanism of Fig. 3.

Considering Figures 1 and 2, there may be seen a tuning mechanism 2 which is arranged beneath a pair of strings 4 of a hammered dulcimer or piano. The tuning mechanism generally comprises a base portion 6 and a sliding bridge 8. The sliding bridge 8 may be seen in greater detail in Figure 2.

A central groove 10 defined in the base portion 6

receives a lower longitudinal tongue 12 which protrudes from the sliding bridge 8 so that respective lateral portions 14 of the sliding bridge rest on the upper edges of the groove 10. The base portion 6 is slightly inclined relative to the strings in order to maintain a desired tension in the strings 4. In an alternative arrangement this could be achieved by ramps provided at the edges of the groove 10 which would allow the base portion to be flat.

A buffer 16 is wedged into one end of the groove 10 at the desired specific point and angle to give the required amount of travel between it and an end-stop 18 for a semi-tonal change in the tuning of the strings 4 given their position in the octave.

Turning to the sliding bridge 8, the upper surface is provided with a semi-cylindrical bridge cap 6 extending laterally across it which in use engages the underside of the two strings 4.

It will be appreciated that only one sliding bridge mechanism and pair of strings has been shown and described, but in practice an array of strings and sliding bridges is provided - each with differing lengths of travel.

In use, the strings 4 will be of a particular gauge and fitted and tuned to a particular note with the sliding bridge in the position shown in Figure 1. If the handle 20 is then used to slide the bridge 8 to the opposite buffer 16, the tuning of the strings 4 will be raised or lowered by a semi-tone. The lengths of the travels of the other bridges (not shown) also correspond to a semi-tonal change in their respective strings.

If the bridge 8 is slid only half way towards the buffer 16, the tuning is raised or lowered by a quarter tone. If the mechanism is slid a quarter of the way from the buffer 18 on which it rests in Figure 1, the tuning of each string will be raised or lowered by an eighth tone and so on. As mentioned before, the actual

distance through which the bridge 8 must move in order to effect a semi-tonal interval change will depend on the pitch of the note and the gauge of the strings 4.

It will be seen that stringed instruments such as pianos or hammered dulcimers which employ the tuning mechanism described above, are no longer restricted to the Western 12 note octave, but instead the mechanism allows the instrument to be mechanically retuned to incorporate, for example, indigenous scales and modes from a wide variety of cultures. Conversely, instruments ordinarily using these scales may be retuned to the Western 12 note octave. This allows a user to experiment in tuning and for example allows an instrument which has been tuned using the principle of equal temperament to be retuned making use of the principles of other types of temperament and vice versa.

Overall the mechanism described above provides flexibility either to use the intended tuning layout of the instrument (by leaving the sliding bridges 8 all in their original positions) or instead to modify the tuning layout.

A further embodiment of the invention which may be retro-fitted to an existing piano is shown in Figures 3 and 4. The standard parts of the piano comprise a key 30, hammer mechanism 32, sound board and strings 4. These are all standard and well known to those skilled in the art and will not therefore be described further.

Mounted a fixed distance above the strings 4 is a base member 34 for a tuning mechanism in accordance with the present invention. An array of sliding bridges 36 is provided between the base member 34 and the strings 4, one of which may be seen in the Figures, so that the bridge caps 22 thereof engage the strings 4. In this embodiment the sliding bridge 36 is associated with a group of three strings 4 which all correspond to the same key 30 and hammer mechanism 32. The other bridges (not shown) are associated with the other keys and have

differing lengths of travel to account for the different base note of these keys. The tension in the strings 4 biases the bridge 36 against the base member 34.

As in the previous embodiment, the sliding bridge 36 is arranged to slide by means of a tongue 38 protruding into a channel 40. However, in this embodiment a further narrower channel 42 is formed through the base member 34 connecting with the first channel 40. This narrower channel 42 accommodates the shaft 44 of a handle 46 which allows the sliding bridge 36 to be moved from above the base member 34.

It will be appreciated by those skilled in the art that the embodiment of Figures 3 and 4 may easily be retro-fitted to an existing piano simply by fitting the base member 34 which has an array of sliding bridges 36 above the strings 4. The mechanism is used exactly as in the previous embodiment to alter the tuning of the respective notes of the piano, except that in this embodiment the lengths of each travel is such as to permit up to a full-tonal change.

It will be appreciated by those skilled in the art that there are many variations and modifications which may be made to the embodiments described within the scope of the present invention. The handle need not pass between the strings as shown in the examples herein but could, e.g. arch over a group of strings.

Claims:

1. A tuning mechanism for altering the tuning of the strings of a stringed instrument, the mechanism comprising a plurality of sliding bridges, each mounted for sliding relative to one or more of the strings over a predetermined travel and in contact with the one or more strings during at least a part of said travel, thereby allowing micro-tonal and semi-tonal interval changes in the tuning of said strings to be effected; wherein the lengths of the respective predetermined travels of the bridges are different to one another.

2. A tuning mechanism as claimed in claim 1 wherein the positions of the sliding bridges are continuously variable within their predetermined travel.

3. A tuning mechanism as claimed in claim 1 or 2 comprising a calibrated scale for each bridge for indicating by how much to move the bridge to attain a desired interval change.

4. A tuning mechanism as claimed in any preceding claim wherein said predetermined travels each correspond to the same interval change in the tuning of the respective strings.

5. A tuning mechanism as claimed in claim 4 wherein said predetermined travels each correspond to a semi-tonal change.

6. A tuning mechanism as claimed in claim 4 wherein said predetermined travels each correspond to a full-tonal change.

7. A tuning mechanism as claimed in any preceding claim wherein each bridge is arranged to be in contact

with the respective string or strings throughout all of its travel.

8. A tuning mechanism as claimed in any preceding claim wherein each sliding bridge comprises a handle for facilitating its direct movement.

9. A tuning mechanism as claimed in any preceding claim wherein the sliding bridges are arranged to move along respective channels or grooves provided in a base.

10. A tuning mechanism as claimed in claim 9 wherein the predetermined travel of each bridge is delimited by the length of the corresponding channel or groove

11. A tuning mechanism as claimed in claim 9 or 10 wherein one end of each predetermined travel is delimited by a stop which can be placed at a desired position along the corresponding channel or groove.

12. A tuning mechanism as claimed in any preceding claim wherein said predetermined travels are delimited by respective stops which are placed at different positions for each bridge.

13. A tuning mechanism as claimed in claim 12 comprising similar adjustable stops associated with each bridge.

14. A tuning mechanism as claimed in any preceding claim comprising means for fixing the bridges in a desired position.

14. A musical instrument comprising a tuning mechanism as claimed in any preceding claim.

15. A stringed musical instrument comprising a

plurality of strings, each string having associated therewith a sliding bridge mounted so as to be able to slide relative to the string over a predetermined travel and in contact with the string during at least part of said travel, thereby allowing micro-tonal and semi-tonal interval changes in the tuning of said string to be effected; wherein the lengths of the respective predetermined travels of the bridges are different to one another.

16. A musical instrument as claimed in claim 14 or 15 comprising a piano or hammered dulcimer.

17. A tuning mechanism for altering the tuning of one or more strings of a stringed instrument in use, said assembly comprising a plurality of sliding bridges and means for mounting said sliding bridges to said instrument so as to permit each bridge to slide relative to one or more strings over a predetermined travel and in contact with the string(s) during at least part of said travel, thereby allowing micro-tonal and semi-tonal interval changes in the tuning of the string(s) to be effected; wherein the lengths of the respective predetermined travels of the bridges are different to one another.

18. A microtonal fluid tuning mechanism for hammered dulcimers and pianos (as well as other related instruments) that consists of a sliding bridge, a groove and buffers fixed at specific points and angles, fitted to each note which, if used, by being slid along the aforementioned groove can affect precise microtonal and semitonal interval changes (as outlined in the description).

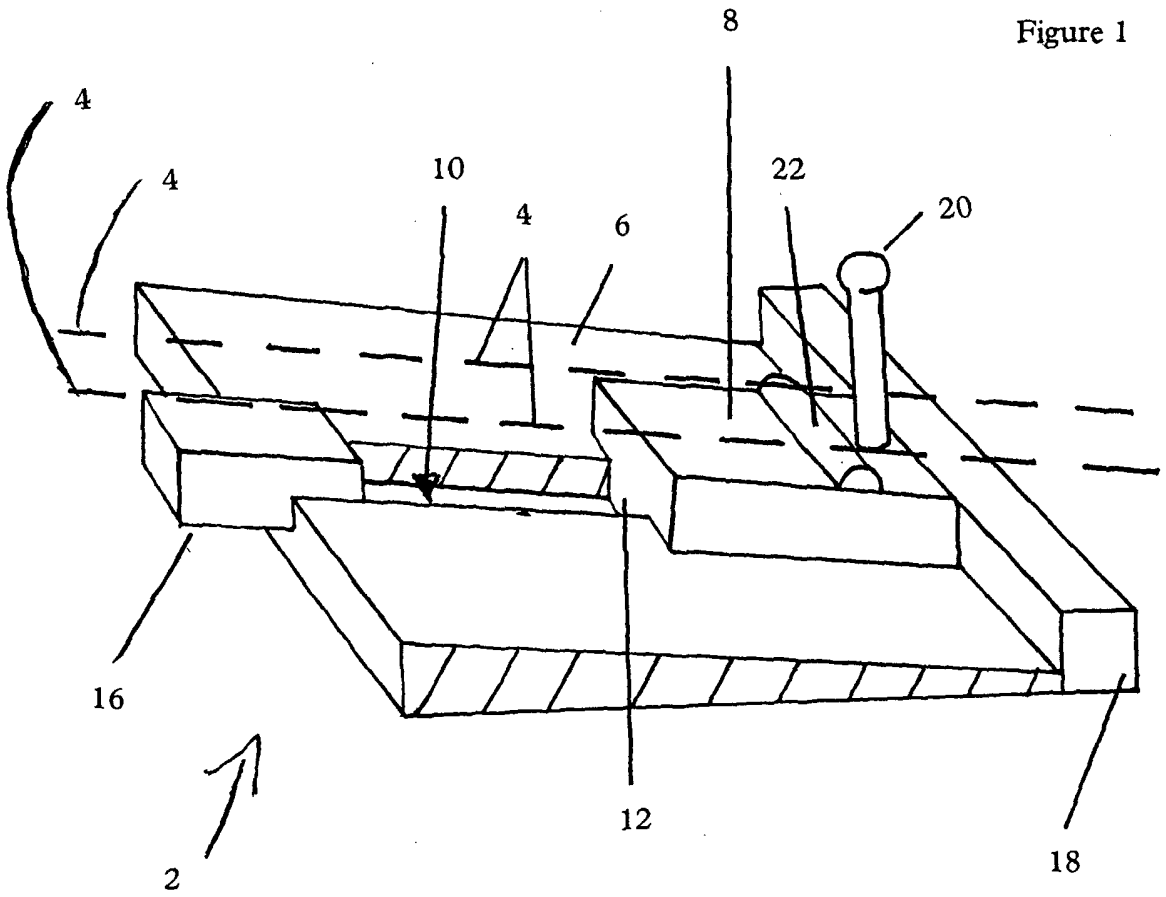
19. A microtonal tuning mechanism for hammered dulcimers and pianos (as well as other related

instruments) that consists of a sliding bridge, a groove and buffers fixed at specific points and angles, fitted to each note which, if used, by being slid along the aforementioned groove can effect precise microtonal and semitonal interval changes.

20. A tuning mechanism substantially as hereinbefore described with reference to the accompanying drawings.

21. A musical instrument substantially as hereinbefore described with reference to the accompanying drawings.

Figure 1



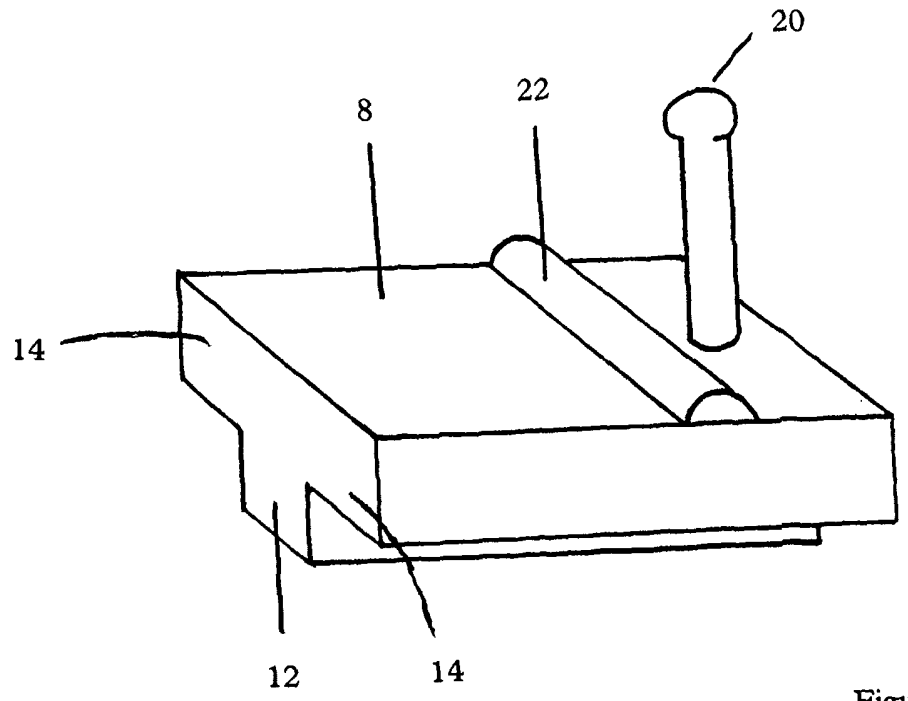


Figure 2

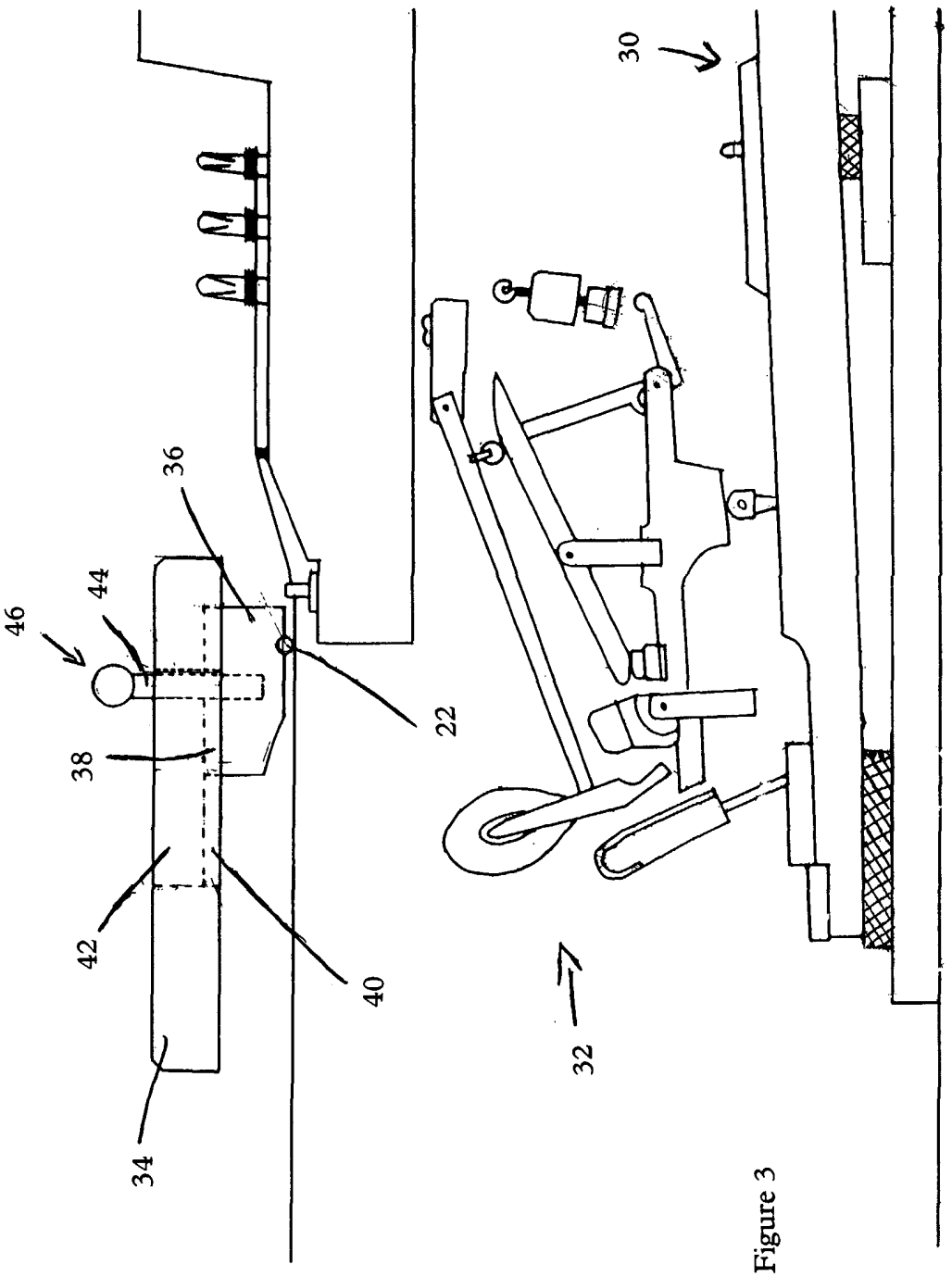
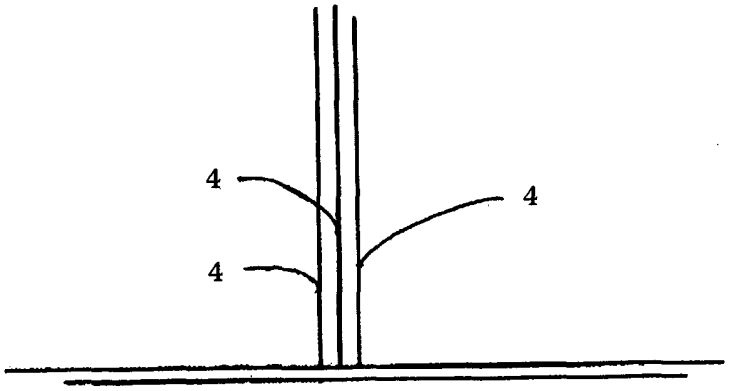


Figure 3



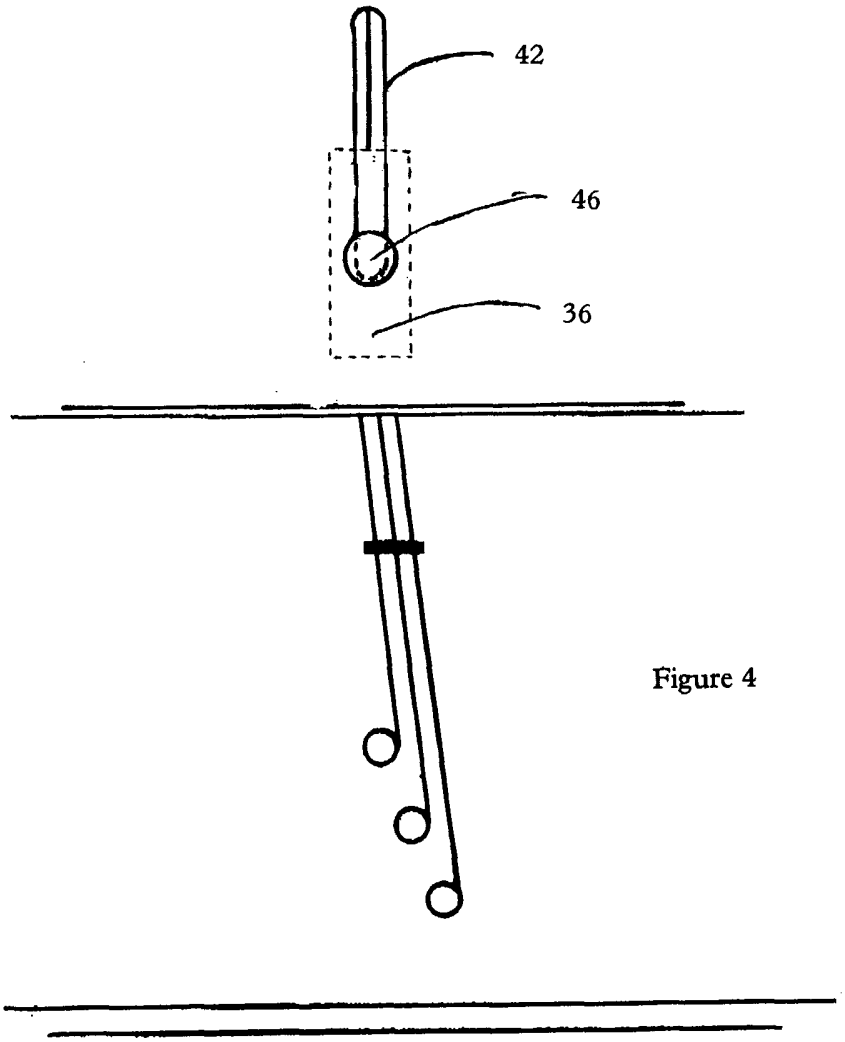


Figure 4