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(54) A reinforced concrete load-bearing pile with multi-branches and enlarged footing and means for forming the pile.

(57) This invention relates to a reinforced concrete load-bearing pile with multi-branches and enlarged footings for reinforcing foundations, and means and method for forming such a pile. The load-bearing pile of the invention comprises a pile body, at least one branch and enlarged footing integrated with the pile body. The means for the pile comprises a pile cavity drilling/pressing device, a branch cavity pressing device and an enlarged footing cavity pressing device. The pile of the present invention possesses higher load-carrying capability, increases the stability of the foundation and saves more than 50% construction materials. The formation means of the invention solves the problem of making branch cavities and is simple in structure.

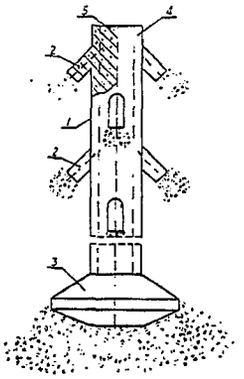

FIG. 1

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A Reinforced Concrete Load-bearing Pile With Multi-branches and Enlarged Footings and Means for Forming the Pile

This invention relates to a reinforced concrete load-bearing pile, especially used for consolidating foundations of buildings and bridges or other foundations, and means and method for forming the pile.

Background of the Invention

Present foundations like driving piles, cast-in-place piles, tree root-like piles, explosion piles and caissons, have disadvantages such as weak load-supporting capability, low stability, waste of material, labor, investment and energy, etc.Especially in case of complicated soft ground, the foundation tends to settle wholly or unevenly due to the low load capacity of the piles. That brings technical difficulty to both design and construction.

Object of the Invention

The object of the invention is to provide a reinforced concrete load-bearing pile with multi-branches and enlarged footings for consolidating foundations and means and method for forming such a pile, to overcome the disadvantages in the prevailing technique.

Summary of the Invention

A reinforced concrete load-bearing pile according to the present invention comprises a pile body, at least one branch and enlarged footing which are integrated with the pile body.

Means for forming the load-bearing pile comprises a pile cavity drilling/pressing device, a branch cavity pressing device and an enlarged footing cavity pressing device.

In forming a pile cavity for a load-bearing pile according to the invention, the pile cavity drilling/pressing device is firstly used to form a main pile cavity; then, the branch cavity pressing device and the enlarged footing cavity pressing device are successively used to form at least one branch cavity and enlarged footing cavity; after the whole pile cavity is completed, reinforcing steel bars may be placed into the cavity and casting is carried out.

The present invention will be more fully understood from the following detailed description in connection with the illustrated embodiment in the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a sketch of a load-bearing pile with multi-branches and enlarged footings according to the invention.

Fig. 2 is a sketch of a pile cavity drilling/pressing device.

Fig. 3. is a sketch of a modified pile cavity drilling/pressing device.

Fig. 4 is a sketch of a branch cavity pressing device.

Fig. 5 is a sketch of an enlarged footing cavity pressing device.

Detailed Description of the Invention

A reinforced concrete load-bearing pile according to the present invention comprises a pile body, at least one branch and enlarged footing which are integrated with the pile body. The branches can be connected to any part of the pile body, preferably arranged in groups along the axis of the pile body. The branches of each group are preferably staggered with those of adjacent groups. The numbers of groups and branches in each group are determined according to the condition of ground, building, etc. The pile body may consist of a concrete pipe with correspondingly arranged openings for forming branches, and a core. The enlarged footings can be connected with the pile body, e.g., at the bottom end of the pile body. The enlarged footing, together with all the branches provides a larger supporting area, thus ensuring higher load-bearing capability of the pile.

The load-bearing pile according to the present invention can be wholly or partly casted-in-place after a corresponding cavity is formed. Means for forming the pile comprises a piie cavity drilling/pressing device, a branch cavity pressing device and an enlarged footing cavity pressing device.

The pile cavity drilling/pressing device can be used to form a cavity for the pile body. It consists of a pipe body with a blade portion provided at one end and strengthening portion at the end part of the blade portion. There can be at least one opening provided on the pipe body used for forming branch cavities. In order to remove soil inside the pipe body to form the pile cavity, means such as an earth auger with screw blades can be provided. In case of soft ground, a movable conical head is provided at the beginning end of the pipe body forming the pile cavity without removing any soil. A modified structure of the device may have a spiral

cutting blade connected to the outside of the pipe body.

The branch cavity pressing device can be either single-armed or multi-armed. Each arm has a chisel bearing, a support connected to the bearing bottom and a chisel which is arranged inside the bearing and composed of flexibly connected a chisel end, power transmitting parts and a chisel head. As for a multi-armed branch cavity pressing device, a movable support can be futher provided at the bottoms of the supports for positioning and supporting, and the chisel bearings can be connected or integrated. The said support of the device guides the direction of the chisel head. The transmilting parts can be balls preferably.

The enlarged footing cavity pressing device comprises a column with a collar fixed at one end and two collars slidably mounted thereon, pairs of pivoted arms pivots with the collars at the same side of the column, a sleeve is slidably provided on the other end of the column. Preferably two pairs of pivoted arms are arranged symmetrically.

This invention has the following advantages:

1. A load-bearing pile according to the invention has substantially higher load-carrying capability and foundation stability than those of ordinary load-bearing piles, overcoming at the same time residual settlement problems of foundations and rendering possible realization of a more solid and stable foundation.

2. With this kind of piles, more than 50% of the construction material may be saved compared with those of all other sorts of prevailing foundations. Also there may be economy in manpower, energy and investment, shortening construction period and lowering cost.

3. The formation means of a pile of the invention has the advantages of simple construction and easy maintenance, overcoming the difficulty of making branch cavities in particular, rendering possible embodiment and application of the techniques of a load-bearing pile according to the invention.

Referring to Fig. 1, branches 2 are obliquely integrated with a pile body 1, which comprises a concrete pipe 4 and a core 5. The concrete pipe 4 may be embeded reinforcing steel. The branches 2 are arranged in pairs along the pile body 1. The two branches 2 in each pair are symmetrically arranged and staggered with those in adjacent pairs. An enlarged footing 3 connects to the bottom end of the pile body 1.

Fig. 2 shows a pile cavity drilling/pressing device which is in the form of a pipe. A blade portion 11 is provided at one end of the pipe body 14. The thickness of the pipe wall increases from the blade end. At the end part of the blade portion 11, a strengthening portion, which is in the form of a round collar 12, is provided. At least one opening 13 can be provided on the pipe body 14 for forming branch cavities. The device can be used for either soft ground or stiff ground, preferably for firm ground. It can be driven into ground by pressing.

Fig. 3 shows a modified pile cavity drilling/pressing device, which is preferred for soft ground. This device is further provided with a spiral cutting blade 23 connected to the outside of the pipe body. Means for removing soil such as an earth auger or a pump (not shown) is provided; or a movable conical head 25 is provided at the blade end of the pipe body to form a pile cavity without removal of any soil. This device can be driven into ground by rotating.

Fig. 4 shows a preferred embodiment of a branch cavity pressing device which is symmetrically twin-armed. Each of the arm has a chisel bearing 30, a support 31 connected to the bearing bottom, and a chisel arranged in the cavity of the chisel bearing 30 and composed of flexibly connected a chisel end 32, power transmitting balls 33 and a chisel head 34. A movable support 35 is provided at the bottoms of the supports 31. The supports 31 are obliquely arranged and can be used as guides.

Fig. 5 shows a preferred enlarged footing cavity pressing device. A fixed collar 42 is provided at one end of a column 37. Two collars 39 slidably mounted on the column 37. A pair of pivoted arms 40 pivot with the movable collars 39 at the same side of the column 37, and another pair of arms 40 at the other side. The said two pairs of arms are symmetricaly arranged. A sleeve 38 is slidably mounted at the other end of the column 37. As the sleeve 38 moves downwardly, the pivoted arms 40 are folded. Thus, the radial dimension of the device is increased.

In forming a reinforced concrete load-bearing pile according to the invention, a pile cavity is firstly formed. Then branch cavities and enlarged footing cavities are to be formed. As a cavity of the pile is completed, reinforcing steel can be put in and casting-in-place can be carried out.

The pile cavity drilling/pressing device can be used to form the pile cavity. Either a pipe type device or a screw type device can be used according to the degree of compactness of the soil. The device can be driven into the ground either vertically or at an angle of inclination. An earth auger 24 is used to take out the soil (or a mud pump can be used to pump out the mud). If a movable conical head 25 is mounted at the beginning part of the device, a pile cavity may be formed without taking out the soil. If the ground is stiff, the pile drilling/pressing device can be taken out when the cavity is made. As the device is being withdrawn, the branch cavities can be made through the open-

ings on the pipe body, and the enlarged footing cavities can also be made at the end of the pipe body. In case of the soil layer which is easy to collapse, the pile drilling/pressing device may be withdrawn first, and a precast concrete tube 4 is put in instead. Then the branch cavities and the enlarged footing cavities are made. In forming branch cavities, the chisel head 34 of the branch cavity pressing device is directed to either the openings 13 on the pipe body 14 of the drilling/pressing device (there may be a pair of openings at one level and another pair of openings at different positions of a different level), or to the openings provided on the precast concrete pipe 4. Pressure is applied at the chisel end 32. Since the chisel end 32, the power transmitting balls 33 and the chisel head 34 are connected by a steel cable, the chisel head 34 can be taken out at any time for filling consolidating material (soilid waste, backfill, etc), so that the surroundings and base of the branch cavities can be consolidated. In forming the cavities for enlarged footings,the enlarged footing cavity pressing device is introduced into the pile cavity to a predetermined depth (there can be more than one enlarged footing for one pile), then,the pressing sleeve 38 is pressed continually while the device is rotated. The pivoted arms 40 may form a cavity for the enlarged footing after the device being rotated 180°. Enlarged footing may also be made with the branch cavity pressing device by turning the chisel bearing 30 while pressing the chisel end 32, getting the same effect as using the enlarged footing cavity pressing device. In forming cavities for enlarged footings, while the cavities are being pressed, filling materials may be added, and the base may be compacted by means of rammers so as to increase the degree of compactness of the soil layer. After forming the pile cavity, the branches and enlarged footing cavities, reinforcing steel bars may be placed into the cavity and concrete may be cast. Thus the entire process of making the reinforced concrete load-bearing pile with multi-branches and enlarged footings is completed. Branches may be precasted. When the branch cavities are made, the precasted branches may be put into place by means of the branch cavity pressing device. The pile can finally be casted.

Thus, while the invention has been described in relation to a particular embodiment, those having skill in the art will recognize modifications of materials, structure and the like which will still fall within the scope of the present invention.

Claims

1. A reinforced concrete load-bearing pile for consolidating foundations having a pile body, at least one branch and enlarged footing integrated with the body.

2. A pile according to claim 1, wherein the branches are arranged in groups along the axis of the pile body.

3. A pile according to claim 2, wherein there are two branches in a group.

4. A pile according to claim 2, wherein the branches of each group are symmetrically arranged and staggered with those of adjacent groups.

5. A pile according to claim 1, wherein the branches are precasted.

6. A pile according to claim 1, wherein the pile body comprises a concrete pipe with at least one branch opening thereon and a core.

7. Means for forming a pile according to claim 1, comprising a pile cavity drilling/pressing device, a branch cavity pressing device and an enlarged footing cavity pressing device.

8. Means for forming a pile according to claim 7, wherein said branch cavity pressing device has a chisel bearing, a support connected to the bearing bottom and a chisel arranged in the cavity of the chisel bearing and composed of flexibly connected a chisel end, power transmitting parts and a chisel head.

9.Means for forming a pile according to claim 7, wherein said branch cavity pressing device is multi-armed, each arm of the device has a chisel bearing, a support connected to the bearing bottom, a chisel arranged in the cavity of the chisel bearing and composed of flexibly connected a chisel end, power transmitting parts and a chisel head, a movable support is provided at the bottoms of the supports.

10. Means for forming a pile according to claim 8 or 9, wherein said power transmitting parts are ball shaped.

11. Means for forming a pile according to claim 9, wherein said branch cavity pressing device is symmetrically twin armed, the chisel bearings are integrated formed.

12. Means for forming a pile according to claim 7, wherein said pile cavity drilling/pressing device comprises a pipe body, a blade portion is provided at the begining end of the pipe body with a strengthening portion at the end part of the blade portion.

13. Means for forming a pile according to olaim 12, wherein said pile cavity drilling/pressing device has at least one branch opening provided on the pipe body.

14. Means for forming a pile according to claim 12. wherein means for removing soil is provided.

15. Means for forming a pile according to claim 14, wherein the said means is an earth auger with

screw blades.

16. Means for forming a pile according to claim 12, wherein a spiral cutting blade is provided outside the pipe body.

17. Means for forming a pile according to claim 12, wherein a movable conical head is provided at the beginning end of the pipe body.

18. Means for forming a pile according to claim 7, wherein said enlarged footing cavity pressing device comprises a column with a collar fixed at one end and two collars slidably mounted thereon, pairs of pivoted arms pivots with the collars at the same side of the column, a sleeve is slidably provided on the other end of the column.

19. Means for forming a pile acording to claim 18, wherein two pairs of pivoted arms are symmetrically arranged.

20. A method for forming a pile according to claim 1, comprising forming a pile cavity, forming at least one branch cavity, forming at least one enlarged footing cavity and casting the pile.

21. A method for forming a pile according to claim 8 or 9, wherein the branch cavity pressing device is introduced into the pile cavity to a predetermined position, pressure is applied on the chisel end to drive the chisel head into the earth.

22. A method for forming a pile according to claim 18, wherein the enlarged footing cavity pressing device is introduced into the pile cavity to a predetermined position, the device is rotated as the sleeve is pressed to enlarge the space for an enlarged footing.

23. A method for forming a pile according to claim 8 or 9, wherein the branch cavity pressing device is introduced into the pile cavity to a predetermined position, the device is rotated to enlarge the space for an enlarged footing.

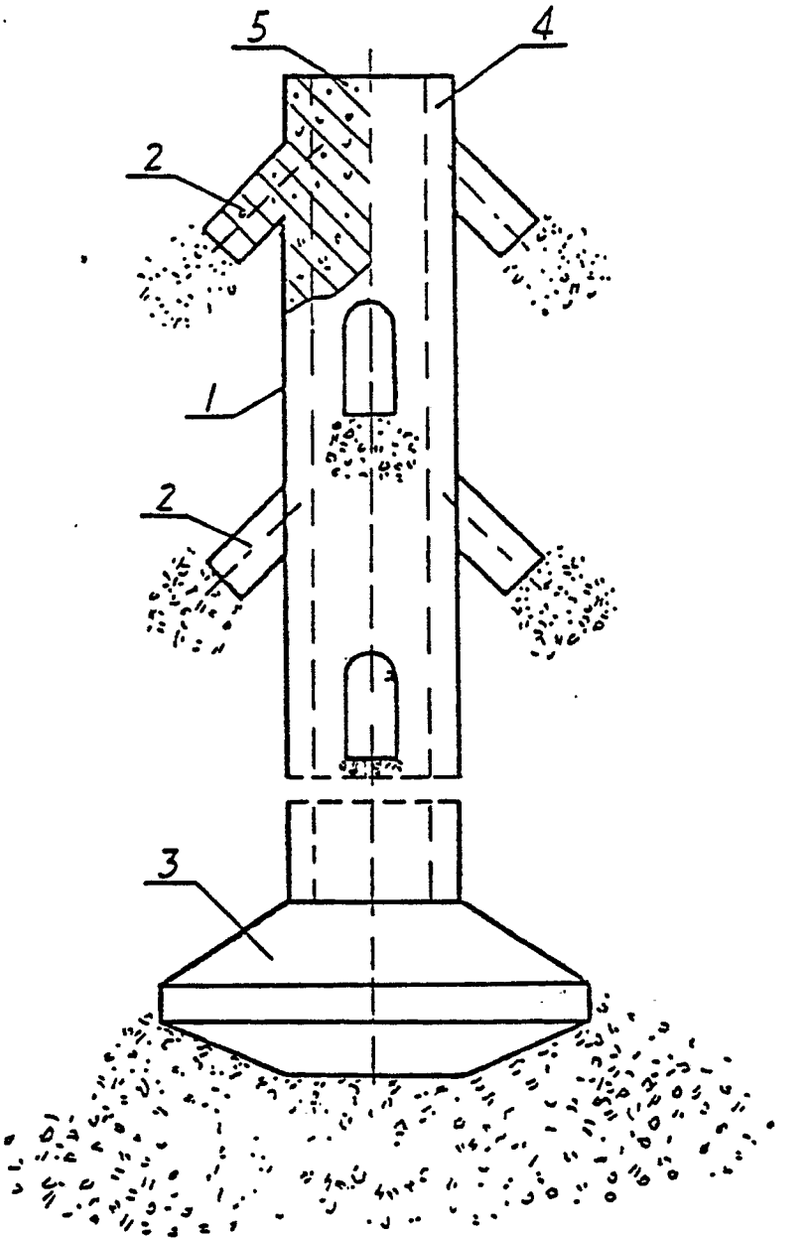

FIG. 1

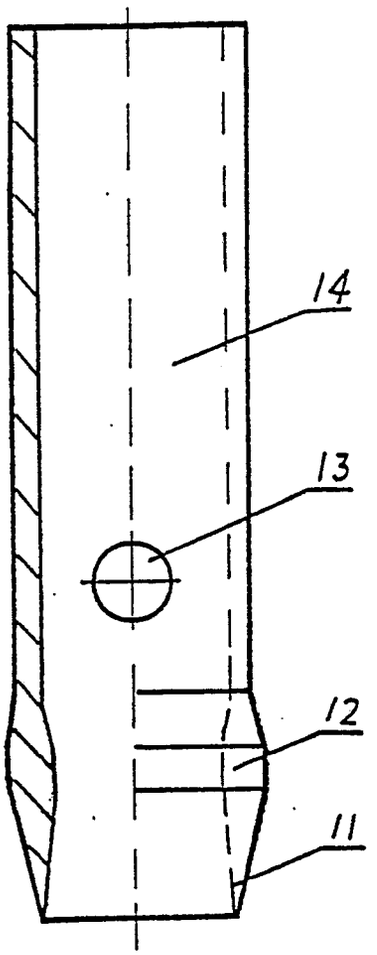

FIG. 2

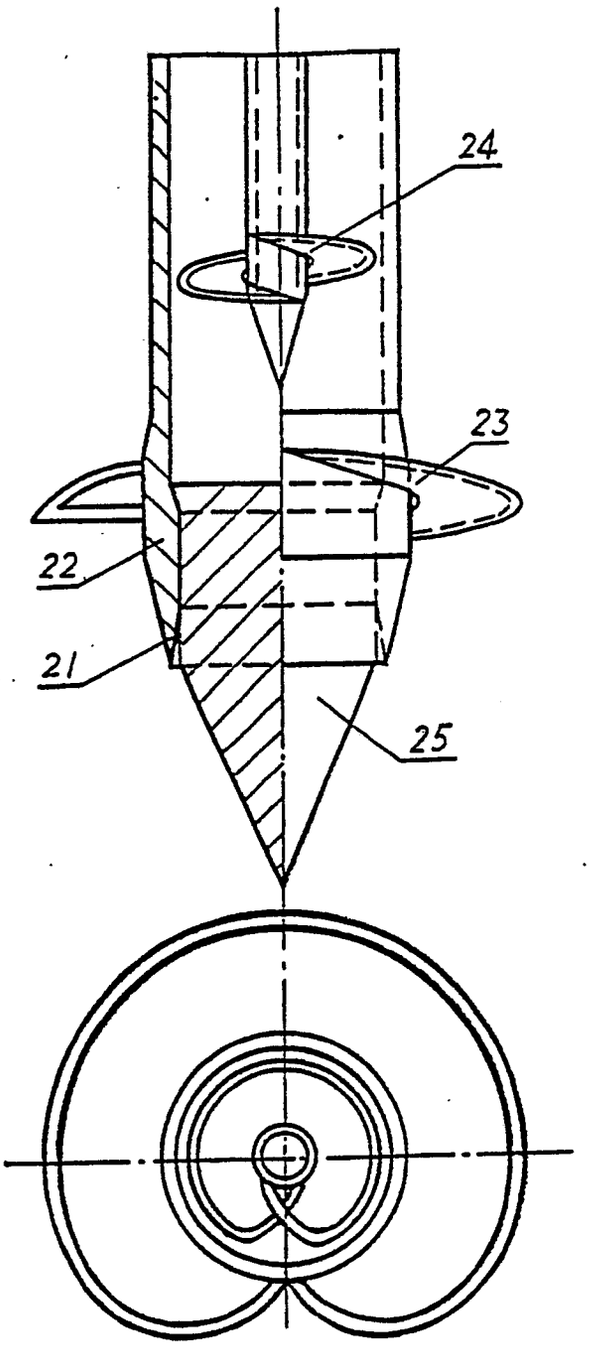

FIG. 3

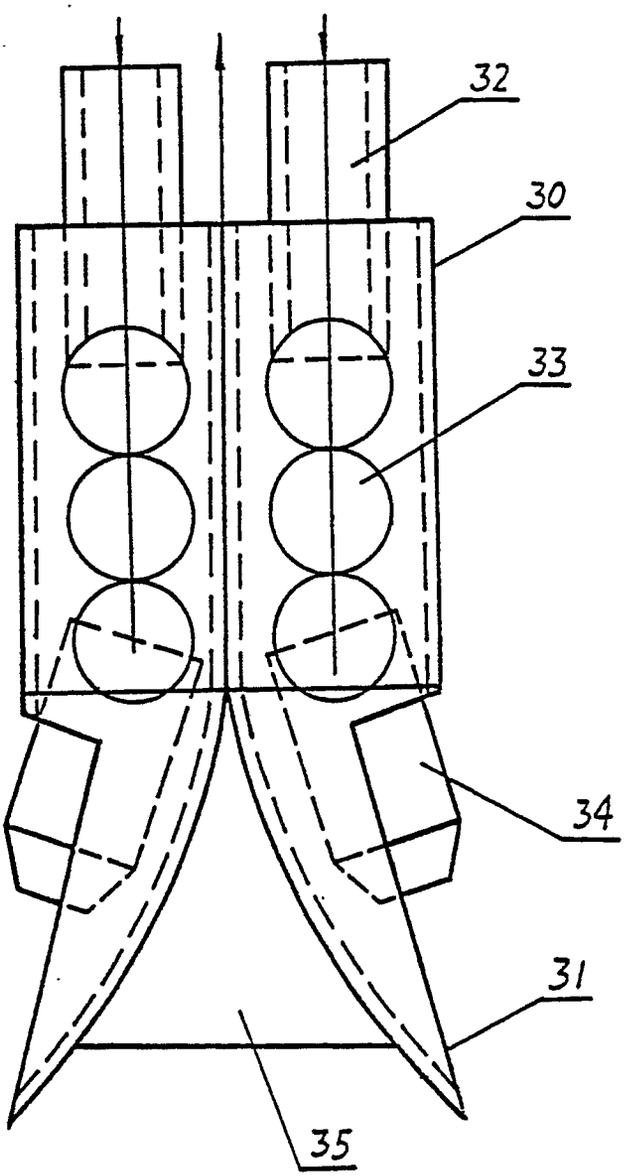

FIG. 4

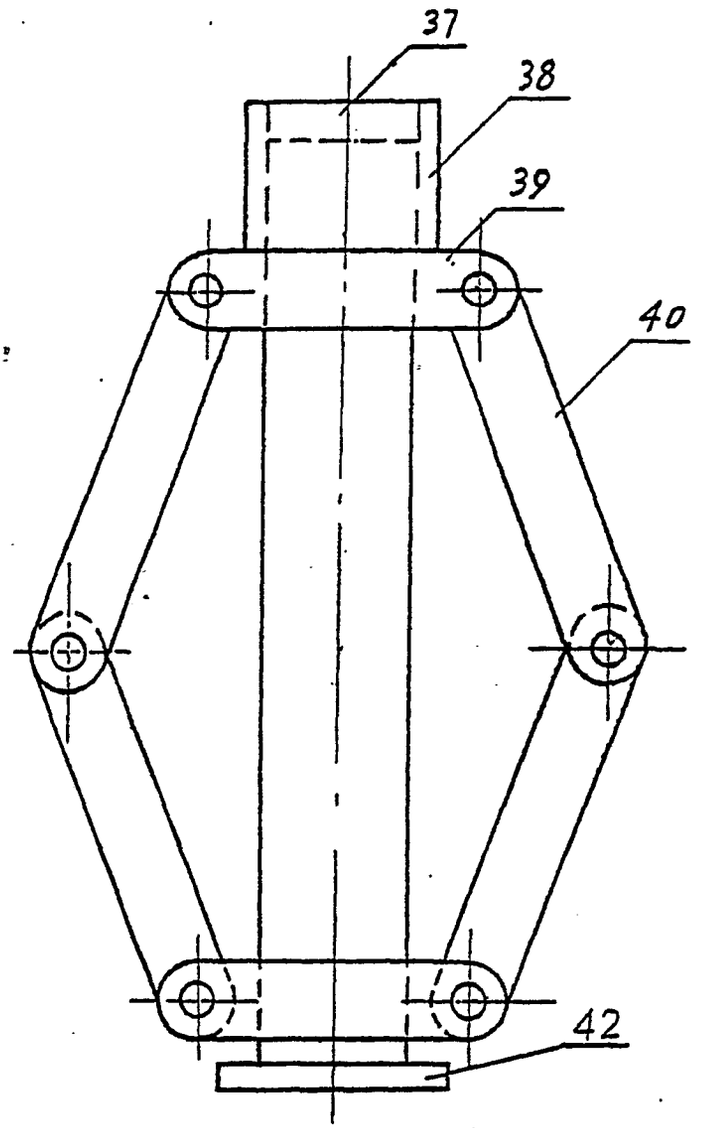

FIG. 5