TITLE OF THE INVENTION

Pipe lifting device

FIELD OF THE INVENTION

This invention relates to a pipe lifting device.

BACKGROUND OF THE INVENTION

Typically, industrial plants have piping systems with lots of pipes for transferring fluids, e.g., gases or chemicals in production processes. After prolonged use periods, these pipes tend to deteriorate, for example, a surface corrosion of the pipe due to environmental or chemical conditions. If this deterioration is not detected and maintained in a timely manner, there is a risk that the pipe system will be damaged. This would affect the production process and cause harm to the operator, hence; it is imperative to regularly inspect operating conditions of the pipes, especially in easily deteriorated areas such as pipe joints, etc., in order to perform proper maintenance and reduce the chance of any damages.

However, in some cases, it may be inconvenient to inspect the readiness condition of the pipe since the pipe is attached to the pipe installation equipment or the external pipe supporting structure. It is therefore necessary to move the pipes away from such equipment or external supporting structures, for example, by lifting or putting the pipes further apart before inspection.

Hence, to facilitate the pipe inspection, there is a need to develop a device for lifting or transferring the pipes from the pipe installation equipment or the external pipe supporting structure. Examples of related prior arts are shown below.

US patent publication no. 2013334482 A1 discloses an apparatus for lifting pipes in a pipe rack to inspect the point of contact with the supporting beam, and to fix any damage caused by corrosion and wear and tear. However, such lifting apparatus has some drawbacks, for example, excessive stress on the pipe, especially in the lifting area; loose clamping and imbalance as lifting caused pipe’s slippage during operation.

US patent publication no. 20150226352 A1 discloses a pipe clamp provided with a tension gauge and a use of the tension gauge on the pipe clamp. The pipe clamp includes at least two segments connected with at least one hinge. The pipe clamp is further provided with a threaded bolt arranged to open and close the pipe clamp, and also at least one stress gauge arranged to measure the tension of the pipe clamp around the flange of the pipe when the pipe clamp is dosed by the threaded bolt.

Commercially available equipment of PG Systemtechnik is a pipe lifting device for lifting the pipe from the supporting structure. The device consists of a frame and two lifting units where each unit is arranged at each end of the long frame. Each lifting unit consists of a threaded rod and a pipe clamp connected to the threaded rod. The lifting device is moved up and down by rotating the thread arranged at the threaded rod.

However, the above pipe lifting device still has some drawbacks, namely, that the lifted pipe has a chance of dislodging from the pipe clamp. Besides, during the lifting, the operator must manually turn the thread providing a lot of inconvenience and time-consuming operations.

From the aforementioned examples of the patent documents and the existing equipment, it is apparent that an improvement of pipe lifting devices is still necessitated to enhance efficiency and safety as applied.

SUMMARY OF THE INVENTION

The invention relates to a pipe lifting device comprising a supporting structure; a structural fastening assembly assembled to the supporting structure for fastening to an external pipe supporting structure; at least two power transmission assemblies mounted on the supporting structure on opposite sides of each other along the longitudinal direction of the pipe for transmitting power to move the pipe; and at least two pipe clamping assemblies assembled to each power transmission assembly for clamping the pipe. The pipe lifting device further comprises a stress reducing means assembled to the pipe clamping assembly for reducing the pipe's stress as lifting the pipe.

An objective of this invention is to provide a pipe lifting device that can be easily assembled to the pipe more quickly and can reduce pipe stress while being lifted or moved. This provides a less likelihood of damage to the pipe system and equipment during operation and ensures greater safety for workers.

The pipe lifting device according to this invention is preferably suited for lifting pipe while fluid flows through the pipes. Therefore, there is no need to stop the system while maintaining it.

In another embodiment, this invention is related to a use of the pipe lifting device as described above for pipe lifting.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of the first exemplary embodiment of the pipe lifting device according to this invention.

Figure 2 is a side view of the first exemplary embodiment of the pipe lifting device according to this invention.

Figure 3 is a perspective view of the second exemplary embodiment of the pipe lifting device according to this invention.

Figure 4 is a side view of the second exemplary embodiment of the pipe lifting device according to this invention.

Figure 5 is a perspective view of the third exemplary embodiment of the pipe lifting device according to this invention.

Figure 6 is a side view of the third exemplary embodiment of the pipe lifting device according to this invention.

Figure 7 is a perspective view of the fourth exemplary embodiment of the pipe lifting device according to this invention.

Figure 8 is a side view of the fourth exemplary embodiment of the pipe lifting device according to this invention.

Figure 9 is a side view of a beam which is the first exemplary embodiment of the stress reducing means according to this invention.

Figure 10 is a perspective view of a magnet which is the second exemplary embodiment of the stress reducing means according to this invention.

Figure 11 is a perspective view of the first exemplary embodiment of the pipe clamping assembly according to this invention.

Figure 12 is a perspective view of the second exemplary embodiment of the pipe clamping assembly according to this invention.

Figure 13 is a side view of a holding hook which is the first exemplary embodiment of the structural fastening assembly according to this invention.

Figure 14 is a perspective view of an angle member and a connecting member which are the second exemplary embodiment of the structural fastening assembly according to this invention.

Figure 15 is a perspective view of an angle member and a connecting member which are the third exemplary embodiment of the structural fastening assembly according to this invention.

Figure 16 is a perspective view of the pipe lifting device according to the first exemplary embodiment of this invention as installed with the external pipe supporting structure.

Figure 17 is a perspective view of the pipe lifting device according to the fourth exemplary embodiment of this invention as installed with an external pipe supporting structure.

DETAILED DESCRIPTION OF THE INVENTION

The invention is further described in the following detailed description with reference to the accompanying drawings. The same reference number in the drawings is applied and described identical or similar parts or same function throughout the description of the invention.

Unless otherwise specified, the technical and scientific terms used herein will become apparent to those of ordinary skill in the art from reading of the following detailed description and the appended claims.

Throughout the present specification and the accompanying claims, the words “consist of”, "comprise", “have” and "include" and variations such as "comprises", "comprising", "consists of", "consisting of", “has”, “having”, "includes", and "including" are to be interpreted inclusively. That is, these words are intended to convey the possible inclusion of other elements or integers not specifically recited, where the context allows.

Any tools, devices, equipment, methods, materials, or chemicals mentioned herein are intended to indicate tools, devices, equipment, methods, materials or chemicals used by those skilled in the art unless specified otherwise.

According to this invention, the term "pipe" refers to any objects that are long, like pipes, both hollow and solid such as light poles, cable pipes, water pipes, industrial pipes, etc.

Figures 1-8 shows the first to fourth examples of the pipe lifting device according to this invention. The pipe lifting device comprises a supporting structure (1); a structural fastening assembly (2) assembled to the supporting structure (1) for fastening to an external pipe supporting structure; at least two power transmission assemblies (3) mounted on the supporting structure (1) on opposite sides of each other along the longitudinal direction of the pipe for transmitting power to move the pipe; and at least two pipe clamping assemblies (4) assembled to each power transmission assembly (3) for clamping the pipe.

In addition, the pipe lifting device according to this invention further comprises a stress reducing means assembled to the pipe clamping assembly (4) for reducing the pipe’s stress as the pipe lifted, thereby preventing damage to the pipe system and equipment during operation and also providing greater safety for workers.

According to the first exemplary embodiment, the stress reducing means is a beam (B) which is assembled to each pipe clamping assembly (4) and is laid along the longitudinal direction of the pipe. For examples, the beam (B) may be made of aluminum, carbon steel, metal alloy or angle steel bar where the beam (B) is straight or curved. An exemplary embodiment in Figure 9, the beam (B) has a straight middle section and tilted downward ends.

According to the above embodiment, the stress reducing means which is the beam (B) arranged between the upper part of each pipe clamping assembly (4) can enhance the strength of the pipe attached to the pipe clamping assembly (4) and reduce a chance of damage to the lifted pipe. This is because the device carries a portion of the pipe weight and force generated by lifting the pipe, i.e., part of the force generated by lifting the pipe transferred to the beam (B).

According to another second exemplary embodiment, the stress reducing means is at least one magnet (M) assembled to the pipe lifting device in a way that the magnet (M) attracts to an external surface of the pipe as the pipe lifted. A preferred example is the magnet (M) attached to each pipe clamping assembly (4).

According to a more specific exemplary embodiment, the stress reducing means is at least one magnet (M) assembled to an inner wall of each pipe clamping assembly (4) in a way that the magnet~~ic~~ (M) attracts to the external surface at an upper part or a lower part of the pipe as the pipe lifted. Alternatively, the stress reducing means is at least two magnets (M) assembled to an inner wall of each pipe clamping assembly (4) in a way that the magnet~~ic~~ (M) attracts to the external surface at an upper part and a lower part of the pipe as the pipe lifted. Alternatively, the stress reducing means is at least four magnets (M) assembled to an inner wall of each pipe clamping assembly (4) in a way that the magnet~~ic~~ (M) attracts to the external surface at an upper left part, an upper right part, a lower left part and a lower right part of the pipe as the pipe lifted. Preferably, the magnet (M) has a surface corresponding to the pipe's curvature such that providing a better clamp on the pipe's surface.

Figure 10 illustrates a perspective of an exemplary embodiment of the rod-shaped magnet~~ic~~ (M), where its upper end is tapered to fit into a recess arranged in the inner wall of the pipe clamping assembly (4) and its lower end has a cross-section of a concave shape in the middle to enhance a better clamp between the magnet and the pipe's surface.

Examples of the preferred magnet (M) used in this invention are electromagnet, permanent magnet, temporary magnet, preferably permanent magnet. The magnet that is particularly preferred in this invention should have a pull strength at 50-500 kg, preferably 80-

350 kg, and more preferably 100-300 kg. However, the magnet with various pull strengths can be employed to fit the size, shape and weight of the pipe part attached to the magnet.

According to the above embodiment, the stress reducing means which is the magnet (M) can lessen the chance of damage to the lifted pipe since the pipe is exposed to minimal or no stress during lifting. This is because the lifted pipe is magnetized in place and does not slide during lifting.

According to this invention, each pipe clamping assembly (4) is placed 30-120 cm away from each other along the longitudinal direction of the pipe, preferably 50-90 cm, and more preferably 70-85 cm.

The placement of the two-pipe clamping assembly (4) along the longitudinal distance specified above provides moderate stress while lifting pipe. This minimizes the chance of damage to the pipes during lifting.

In an embodiment, each pipe clamping assembly (4) clamps around the pipe to fix the pipe in the desired position without dislocating it.

In an embodiment of this invention, the pipe clamping assembly (4) comprises a lower pipe clamping assembly (4.1) mounted to the power transmission assembly (3) and an upper pipe clamping assembly (4.2) detachably attached to the lower pipe clamping assembly (4.1). For example, the upper pipe clamping assembly (4.2) is detachably assembled to the lower pipe clamping assembly (4.1) by means of screw or magnet. The attachment between the upper pipe clamping assembly (4.2) and the lower pipe clamping assembly (4.1) is not only limited to a means of screw or magnet. Any other means providing the same result can be applied.

The detachable lower pipe clamping assembly (4.1) and upper pipe clamping assembly (4.2) in this invention allows the operator to detach the upper pipe clamping assembly (4.2) from the lower pipe clamping assembly (4.1) while installing the pipe lifting device to the external pipe supporting structure. This will benefit the operator to disassemble and assemble the device more conveniently and quickly since the modular device is lighter and smaller in size. In some cases, for example, when no fluid flowing inside the pipe, only the pipe clamping assembly (4) with the lower pipe clamping assembly (4.1) is required.

Figures 11 and 12 show the first and second exemplary embodiments of the pipe clamping assembly according to this invention, wherein the lower pipe clamping assembly (4.1) comprises an inner wall (4.1.1) that supports the lower part of the pipe, a flat lower wall (4.1.2), and two side walls (4.1.3) that protrude upwardly in an inclined manner from the lower wall

(4.1.2). The side wall (4.1.3) is inclined to the lower wall (4.1.2) at an angle of 40-70 degrees, preferably 60-70 degrees.

The upper pipe clamping assembly (4.2) comprises an inner wall (4.2.1) that supports an upper part of the pipe, a flat upper wall (4.2.2), and two side walls (4.2.3) that protrude downwardly in an inclined manner from the upper wall (4.2.2). The side wall (4.2.3) is inclined to the upper wall (4.2.2) at an angle of 40-70 degrees, preferably 60-70 degrees.

The inner wall (4.1.1) of the lower pipe clamping assembly (4.1) and the inner wall (4.2.1) of the upper pipe clamping assembly (4.2) can be formed into various shapes, e.g., convex as semi-circle, square, polygon, etc. to complement the pipe's shape.

The preferred thickness of the lower pipe clamping assembly (4.1) and the upper pipe clamping assembly (4.2) are, for example, in a range of 5-7 cm since this thickness provides the lower pipe clamping assembly (4.1) and the upper pipe clamping assembly (4.2) with rational weight, adequate strength in use, and also sufficient space supporting the pipe's surface.

The lower pipe clamping assembly (4.1) and the upper pipe clamping assembly (4.2) may be made of aluminum or carbon steel. Other materials with the proper strength and weight for use in the manner described above is also applicable.

The upper pipe clamping assembly (4.2) further comprises at least one hole (4.2.4) arranged at an upper part of the upper wall (4.2.2) for inserting a latch through the upper pipe clamping assembly (4.2) and rests against the pipe's surface.

In the first exemplary embodiment as shown in Figures 1-4, the supporting structure (1) is a rectangular or oval or circular shape along the longitudinal direction of the pipe. Preferably, the supporting structure (1) is hollow in order to make it lighter and convenient to move the device.

The supporting structure (1) may comprise a plurality of holes (1.1) arranged at the side wall for assembling the structural fastening assembly (2) to said hole (1.1). These holes (1.1) are not only intended for assembling to the structural fastening assembly (2), but also reducing an overall weight of the supporting structure (1).

In the second exemplary embodiment as shown in Figures 5-8, the supporting structure (1) is at least two vertical plates (1a,1b) arranged away from each other along the longitudinal direction of the pipe where each power transmission assembly (3) is mounted to the vertical plates (1a,1b).

In the first exemplary embodiment as shown in Figures 1-4, the structural fastening assembly (2) comprises a pivot (2.1) arranged transversely in a middle of each side wall of the supporting structure (1), for example, the pivot (2.1) may be arranged across the hole (1.1) of each side wall of the supporting structure (1), etc. At least two holding hooks (2.2) are rotatably connected to the pivot (2.1) opposing each other for mounting to the external pipe supporting structure, and a lock mechanism (2.3) provided at each holding hook (2.2) for restricting a movement of the holding hook (2.2). Preferably, the structural fastening assembly (2) is fastened to the external pipe supporting structure by rotating around the supporting structure (1) or longitudinally sliding along the supporting structure (1).

According to preferred embodiment in Figure 13, the holding hook (2.2) comprises a bar (2.2.1) having curve shape where one end of the bar (2.2.1) is rotatably connected to the pivot (2.1) and a mounting plate (2.2.2) provided at the other end of the bar (2.2.1). The lock mechanism (2.3) comprises an insert hole (2.3.1) provided on each holding hook (2.2), and a mounting bolt (2.3.2) for fastening the supporting structure (1) and the insert hole (2.3.1) for restricting a movement of the holding hook (2.2). More preferably, the slot (2.3.1) arranged on each holding hook (2.2) is aligned.

In the second exemplary embodiment of the structural fastening assembly (2) according to this invention as shown in Figures 5-8 and 14-15, the structural fastening assembly (2) comprises a plurality of angle members (2.4) where one end of each member is mounted to the supporting structure (1) and where a pair of angle members (2.4) is assembled into an invert U-like shape structure to cover the external pipe supporting structure. A preferred example is the structural fastening assembly (2) comprising two pairs of angle members (2.4) where each pair is assembled into an invert U-like shape structure to cover the external pipe supporting structure, spaced apart along the longitudinal direction of the external pipe supporting structure. In addition, the structural fastening assembly (2) further comprises a connecting member (2.5) assembled to the other end of each pair of the angle members (2.4) assembled into the invert U-like shape structure for connecting the angle members (2.4) together in such a way that a width of the invert U-like shape structure is adjustable along with the width of the external pipe supporting structure.

Figures 16 and 17 presents the pipe lifting device according to the first and second exemplary embodiments of this invention as installed to the external pipe supporting structure.

The installation of the pipe lifting device according to this invention to the supporting structure for each embodiment is as follows.

In case the supporting structure is a H-beam or I-beam shape, the operator moves the pipe lifting device into the lifting area, then the operator rotates the bar (2.2.1) of the holding hook (2.2) into the fastening position where the mounting plate (2.2.2) is attached to the extension of the H-beam or I-beam. Finally, the operator inserts the mounting bolt (2.3.2) through the hole (1.1) and the insert hole (2.3.1) to prevent a dislocation of the bar (2.2.1) from the fastening position.

In case the supporting structure is a concrete beam, the operator moves the pipe lifting device into the lifting area, then the operator take the invert U-like shape angle member (2.4) to cover the external pipe supporting structure and adjust the width between the angle member using the connecting member (2.5) to fix the pipe lifting device position from any movement.

Preferably, the power transmission assembly (3) of this invention may be selected from jack, electric jack, hydraulic jack, gear, and electric motor.

The pipe lifting device according to the invention further comprises a control unit connected to the power transmission assembly (3) for controlling a movement of the power transmission assembly (3), where the connection can be a wired or wireless connection.

Additionally, the pipe lifting device according to this invention may further comprise at least one auxiliary device to enhance an operational efficiency. The auxiliary device may be selected at least from, for example, stress gauge, pipe thickness gauge, distance measuring device, and automatic alert device.

The use of the device according to this invention for lifting pipes is also further described herein.

Preferably, the pipe lifting by the device according to this invention is performed at a vertical or horizontal distance up to 15 cm, preferably up to 10 cm. This specified distance has a positive effect on the pipe itself, i.e., not be exposed to excessive stress during the lifting.

As an example, the pipe lifting is performed by moving the pipe at a distance of 0.1-15 cm, preferably 0.3-0.8 cm each time. This operation improves the safety of the work, no surplus pipe's stress, and no rapid increase in pipe's stress.

The pipe lifting according to this invention may be performed in conjunction with any auxiliary device to measure relevant parameters and boost operational efficiency. The accessory

is selected, for example, from stress gauge, pipe thickness gauge, distance measuring device, and automatic alert device.

Use of the pipe lifting device of this invention

The devices of this invention with and without the beam (B) installation between each pipe clamping assembly (4) were employed for a comparative experiment to lift the pipes with the fluid flowing through. In this experiment, the corroded metal pipes equipped with stress gauge were used to measure stress during lifting. Two lifting distances were applied – 6.4 cm (two times) and 6.9 cm (three times). The stress value for each lifting was measured and displayed in Table 1.

Table 1 Comparative pipe stress values between the pipe lifted by the device with and without the beam (B)

Lifting distance (cm)	Pipe's stress (MPa)	
	Using device with beam	Using device without beam
6.4	141	263
6.4	124	263
6.9	233	356
6.9	224	356
6.9	199	340

From the experimental results in Table 1, it is obvious that, at the same lifting distance, the pipe stress values lifted by the device with the beam (B) is less than the one lifted by the device with no beam (B).

In addition, the inventor conducted pipe lifting experiments in a non-fluid flowing condition by the device with magnet~~ic~~ (M) attached to each pipe clamping assembly (4) compared to the device having no magnet (M). The pipe was lifted at an initial lifting distance of 5 cm and increased by 5 cm at a time. Three lifts were performed, and the stress was measured. The resulting stress value is shown in Table 2.

Table 2 Comparative pipe stress values between the pipe lifted by the device with and without the magnet (M)

	Pipe's stress (MPa)

Lifting distance (cm)	Using device with magnet	Using device without magnet
5	5.12	7.54
10	7.88	19.29
15	18.28	28.69

From the experimental results in Table 2, it can be seen that, at the same lifting distance, the pipe stress values lifted by the device with the magnet (M) is less than the one lifted by the device with no magnet~~ic~~ (M).

The experimental results in Tables 1 and 2 clearly show that the device according to this invention can be applied to lift pipes efficiently and greatly stress reduction in the pipe. Hence, this lessens the risks associated with pipe damage during operation.

BEST MODE OF THE INVENTION

Best mode of the invention is as described in the detailed description of the invention.

WHAT IS CLAIMED IS:

1. A pipe lifting device comprising

a supporting structure (1);

a structural fastening assembly (2) assembled to the supporting structure (1) for fastening to an external pipe supporting structure;

at least two power transmission assemblies (3) mounted on the supporting structure (1) on opposite sides of each other along the longitudinal direction of the pipe for transmitting power to move the pipe; and

at least two pipe clamping assemblies (4) assembled to each power transmission assembly (3) for clamping the pipe.

wherein the pipe lifting device comprises a stress reducing means assembled to the pipe clamping assembly (4) for reducing the pipe's stress as the pipe lifted, and

wherein the stress reducing means is a beam (B) which is assembled to each pipe clamping assembly (4) and is laid along the longitudinal direction of the pipe, or at least one magnet (M) assembled to the pipe lifting device in a way that the magnet (M) attracts to an external surface of the pipe as the pipe lifted, or a combination of the said beam (B) and at least one magnet (M).

2. The pipe lifting device as claimed in claim 1, wherein each pipe clamping assembly (4) clamps around the pipe.

~~3. The pipe lifting device as claimed in claim 1, further comprising a stress reducing means assembled to the pipe clamping assembly (4) for reducing the pipe's stress as the pipe lifted.~~

~~4. The pipe lifting device as claimed in claim 3, wherein the stress reducing means is a beam (B) which is assembled to each pipe clamping assembly (4) and is laid along the longitudinal direction of the pipe.~~

~~5.~~3. The pipe lifting device as claimed in claim 1~~4~~, wherein the beam (B) is made of aluminum, carbon steel, metal alloy or angle steel bar.

~~6.~~4. The pipe lifting device as claimed in claim 1~~4~~ or 3~~5~~, wherein the beam (B) is straight or curved.

~~7.~~5.The pipe lifting device as claimed in any one of claims 1, 3~~4~~ - 4~~6,~~ wherein the beam (B) has a straight middle section and tilted downward ends.

~~8. The pipe lifting device as claimed in claim 3, wherein the stress reducing means is at least one magnet (M) assembled to the pipe lifting device in a way that the magnet (M) attracts to an external surface of the pipe as the pipe lifted.~~

~~9.~~6.The pipe lifting device as claimed in claim 1~~8~~, wherein the magnet (M) is assembled to each pipe clamping assembly (4).

~~10.~~7. The pipe lifting device as claimed in claim 1~~8~~ or 6~~9~~, wherein the stress reducing means is at least one magnet (M) assembled to an inner wall of each pipe clamping assembly (4) in a way that the magnet~~ic~~ (M) attracts to the external surface at an upper part or a lower part of the pipe as the pipe lifted.

~~11.~~8. The pipe lifting device as claimed in claim 1 ~~8~~ or 6~~9~~, wherein the stress reducing means is at least two magnets (M) assembled to an inner wall of each pipe clamping assembly (4) in a way that the magnet~~ic~~ (M) attracts to the external surface at an upper part and a lower part of the pipe as the pipe lifted.

~~12.~~9. The pipe lifting device as claimed in claim 1~~8~~ or 6~~9~~, wherein the stress reducing means is at least four magnets (M) assembled to an inner wall of each pipe clamping assembly (4) in a way that the magnet~~ic~~ (M) attracts to the external surface at an upper left part, an upper right part, a lower left part and a lower right part of the pipe as the pipe lifted.

~~13.~~10. The pipe lifting device as claimed in any one of claims 1, 6~~8~~ - 9~~12~~, wherein the magnet (M) has a surface corresponding to the pipe's curvature.

~~14.~~11. The pipe lifting device as claimed in any one of claims 1, 6~~8~~ - 10~~3~~, wherein the magnet (M) has a pull strength at 50-500 kg, preferably 80-350 kg, and more preferably 100-300 kg.

~~15.~~12. The pipe lifting device as claimed in claim 1 or 2, wherein the pipe clamping assembly (4) is placed 30-120 cm away from each other along the longitudinal direction of the pipe.

~~16.~~13. The pipe lifting device as claimed in claim 12~~15~~, wherein the pipe clamping assembly (4) is placed 50-90 cm, more preferably 70-85 cm away from each other along the longitudinal direction of the pipe.

~~17.~~14. The pipe lifting device as claimed in any one of claims 1, 2, 12~~15~~, 13~~16~~, wherein the pipe clamping assembly (4) comprises a lower pipe clamping assembly (4.1) mounted to the power transmission assembly (3) and an upper pipe clamping assembly (4.2) detachably assembled to the lower pipe clamping assembly (4.1).

~~18.~~15. The pipe lifting device as claimed in claim 14~~17~~, wherein the upper pipe clamping assembly (4.2) is detachably assembled to the lower pipe clamping assembly (4.1) by means of screw or magnet.

~~19.~~16. The pipe lifting device as claimed in claim 14~~17~~ or 15~~18~~, wherein the lower pipe clamping assembly (4.1) comprises an inner wall (4.1.1) that supports a lower part of the pipe, a flat lower wall (4.1.2), and two side walls (4.1.3) that protrude upwardly in an inclined manner from the lower wall (4.1.2).

~~20.~~17. The pipe lifting device as claimed in claim 16~~19~~, wherein the side wall (4.1.3) is inclined to the lower wall (4.1.2) at an angle of 40-70 degrees, preferably 60-70 degrees.

~~21.~~18. The pipe lifting device as claimed in claim 14~~17~~ or 15~~18~~, wherein the upper pipe clamping assembly (4.2) comprises an inner wall (4.2.1) that supports an upper part of the pipe, a flat upper wall (4.2.2), and two side walls (4.2.3) that protrude downwardly in an inclined manner from the upper wall (4.2.2).

~~22.~~19. The pipe lifting device as claimed in claim 18~~21~~, wherein the side wall (4.2.3) is inclined to the upper wall (4.2.2) at an angle of 40-70 degrees, preferably 60-70 degrees.

~~23.~~20. The pipe lifting device as claimed in any one of claims 14~~17~~-19~~22~~, wherein the lower pipe clamping assembly (4.1) and the upper pipe clamping assembly (4.2) have a thickness in a range of 5-7 cm.

~~24.~~21. The pipe lifting device as claimed in any one of claims 14~~17~~-20~~23~~, wherein the lower pipe clamping assembly (4.1) and the upper pipe clamping assembly (4.2) are made of aluminum or carbon steel.

~~25.~~22. The pipe lifting device as claimed in any one of claims 14~~17~~-21~~24~~, wherein the upper pipe clamping assembly (4.2) further comprises at least one hole (4.2.4) arranged

at an upper part of the upper wall (4.2.2) for inserting a latch through the upper pipe clamping assembly (4.2) and rests against the pipe's surface.

~~26.~~23. The pipe lifting device as claimed in claim 1, wherein the supporting structure (1) is a rectangular or oval or circular shape along the longitudinal direction of the pipe comprising a plurality of holes (1.1) arranged at ~~a~~the side wall of the supporting structure (1) for assembling the structural fastening assembly (2) to said hole (1.1).

~~27.~~24. The pipe lifting device as claimed in claim 1, wherein the supporting structure (1) is at least two vertical plates (1a,1b) arranged away from each other along the longitudinal direction of the pipe.

~~28.~~25. The pipe lifting device as claimed in claim 1, wherein the structural fastening assembly (2) comprises a pivot (2.1) arranged transversely in a middle of each side wall of the supporting structure (1), at least two holding hooks (2.2) rotatably connected to the pivot (2.1) opposing each other for mounting to the external pipe supporting structure, and a lock mechanism (2.3) provided at each holding hook (2.2) for restricting a movement of the holding hook (2.2).

~~29.~~26. The pipe lifting device as claimed in claim 25~~28~~, wherein the structural fastening assembly (2) is fastened to the external pipe supporting structure by rotating around the supporting structure (1) or longitudinally sliding along the supporting structure (1).

~~30.~~27. The pipe lifting device as claimed in claim 25~~28~~, wherein the holding hook (2.2) comprises a bar (2.2.1) having curve shape where one end of the bar (2.2.1) is rotatably connected to the pivot (2.1) and a mounting plate (2.2.2) provided at the other end of the bar (2.2.1).

~~31.~~28. The pipe lifting device as claimed in claim 25~~28~~, wherein the lock mechanism (2.3) comprises an insert hole (2.3.1) provided on each holding hook (2.2), a mounting bolt (2.3.2) for fastening the supporting structure (1) and the insert hole (2.3.1) for restricting a movement of the holding hook (2.2).

~~32.~~29. The pipe lifting device as claimed in claim 1, wherein the structural fastening assembly (2) comprises a plurality of angle members (2.4) where one end of each member is mounted to the supporting structure (1) and where a pair of angle members (2.4) is assembled into an invert U-like shape structure to cover the external pipe supporting structure.

~~33.~~30. The pipe lifting device as claimed in claim 29~~32~~, wherein the structural fastening assembly (2) comprises two pairs of angle members (2.4) where each pair is assembled into an invert U-like shape structure to cover the external pipe supporting structure, spaced apart along the longitudinal direction of the external pipe supporting structure.

~~34.~~31. The pipe lifting device as claimed in claim 29~~32~~ or 30~~33~~, wherein the structural fastening assembly (2) further comprises a connecting member (2.5) assembled to the other end of each pair of the angle members (2.4) assembled into the invert U-like shape structure for connecting the angle members (2.4) together in such a way that a width of the invert U-like shape structure is adjustable along with the width of the external pipe supporting structure.

~~35.~~32. The pipe lifting device as claimed in claim 1, wherein the power transmission assembly (3) is selected from jack, electric jack, hydraulic jack, gear system, and electric motor.

~~36.~~33. The pipe lifting device as claimed in any one of claims 1-32~~35~~, further comprising a control unit connected to the power transmission assembly (3) for controlling a movement of the power transmission assembly (3).

~~37.~~34. The pipe lifting device as claimed in any one of claims 1-33~~36~~, further comprising at least one auxiliary device selected from stress gauge, pipe thickness gauge, distance measuring device, and automatic alert device.

~~38.~~35. A use of the pipe lifting device as claimed in any one of claims 1-34~~37~~ for pipe lifting.

~~39.~~36. The use of the pipe lifting device as claimed in claim 35~~38~~, wherein the pipe lifting is performed at a vertical or horizontal distance up to 15 cm, preferably up to 10 cm.

~~40.~~37. The use of the pipe lifting device as claimed in claim 35~~38~~ or 36~~39~~, wherein the pipe lifting is performed by moving the pipe at a distance of 0.1-15 cm, preferably 0.3-0.8 cm each time.

~~41.~~38. The use of the pipe lifting device as claimed in any one of claims 35~~38~~-37~~40~~, wherein the pipe lifting is performed in conjunction with at least one auxiliary device selected from stress gauge, pipe thickness gauge, distance measuring device, and automatic alert device.