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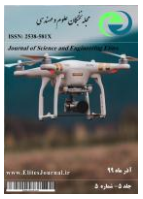

Robots Replacing Workers in Wells with Drill Rods or Tubes with Welding, Cutting and Research Capabilities

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Abstract

Despite the advancement and development of science and technology around the world, we still see the disappearance of a number of workers in wells, mines, tunnels and the like of those working people who, unfortunately, due to negligence in the workshops, the attention of some Officials to the implementation of their projects and forces, the lack of innovation in science and the drilling industry in some countries, the number of injured and their deaths reach hundreds and possibly thousands as well. Generally, the wells of oil, water and sewage, and other deep wells that are drilled, are not readily accessible by their deep depths. This means that humans are not able to reach the bottom of the well to replace equipment and repairs at well depths. According to the present study, when drilling rods or deep water and sewage pipes, in some cases, such as deep-well debris, high heat, corrosion of the area of the welds, fractures, and eclipse due to pressure from the period The unusual pipe or rod, or the pressure caused by the total weight of the pipe or wellbore, is affected by a lot of accidents and is subject to fatigue and rupture, resulting in fracture or cracking of the rod in the ground (wells), which ultimately leads to The drill rod is removed from the drill, which is surely the best and fastest way to solve such problems using the robot instead of humans.

Key words: robots, borehole or pipe wells, welding and cutting, researches.

1- Introduction

The oil wells and other deep wells, such as drilled wells, are not easily accessible due to their vast depths, which means that humans are not able to replace and replace equipment, repairs and use of some tools at wells. Bring yourself to the bottom of some wells. This issue has been motivated, so that many elites and engineers from different countries of the world consider the problem to solve this problem, each of which provides solutions that can be used to design one such as (build

a robot with application in wells with drill rods or tubes with welding ability, cutting, etc.) from Iran. The project was a device or a robot that was first registered in the Iranian Patent and Industrial Property Organization and won dozens of national and international awards from European and Asian countries. The technology of this robot is that it can easily carry out operations that are conducted by experts and workers on the ground or so-called wellhead from the well, and no longer requires the presence of workers inside the wells [1].

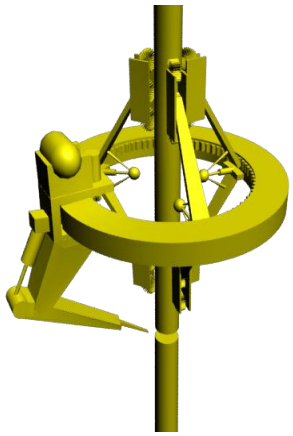

Fig 1- A View of Robots replacing workers in wells Designed with 3D MAX Software

2- Problem Statement

The application of this robot in brief is welding, cutting on objects in the wells, as well as their use in relation to mechanical research and the type of soil classification and well walls through (sampling, photo and video), Testing, searching and research of geology and the presence of faults and their type in the site, testing and operation of hazardous wells instead of human use, oxygen-free wells or blast-furnace wells, wells with spill nozzles and In total, pipe repair at heights above ground level and places with low access in refineries, petrochemicals, pipes [1].

As an example in the drilling industry: When drill bits of the mineral machinery (wagon drill) during excavation of the depths of the earth and creating a hole in it, in some cases, such as erosion of metals in the wells, excessive heat, corrosion of the site of the bouts, fractures and Dirty due to pressure from the tube or rod, or the pressure caused by the weight of the whole tube or wellbore, has resulted in the failure of many incidents and limitations, resulting in the breakage or cracking of these rods inside the ground inside The wells are drilled from the drill rod and the drill rod is released from the inside, due to the separation of these two pieces and the short The time and cost of avoiding additional drilling costs and the project to run a well or a well re-replace this well along with that well is not feasible [1].

The solving this great problem is here " in such a situation, the best, quickest and most cost-effective way to run and run the project without having to take time again, waste of expenses again, as well as manpower, use of It is a robot that uses it so that at first the user or the robot navigator is placed at the top of the well and placed the robot in its place around the tube or drill well, then using the control device to the bottom of the well and The location of the incident or damage will be guided and the operation will be carried out in the relevant project [1].

Is it possible to use the minimum capital and the minimum timing and minimum labor use in such problems with maximum efficiency?

Due to the problems mentioned and using this device without compromising the lives of the workers, considerable savings can be made in time and expenses and the like.

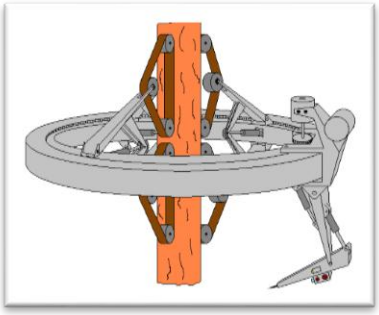

Fig 2- A View of Robots replacing workers in wells designed with Paint software

3- The Importance of the Subject

The using of the modern tools and devices in industries such as construction, water and sewage, petrochemical, oil and gas, nuclear facilities, aerospace industries, and so on, is very important in this regard, the most important and important The design was replaced by robots instead of humans in research programs, welding and cutting, and the like in wells.

Fig 3- Pictures of drill bits in the wells

We've seen and hear the reports and scary scenes over and over again that, unfortunately, a number of workers around the world have died because of design and false calculations, lack of attention and consideration of project officials, as well as mistakes made by the workers themselves during their work. But despite its invention and its production in the civil, mining, water and wastewater wells, drilling, oil, petrochemicals and gas and chemical industries (and also military and space), etc., are witnessing poisoning and The disappearance of workers inside and out of wells and the increase in casualties in wells due to lack of oxygen and the destruction and loss of walls We will not be in them. Considering that this invention will include research and research on the classes and soil mechanics and their sampling and transfer of their data to the top of the well, as well as the welding and cutting of metals into the wells and bringing objects to the top of the well It would have a wide range of technology and convenience in advancing the objectives of the projects to help the workers, and should never forget that the most valuable factor in any construction project, mining and industrial, conservation and care of life Human beings are engineers and workers, and in compliance with this principle, positive opinions and attitudes can be made to improve and secure The desire and willingness to continue to work it among the various strata of the staff, especially the workers of a company, was created [1].

No one can experience without a similar situation. They find out how difficult it can be for miner’s workers to get into the depths of the well if they break down walls and dyspnea?

Every year, we see painful and shocking images of the death scenes of workers who have lost their lives under the rubble. Perhaps the first question that the mindset of any viewer undoubtedly is, what was my destiny if I was a same worker?

4- Literature and Background

The deep wells are generally of two types in terms of services to wells, wells with rods and wells without rods or tubes. These wells are often diametrically spaced 40 or 50 centimeters apart, some of which have a rod or pipe for water supply, oil and gas suction from the well, sewage into the well, etc. Which is used in the oil and gas, petrochemical, water and sewage industries, and this has made it impossible for workers inside it to work, and can only be solved by using a modern system, which is the construction and That system was not just a robot [6].

5- Research Purposes

The research objectives is include: research issues, exploration and exploration of pipes, cutting operations, welding damaged parts, restoration and maintenance of petrochemical pipes at unreachable high heights, performing any operations on water pipes and sewerage In the underground, inside the wells of oil and gas and wells containing hazardous and explosive poisons in the underground, restoration and rehabilitation and intubation of tubes lying at the seafloor, use in heavy water of nuclear power plants and places for which reasons the presence of strong uranium and radioactive substances is extremely dangerous and deadly for humans, and is used in the industry Military and Outer Space Bases that require the use of robots instead of humans [2].

6- Research Questions

Considering the problems mentioned in the various industries considering the lack of use of humans (workers) in their implementation (for example: due to fracture and cracking of drill rods or tubes in drill wells, water and sewage, etc.) In this context, the most important questions to the mind of any expert and responsible are:

- So what can be the best, fastest and least costly way?
- Should you dig a new well next to the old well?
- So what will be the previous cost of digging the previous well?
- Can human beings be used to carry out such problems, and if any, what threatens the lives of workers?
- Can the drilling continue in the first well?
- What steps should be taken to continue drilling in the first well?

7- Research Hypotheses

Due to the unique design of the robot, the applications and operations performed by this robot in the welding and cutting industry are not limited to these cases, and it is worth noting that these robots have other capabilities in There are various industries that can be used in special and very difficult jobs and in non-permeable locations.

In this regard, due to the capabilities of this plan, we can point to the use of this robot in the above-mentioned secretive military and space and nuclear industries, which include the following hypotheses:

- Use in heavy water ponds of nuclear power plants for various operations without human presence (nuclear)
- Use in the manufacture of chemical and military industries that have a very dangerous human existence
- Use in the space industry (carrying out the above-mentioned operations and exploring and exploring space bases on other planets, in outer space shuttles and discos and space missiles).

Generally, the oil wells and other deep wells that are drilled are not accessible at very high depths. This means that people are not able to get to the bottom of the well to replace the equipment and

repair it at the bottom of the well. This was the motive for a robot that could carry out operations on the ground or so-called "head" by experts [1].
The origin of research in this area occurred at the beginning of 2005 in one of the oil and gas wells drilling in southern Iran due to the carelessness of the vehicle and the collision of a vehicle with a gas outlet from the ground (cap) at one of the wells The gas that broke the gas pipeline from the underground reservoir to the top of the well, caused by this collision and the flammability of gas, arose around a severe explosion that resulted in the flaring of very large flames around and the killing of many Workers and engineers were blown up during repairs. Solving this huge and dangerous problem that only a handful of countries and modern companies could handle over a period of at least 2 weeks was much less accomplished by the robot over time. Using this robot, solving such a problem is possible without the presence of humans at the place and at an extremely low cost, and most importantly, without heavy casualties and death.
Another example of this is the problem in one of the wells that have pipes with a diameter of 5 inches and a diameter of 65 centimeters and a height of 50 meters, which is located in the middle of the well and is used to suction the well water from the well It has been cracked over time.
These include erosion, perforation and surrender of the rod against heat and hardness, and even earthquakes, fractures, and ultimately the displacement of pipes at well depths.
It should now be taken into account that if the bar or pipe breaks and remains deep underground within the well, then what should be done with modern equipment?
Or it must be done to get a pipe out of the well and repair it outside the workshop, which requires time and money to finance the project, or it should a band on the well, and dug another well with the situation and condition of the well that is essentially It is financially time-consuming and time consuming and will not be cost-effective.

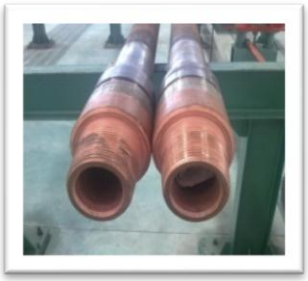

Fig 4- Drill rods attached to drill

Fig 5- Full view of a drill

Or what should be done if there is a high-intensity fire over the wells of oil or gas for various reasons?
If today, experts use a controllable tube on the old tube to restrain it, as shown in Figure 6, in such a way that the control valve connector and the old tube are in the ground and they are welded together with many problems and high dangers. And then attach the new valve (control valve) that is already installed on it, in which case the fire will be extinguished. It should be noted that such a wilderness takes time in this old way of weeks.
Is this the only correct method to be implemented or is there another solution?

Fig 6- The image of the floodgates in the past style

Please note to figure 6 completely, that if there is such an occurrence in the gas or oil pipes where the fire is flowing in its openings, if the use of the human being and the resulting risks are very expensive and expensive, the high torque used by this welding and welding robot will no longer see such inhibitors in the old ways with high risk of wells.
If necessary, there is a need for welding and cutting operations or any other action in the depths of the seas and oceans (such as the Mexican oil spill event leading to contamination of the water, marine environment and the death of thousands of species of living beings and plant).
How to get rid of dangerous organisms such as sharks, human stomachs as a result of the pressure of deep water in the depths of the sea, in spite of the low air and oxygen content of the divers under low water in the long run and their replacement and casualties during this period. In the depths of the deep water, can you repair the damaged oil and gas pipes there? and7. Images of the problems of welder specialists under the sea?
These robots can be applied inside the wells. They can be used for mechanical research, as well as classification of soil and the walls of the well through sampling and photography. The robot conducts operations in the forms of tests, geological research, and finding the existence of fault lines. The robot can be applied in dangerous wells (instead of manpower), oxygen-free wells, and wells which have toxic gases. The remote-control robot is also used for welding, pipe cutting, and repairing pipes [4].

Fig 7- Images of problems of underwater welter specialists in operation restoration and construction of tubes

Failures due to fatigue is one of the costly problems in the oil and gas industry. Drilling line failure occurs in 14% of all rigs and costs about $ 106,000 per event. One of the most important causes of drilling pipe failure is premature and unforeseen failure of notched pipes under tensile loads. Failure of pipes can cause great and costly damage to the drilling operation. Among these

consequences, we can mention the loss of drill pipes (Drill Pipe), drill (Bit), stabilizer (Stablizer), loss of wells, etc [7].
The main reasons for the breakdowns can be summarized as follows:
Fatigue is the main cause of 65% of failures and has a significant impact on the other 12%.
The combination of excessive traction and torque was the cause of failure in 13% of cases.

8- Toughness

Only failures have been reported as the cause of the failure. Due to the multiple uses of pipes in drilling other wells and their frequent opening and closing, these scratches were present in almost all pipes, along with other destructive factors such as corrosion caused by drilling fluid and oscillating loads, growth sites. And the spread of fatigue cracks that eventually cause holes (wash out) or cut (twist off) pipes [7].
According to Fig.8, images of deep underground excavations have been shown to be an example of the use of robot operations in this type of drilling.
- If during the drilling operation, due to high pressure, sudden rotation, previous corrosion of the rod, the tensions caused by the motion of the waves on the rod and drill and various hydraulic reasons, suddenly the drill rod is cut off from the middle part and broken. What should Did you?
- Do you still have to use divers in the past as a way to eliminate this project?
- Is there not a device or robot that can do it safely and safely with less time?

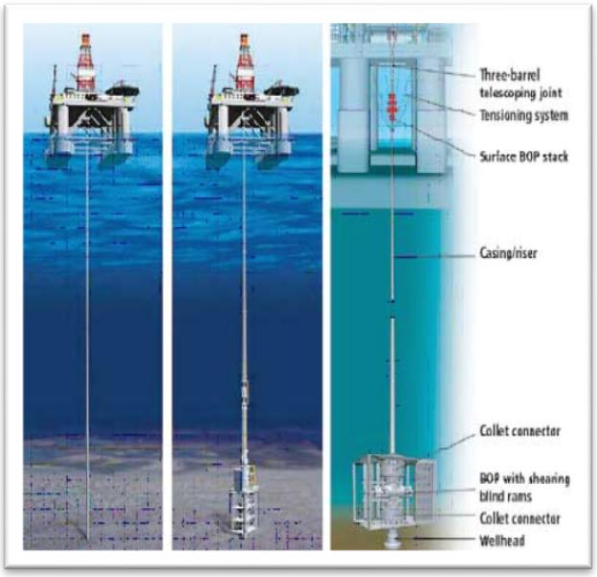

Fig 8- Deep water drilling and using different eruption systems, using surface eruption (left figure), drilling using submarine eruption (middle figure), drilling using surface eruption with ESG system (right figure) [5]

In recent years, the drilling industry has turned to drilling oil and gas wells in deep water. Such wells may have special thermodynamic conditions (low temperature and high pressure) and have a very small boundary between reservoir pressure and fracturing pressure, which these conditions in the well control section cause some problems in drilling operation [4].
In the past, the drilling such wells used submarine eruptions (Subsea BOP) that were installed on the seabed, along with low-pressure risers that continued to the surface of the water. This system had many limitations in terms of well control [4].

9- Type of Corrosion

1. Galvanic Corrosion
2. Uniform Corrosion
3. Concentration Cell Corrosion
4. Pitting Corrosion
5. Intergranular Corrosion
6. Stress Corrosion
7. Dezincification
8. Erosion Corrosion

We will mention only one example of corrosion

10- STRESS CORROSION

Any type of subject corrosion that is exacerbated by stress is called stress corrosion. The combination of corrosion and tensile stress causes cracking and then failure of the metal. One of the characteristics of corrosion under stress is the absence of uniform corrosion [4].

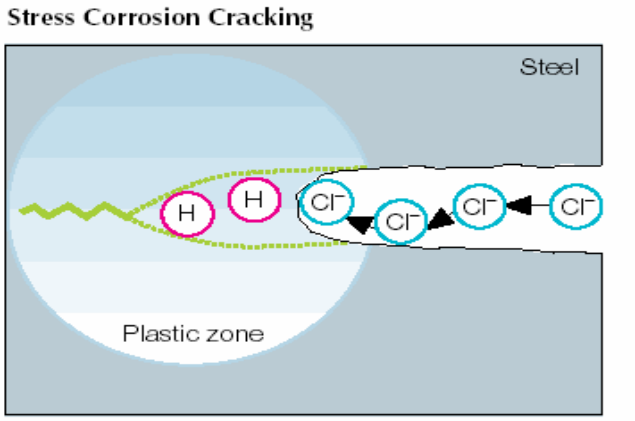

Fig 9- The image above shows the simultaneous effect of tensile stress and corrosion in a crack [4]

Fig 10- The photo above shows the cross section of the stress fracture (stress corrosion is usually branched) [4]

We may see problems such as these in the various industries of oil, gas, petrochemicals, drilling, water and sewage, and we regret it in the future, because of what can be done in the past without human, financial and time losses. We did not do much.

The answer to all of the above questions and the solving of several other problems, such as those in other industries, lies in this robot. A robot capable of having such a problem and problems like

these unbelievably and without the presence of humans inside the well, underwater, at high altitudes, in gaseous, toxic and chemical, and microbial environments with an extraordinary amount of time Low, repair cost is very low.

- How much do you think this device can do to the drilling industry, oil, gas, water, sewage, petrochemicals, etc.?

The design of this robot was carried out by Mr. Morteza Shirmohammadi in late 2006, and was finally officially registered at the Iranian Patent and Trademark Office in late 2006, and has so far been awarded several international, country, provincial, and top-notch titles. Selected in the Olympiads, the festivals of inventions and scientific advisories from several universities in Iran are ranked superior, but because of the lack of use of this project by the Iranian authorities to produce it now, we have It witnesses the use of companies, organizations and organs from workers to robots Beat well. And perhaps if this project is to investigate and analyze the rate of error to be too early to see the difference between profit and loss of use of the invention in the respective industries as a substitute for the human will [3].

11- Research Methodology

The plan includes a number of metal arms and pins or pneumatic jacks or gears, which, using the radio control by the robot driver standing on the well, guides the machine down the well and at the desired location (the location of the incident) Began to perform welding and cutting operations, sampling, etc. inside the well, and the robot operation begins.

This robot is equipped with:

- There are 5 pneumatic jacks or 5 gears for moving the robot and its arms around.
- There are 3 large pillars, each base consisting of two small pins for holding and connecting the robot to the drill pipe and moving it up and down the pipe.
- 1 number of arm with very different characteristics and activities inside the well, CCTV cameras and control device operating from the top of the well with the robot controller.
- A total of 18 displaced reels with 19 high-power, high-power and low-speed DC motors with waterproof, anti-heat and anti-corrosive properties.
- The number of 1 circular circle that circles the arm and the whole robot system around it.
- The number of 7 direct and indirect camcorders, camera, microscopic camera.
- The numbers of 6 modern ribbed belts with high adhesion to objects (metal, plastic, wood, concrete, stone and slippery and slippery surfaces)

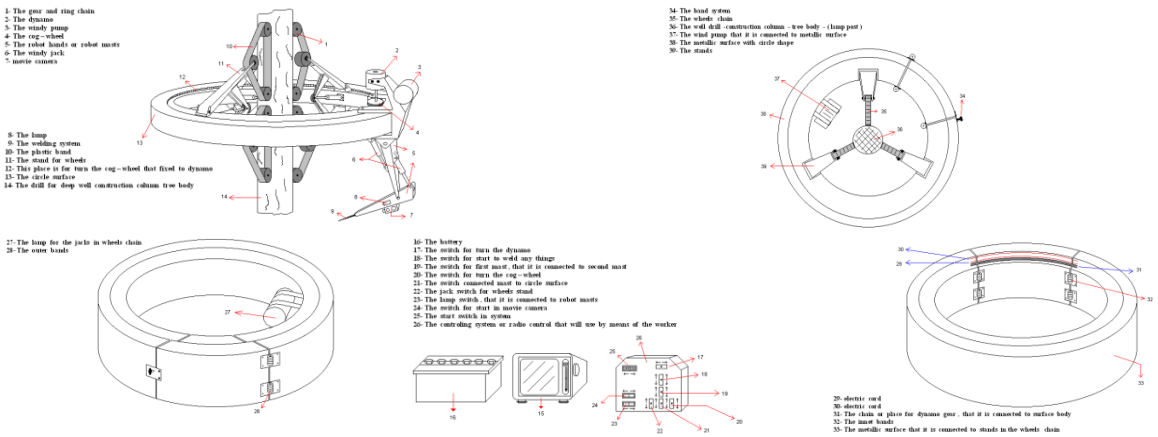

Fig 11- Examples of robot designs along with a detailed description of it

The arm of this robot is equipped with a cutting machine and welding of metals using oxygen and gas, and metal milling, the operation of which is dependent on the robot and the execution of the intended piece that will go along with the robot into the well. Around the machine there is a circular metal plate in which the robot arm around it can be rotated to allow the robot to operate at all angles of welding and cutting, and all user operations on objects in all directions (360 Degree).
Note: The important thing in this device is that, if possible, the dangers of wellbore through the walls of the workers inside it, the lack of oxygen in the depths of the well, etc., there was no need to send old-fashioned manpower to the wells And accidents such as workers' shortness of breath, poisoning due to biting, being blocked and strangled inside the well as a result of the above mentioned factors are minimized and, most importantly, the injuries and casualties of workers in such projects inside the wells Always reach zero [1].
All robot applications include:
- The Welding and cutting tubes at wells with tubes with water or corrosive and toxic and microbial chemicals, water and wastewater wells, on pipes with high altitudes in the oil and gas industry, petrochemicals, marine structures, Dig.
- The removing, displacing objects in all angles and directions to carry out any operations on them performed by the robot moving arm.
- Investigation, research, sampling, marking in geological and mineralogical issues and soil mechanics studies and their classification deep in the earth, without human access to it.
- Possibility of using CCTV cameras, which can be used in various gas environments with a risk of explosion and strangulation, in liquid environments such as water, sewage, toxic and lethal chemicals, and corrosive metals.
- Possibility to use in gas environments up to a minimum and maximum temperature:

$$-30 < \text{Robots} < +30$$

- Ability to use in liquid environments to a minimum and maximum temperature:

$$-45 < \text{Robots} < +15$$

- Possibility to use in vacuum and non-oxygenated environments or Off-Earth (space research) in places where the use of astronauts in those places is dangerous and impossible.
- The ability to repair parts of the robot by itself with the ability to design it.
- The using of Lightweight and robust material on the robot (compressed aluminum with steel and zinc coatings, and in some cases the use of compressed Nano-polymer materials and anti-corrosive materials).
- It has the ability to rotate 360 degrees horizontally deep down the robot.
- Waterproof and anti-corrosive and acidic substances up to $7 < PH < 5$

The view of robot’s rotation capabilities and capabilities in all angles including:

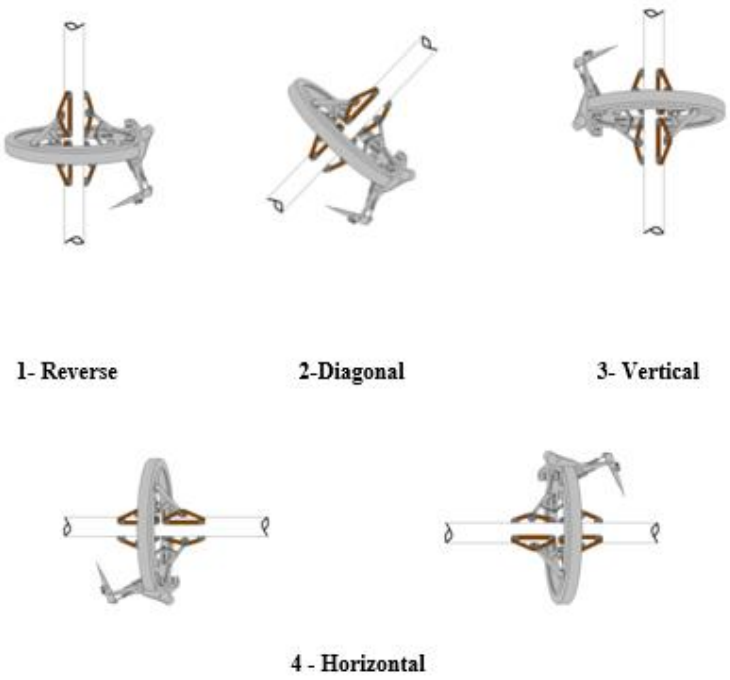

Fig 12 - The angles of different the robot performance on the pipes

12- Findings

1- Research Type: (field and laboratory)
The research in this field has been carried out in many of the civil and mining projects that I myself saw and supervised inside the wells, in connection with the existing problem, its implementation before it is resolved with the device and after it has been removed. It is done with the device.

2- Location of research:
One of the water wells in Iran is in the lowlands of Tehran province with relatively dry areas.

- Well profile:

Well type: Water supply
Depth: 50 meters
Crest diameter: 65 cm
Diameter of the water pipe in the well: 5 inches

3- Research period:
Period of research from December 2006 to March 2006

4- Research community, research sample:
The research sample, along with two ordinary workers, was carried out in one of the wells of a 5-inch tube with a diameter of 65 cm and a height of 50 meters. This tube was located in the middle of the well and was used to inject well water from the well.

5- Sampling method:
The specimen weighs 15 kg and is 50 cm in diameter, which is capable of regulate (large and small) for wells with large diameters and smaller than their thickness.

6- Research results:

The result of this practical research in wells includes:

- (The conventional welding with low amperage and low grade electrode and cutting with a lightweight mini milling machine for cutting software's of less than 3 mm) has been positive.
- Testing and exploring the well walls and walls of well water wells and related fittings using different CCTV cameras used in the body and arms of the machine.
- Testing of pneumatic jacks and electro motors of the device at a depth of 20 meters of the well
- Testing of the Robot rotation around the desired pipe axis
- Testing the gears and their speed and pulling power

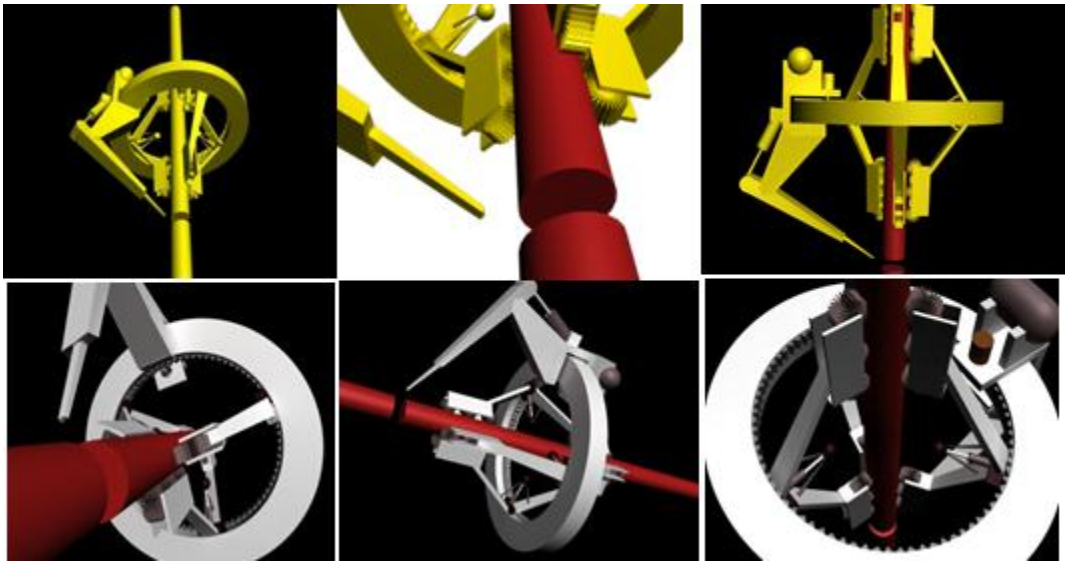

Fig 13- How to operate the welding robot and its attachment in all angles on damaged tubes

Table 1- The results of the robot test

Row	Conclusion on the problem of the proposed project	Project test type	Disadvantages of Operation without Robots	The merits of the operation With the robot	Duration of operation	Place the operation	Kind of the operation
1	Positive	Experimental and Workshop	Insurmountable for the operation of the workers at the bottom of the wells due to the bottom of the well	No need for worker and a lot of financial expenses	2.5 hours	50-meter water well has a conductor in Tehran city	Welded and cracked conductor pipe cracked and rectified at a depth of 32 meters
2	The result is unknown - because of the lack of cooperation of oil companies with the use of this robot	High speed operation and rapid retention of wells in a very short time for its implementation	Excessive environmental warming due to flames of oil and gas wells and high environmental pressure	No casualties and wasting a lot of financial expenses	Much less than old ways	Oil and gas refinery wells in southern Iran	Welding of the flame transfer pipes in the oil and gas refinery
3	Positive	Sampling and operation of the robot in the study of geological layers of soil, rocks, minerals deep underground	Pouring well walls and reducing oxygen at wells	Without the need for the worker, the tools and methods of the old and without casualties at the bottom of the well	3 hours	Dried water well with a depth of 40 meters in Tehran city	Sampling, testing and exploring soil mechanics and rocks at wells
4	Positive	Testing the speed of the robot arms in underwater pressure - Ability to use the robot in fluids even with a thicker viscosity	The dangers of attacking sea animals by humans in the seas - Increasing pressure - Muscle stunts in the water - Risking human vital signs	No need for diver and oxygen equipment in excessive amounts underwater	1.5 hours	Test on the floor of a pool with water depths of 6 meters	Welding underwater pipes

Each of the factors presented in this table 1 shows the results of robot test reports in the four projects mentioned in the water and wastewater, oil and gas industry, exploring deep underground, and finally underwater or at the bottom of the sea, where speed and time The implementation of the human operating robot mechanism has been shown in various project types, including the type of operation, the location of the operation to be performed, the duration of the operation by the robot, the merits and disadvantages of using the robot or man, the type of test and the details of the test And finally, the conclusion is to solve the problem.

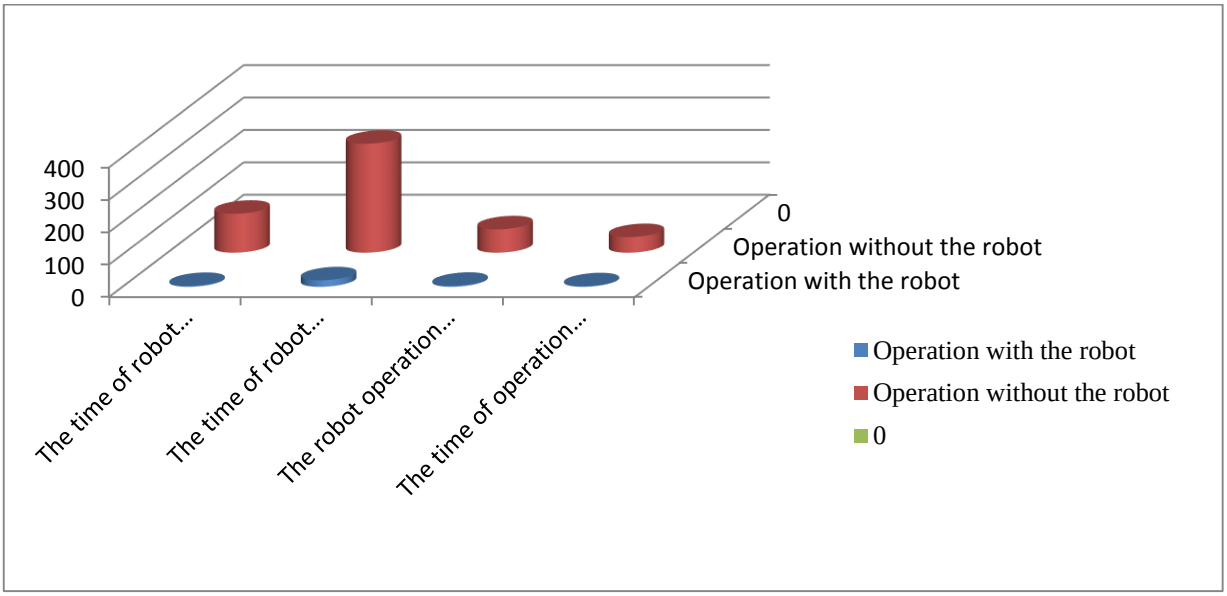

Fig 14- Compare the time of operation efficiency with robots and without robots (The numbers used in the chart above are in hours)

Figure 14: Comparison of the time and speed of operation efficiency using robots and non-robots (human use) in various projects in terms of hours. By considering these parameters, it is possible to analyze the useful mechanism of this model in comparison with each other. The result is an increase in the efficiency of the project with the help of the robot.

13- Discussion and Conclusion

In this research, it has been observed that there is a significant relationship between the previous excavation mechanism and this drilling robot. The use of such new technology and innovations in today's world will greatly improve the evolution and knowledge of the use of robots. It should be noted that according to the research carried out on Iranian and foreign patent sites and with participation in exhibitions and national and international festivals in the countries of Europe and the Americas and Asia, there have not been any domestic or foreign samples Similar to this plan, this has not been seen and recorded.

14- Offers

The using of such devices in the various industries mentioned is not for the benefit of the economic and social status, but for the use and use of such a method, is the mechanism that can provide a broad scientific basis, the practical inventions and discoveries, and the reduction of the focal length of science to action In order to protect the lives of those who spend their night and day to advance their high-quality goals globally, it is best to appreciate such people using new technologies and facilitating job hardships and solving problems. They and most importantly safety and protection of their lives against potential hazards to be.

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