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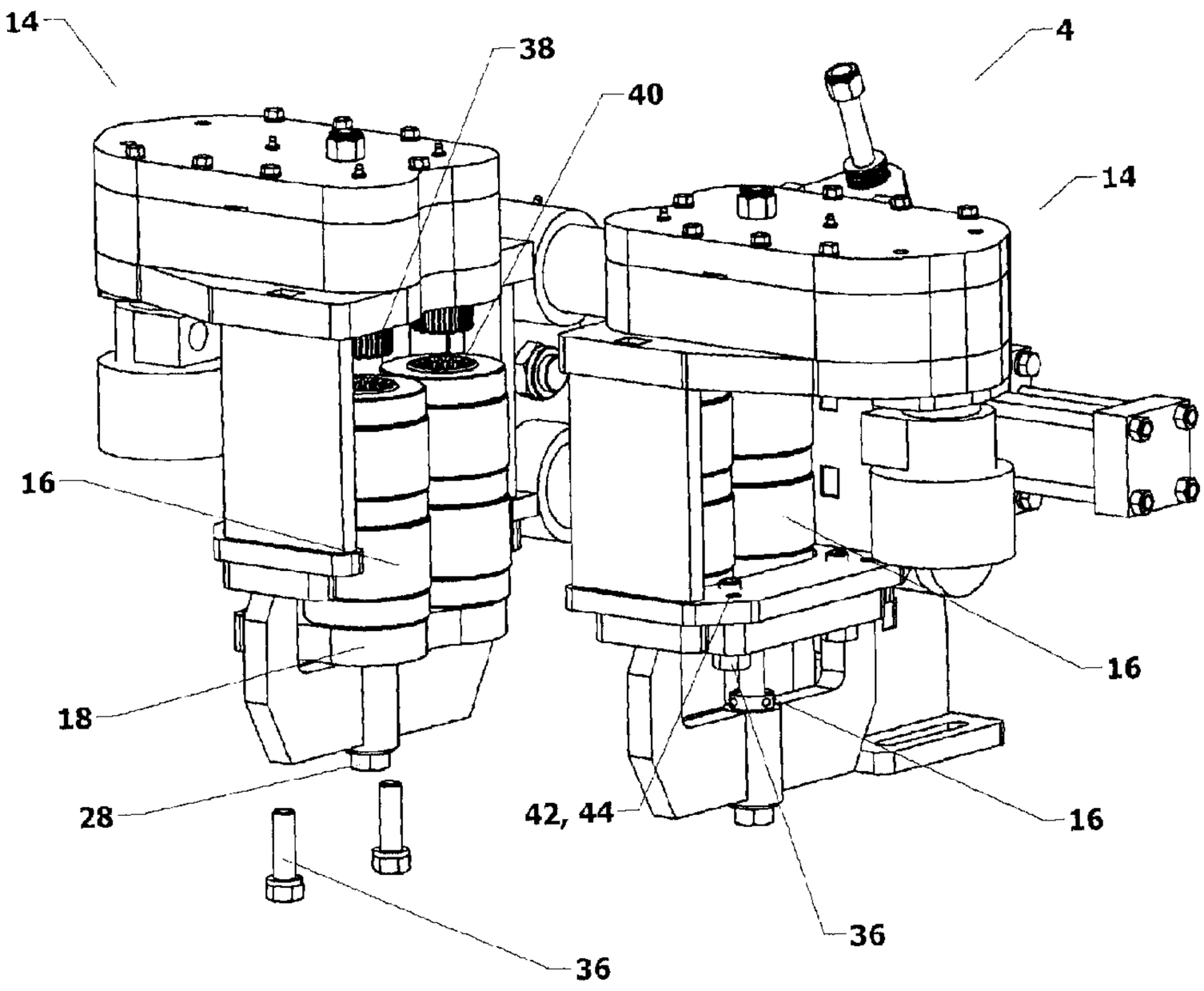

(57) Abrégé/Abstract:
A device is taught for making up or breaking out drill pipe sections. The device comprises one or more roller assemblies. Each roller assembly comprises a support movably attached to the roller assembly by an attachment means, one or more rollers supported on the support and one or more roller motors. The support can be raised and lowered by tightening or loosening the attachment means to allow access to the one or more rollers supported on the support. A mechanical roughneck system is further taught for making up or breaking out drill pipe section comprising the present device. A method is also provided for changing rollers in a spin wrench assembly.

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(54) **Title**: SPIN WRENCH ASSEMBLY

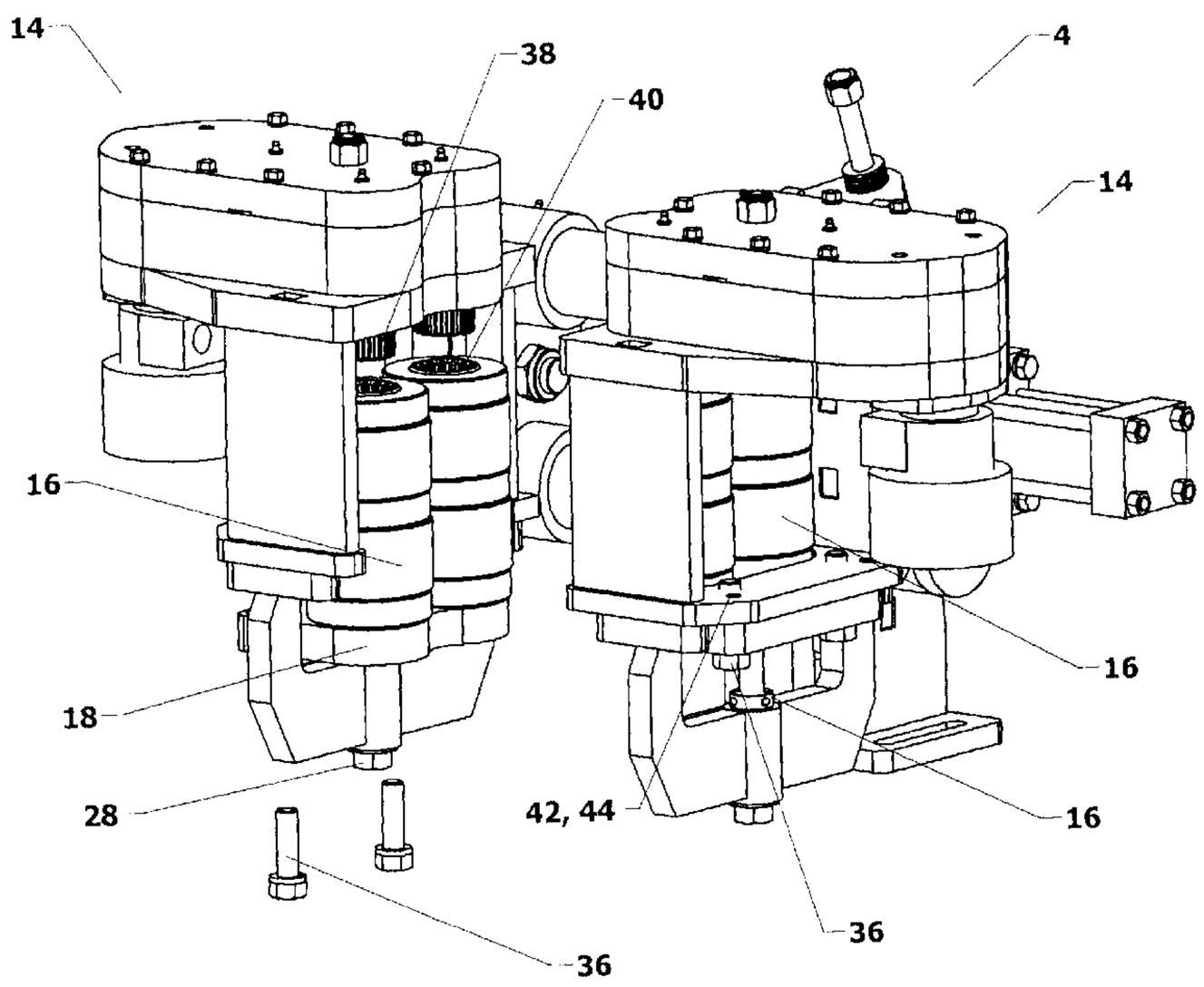

FIGURE 5

(57) **Abstract**: A device is taught for making up or breaking out drill pipe sections. The device comprises one or more roller assemblies. Each roller assembly comprises a support movably attached to the roller assembly by an attachment means, one or more rollers supported on the support and one or more roller motors. The support can be raised and lowered by tightening or loosening the attachment means to allow access to the one or more rollers supported on the support. A mechanical roughneck system is further taught for making up or breaking out drill pipe section comprising the present device. A method is also provided for changing rollers in a spin wrench assembly.

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Spin Wrench Assembly

Field of the Invention

The present invention relates to a device and a system for making up and breaking out drill pipe sections in a drill pipe string. The invention also relates to a method of replacing rollers used in rotating drill pipe sections during make up and break out operations.

Background

In down-hole drilling and extraction processes drill pipe is run down the wellbore for the purposes of drilling and performing wellbore operations. Drill pipe is made up by connecting multiple threaded drill pipe sections together and feeding them into the wellbore. Typically, drill pipe sections have a tapered male thread at one end, also called the pin joint, and a female thread at the other end, also called a box joint. The male end of a first drill pipe section is threaded into the female end of a second drill pipe section to makeup the drill pipe. Rotation of one drill pipe section into another drill pipe section is conducted until the tapered ends engage one another at the shoulder point.

A number of devices may be used to make up drill pipe sections including power tongs and mechanical roughnecks. Power tongs are more commonly used in making up casing strings or tubular sections, and in some cases do not posses sufficient strength to make up drill pipe.

Mechanical roughnecks typically comprise a gripping section for gripping the drill pipe sections to be connected, and a second, rotating section for centering a second drill pipe section over the first drill pipe section and rotating the second drill pipe section into the first.

The rotating section, often called a spinner or spin wrench comprises one or more rollers that engage the second drill pipe section and rotate it. The spatial arrangement of the rollers may be fixed or may be movable to accommodate different

diameters of drill pipe.

Through constant use and frictional engagement against the drill pipe surface, the rollers often become worn and must then be replaced. On site replacement of the rollers at the rig floor can be time consuming and cumbersome, leading to lost production time and extra work for the operators. Rollers are generally held in place by multiple bolts, which must be undone on each of multiple rollers before the rollers can be removed. Each roller typically weighs 15 to 20 pounds (about 7 to 9 kilograms) and the height of the rollers on the spin wrench make removal cumbersome and dangerous.

Some effort has been made to ease removal and replacement of rollers. For example, in some prior art spinners, an entire assembly comprising multiple rollers, multiple motors and a connective assembly, can be removed as one piece. The weigh of such a piece is greater than that of the rollers, thus requiring a crane, winch or similar equipment to support it. The piece must also be replace with a full new assembly, even in cases where only one roller requires replacement.

A need and interest therefore exists in the art to develop improved mechanical roughneck spinning devices and methods for roller replacement for drill pipe makeup and breakout operations.

Summary

A device is taught for making up or breaking out drill pipe sections. The device comprises one or more roller assemblies. Each roller assembly comprises a support movably attached to the roller assembly by an attachment means, one or more rollers supported on the support and one or more roller motors. The support can be raised and lowered relative to the roller assembly by tightening or loosening the attachment means to allow access to the one or more rollers supported on the support.

A mechanical roughneck system is further taught for making up or breaking out drill pipe section. The system comprises a clamp assembly movably connected at a lower end of a frame, wherein the clamp assembly comprises a lower clamp for engaging and grasping a first drill pipe section and an upper clamp for engaging and grasping a second

drill pipe section. The system further comprises a spin wrench assembly connected to an upper end of the frame, said spin wrench assembly comprising one or more roller assemblies. Each roller assembly comprises a support movably attached to the roller assembly by an attachment means, one or more rollers supported on the support and one or more roller motors, wherein the support can be raised and lowered relative to the roller assembly by tightening or loosening the attachment means to allow access to the one or more rollers supported on the support. The system further comprises a hydraulic valving to actuate one or more functions of the spin wrench and clamp assembly and a console to controls the hydraulic valving.

A method is also provided for changing rollers in a spin wrench assembly. The method comprises supporting one or more rollers on a support, movably attaching said support to the spin wrench assembly by attachment means, loosening attachment means to lower the support and the one or more rollers, removing and replacing individual rollers from the support and tightening the attachment means to raise the support back into engagement with the spin wrench assembly.

Brief Description of the Drawings

The present invention will now be described in greater detail, with reference to the following drawings, in which:

Figure 1 is perspective view of one example of the mechanical roughneck of the present invention;

Figure 2 is an left side elevation view of one example of the mechanical roughneck of the present invention;

Figure 3 is a front elevation view of one example of the mechanical roughneck of the present invention;

Figure 4 is a first isometric view of one example of the spin wrench assembly of the present invention with the support in a raised position;

Figure 5 is a second isometric view of on example of the spin wrench assembly of the present invention, with the support shown in both a raised and a lowered position; and

Figure 6 is a schematic diagram of one method of the present invention.

Description of the Invention

The present invention relates to a device and system for making up and breaking out sections of drill pipe. More specifically, the present invention relates to a spin wrench assembly and its arrangement of rollers. The rollers of present invention provide ease of removal and replacement.

An example of a mechanical roughneck of the present invention is shown in Figures 1 and 2. With reference to this figure, the mechanical roughneck 2 comprises a spin wrench assembly 4 connected to an upper end of a vertical frame 8 and a clamp assembly 6 connected at a lower end of the frame 8. The clamp assembly 6 comprises a lower clamp 10 for grasping a box joint of the first drill pipe section (not shown), and an upper clamp 12 for rotatably grasping a pin joint of the second drill pipe section (not shown). The clamp assembly 6 can be moved horizontally to position itself around the drill pipe sections. The lower clamp 10 and upper clamp 12 define a first opening 30 in which the drill pipe sections fit. Preferably jaws (not shown), attached to ends of the clamp cylinders 34 are movable to accommodate different drill pipe diameters. The upper clamp 12 and lower clamp 10 are fixed in axial alignment, to ensure axial alignment and centering of the second drill pipe section as it engages or is broken out of the first drill pipe section.

With reference to Figures 3, 4 and 5, the spin wrench assembly 4 comprises one or more roller assemblies 14 movably connected to a spin wrench support arm 22 and defining a second opening 32. Although two roller assemblies connected to a single straight spin wrench support arm 22 are illustrated in the drawing, it would be well understood by a person skilled in the art that multiple roller assemblies may be arranged along a curved or angled spin wrench support arm 22 or along multiple spin

wrench support arms 22 to define opening 32, without departing from the scope of the present invention. The roller assemblies 14 are movable relative to one another along the spin wrench support arm 22 to thereby enlarge or reduce the size of the second opening 32. This allows the spin wrench assembly 4 to accommodate second drill pipe sections of varying diameter, while maintaining axial alignment between the second drill pipe and the first drill pipe sections.

Each roller assembly 14 comprises one or more rollers 16 rotatably supported on a support 18. One example of the support 18 is illustrated in the drawings in the form of a plate, although a number of different supports are possible including but not limited to platforms, frames and brackets.

The one or more rollers 16 are rotated by one or more roller motors 20. In one embodiment of the present invention, one roller motor 20 is connected to each of the one or more rollers 16, however it would be understood to a person of skill in the art that the one or more rollers 16 could be driven by one motor 20 to drive them all. In the latter embodiment, a pulley or chain mechanism may be used to allow the one or more roller assemblies 14 to move together or apart to accommodate different sizes of drill pipe.

In a preferred embodiment illustrated in the drawings, hydraulic valving 24 is used to function the mechanical roughneck. Alternatively, operational power can be delivered electrically or pneumatically. The hydraulic valving can provide energy for horizontal movement of the lower clamp 10 and the upper clamp 12 and horizontal movement of the spin wrench assembly 4. The hydraulic valving 24 may also preferably operate rotation of the spin wrench roller motors 20 and rotation of the upper clamp 12 when the second drill pipe section is rotated into or out of the first drill pipe section. Movement of the mechanical roughneck can be controlled from a console 26 preferably mounted to the tool. The console 26 may be a fixed, local device, or alternatively can be a remote wireless or hardwired console 26. It is also possible to use a non-fixed, local console 26, for example mounted on a stand that can be moved along a rig floor.

Figures 4 and 5 show a detail of the roller assemblies 14 and their components. With reference to these figures, the support 18 is attached to the roller assembly 14 by a movable attachment means 28. The attachment means 28 are preferably illustrated in the figures as a screw mechanism such as a jack screw, although it would be understood that other means including but not limited to bolts, clips or other movable attachment means would also work and are encompassed in the present invention. The attachment means 28 more preferably comprises a screw fastened through a locking collar 46 into a bottom surface of the support 18.

Referring to Figure 5, the attachment means 28 can be loosened to lower the support 18, thereby allowing access to the rollers 16 for removal or replacement, as seen in the left hand side roller assembly 14. The attachment means 28 can also be tightened to raise the support 18 back into a position for operation, as seen in the right hand side roller assembly 14.

As seen in Figure 5, one or more mounting bolts 36 can be preferably used to further secure the support 18 to the roller assembly 14 during drill pipe makeup or break out, as seen on the right hand side roller assembly 14. These bolts 36 are then removed prior to loosening of the attachment means 28, as seen in the left hand side roller assembly 14.

In a further preferred embodiment, guide pins 42, seen in Figures 4 and 5, can extend from a lower frame portion of the roller assembly 14. These guide pins 42 align with corresponding guide pin holes 44 in the support 18 to facilitate alignment of the support 18 with the roller assembly 14 during raising and lowering of the support 18.

With reference to the left hand side roller assembly 14 of Figure 5, the one or more rollers 16 are preferably rotatably mounted into the roller assembly 14 by means of a rotary drive mechanism having an external rotary connection 38 formed on the roller assembly and a corresponding internal rotary connection 40, formed on an inner end of the roller 16. The rotary drive mechanism can be of any form known in the art including but not limited to splines, keys, hexagonal connections and square

connections. Most preferably, the rotary drive mechanism comprises an external spline formed on the roller assembly and a corresponding internal spline formed on an inner end of the roller 16, wherein both splines have toothed surfaces. While Figure 5 shows the external rotary connection 38 and internal rotary connection 40 at an upper end of the rollers 16, it is also possible that these features are instead present at a lower end of the rollers 16. When the external rotary connection 38 and internal rotary connection 40 are preferably located at an upper end of the rollers 16, the lower end of the rollers 16 may comprise a shaft (not shown) that fits into a bushing or bearing (not shown) formed into to the support 18.

More preferably, the toothed surfaces of the external rotary connection 38 and the internal rotary connection 40 have a chamfered end profiles to allow the toothed surfaces to rotate slightly as the chamfered ends meet and facilitate alignment of the toothed surfaces as the rollers 16 engage into the roller assembly 14. Further preferably, the external rotary connections 38 can extend at different lengths from the roller assembly 14, so that a first roller internal rotary connection 40 aligns with engages the longer external rotary connection 38 before subsequent rollers 16, thereby facilitating engagement of the rollers 16 without requiring simultaneous alignment of each internal rotary connection 40 with its corresponding external rotary connection 38.

The rollers 16 of the spin wrench assembly 4 are operated by the roller motors 20 to rotate the second drill pipe section into the first pipe section or to break out the two drill pipe sections. Such rollers 16 are well known in the art and can have metallic or elastomeric surfaces, with or without abrasive materials added to the surface material. During operation, the rollers 16 are in constant frictional contact with the drill pipe section and will experience varying degrees of torque depending on pipe thread condition, size of threads, weight of pipe and other factors. In such conditions wear of the rollers' 16 surface or general breakage is not uncommon.

In the present invention, removal, repair and replacement of the rollers 16 are facilitated by the movable support 18. Referring to the process diagram of Figure 6, the rollers are first supported on support 18, which is movably attached to the roller

assembly. Loosening attachment means 28 lower the support 18 and allows access to the one or more rollers 16 supported thereon. Once lowered, the one or more rollers 16 can be removed individually as needed and replaced. There is no need to replace the entire roller assembly 14. Then, the attachment means 28 is tightened to raise the support 18 and one or more rollers 16 back into engagement with the spin wrench assembly 14.

In a preferred embodiment of the present method, mounting bolts 36 are removed before loosening the attachment means 28 and are re-fastened to the roller assembly 14 after tightening of the attachment means 28. In a further preferred embodiment of the present method, the support 18 is aligned with the roller assembly 14 by means of the guide pins 42 and guide pin holes 44 as it is raised.

In a further preferred embodiment of the present method, the one are more rollers 16 rotatably engage the spin wrench assembly 14 by engaging external rotary connections 38 on the spin wrench assembly with internal rotary connection 40 on the one or more rollers 16.

The lowered support 18 supports the weight of the roller assembly 14 during removal. Such roller assemblies can weigh around 50 pounds (about 23 kg), and typically require the use of a crane or winch line for support during maintenance operations. The tools required for loosening the attachment means 28 and removing a roller 16 in the present invention are those typically carried by an operator during regular rig operations.

The present invention allows for the changeover of single rollers 16, in-situ without the need for secondary methods of supporting the weight of a roller assembly 14 such as a winch line or crane.

In the foregoing specification, the invention has been described with a specific embodiment thereof; however, it will be evident that various modifications and changes may be made thereto without departing from the scope of the invention.

Claims

1. A device for making up or breaking out drill pipe sections, said device comprising:

a) one or more roller assemblies, each roller assembly comprising;

i. a support movably attached to the roller assembly by an attachment means;

ii. one or more rollers supported on the support and rotatably mounted in the roller assembly; and

iii. one or more roller motors,

wherein the support can be raised and lowered relative to the roller assembly by tightening or loosening the attachment means to allow access to the one or more rollers supported on the support.

2. The device of claim 1, wherein the one or more rollers are removed from the roller assembly individually.

3. The device of claim 1, wherein the roller assemblies are spatially arranged and movable relative to one another to define an opening of variable size for receiving drill pipe sections having varying diameters.

4. The device of claim 1, wherein the device comprises two roller assemblies.

5. The device of claim 1, wherein the roller assemblies each comprise two rollers supported on the support.

6. The device of claim 1, wherein the support comprises a base plate and the attachment means comprises a jack screw.

7. The device of claim 6, wherein the jack screw is fastened through a locking collar into a bottom surface of the support.

8. The device of claim 1, further comprising one or more fully removable mounting bolts to secured through the support into the roller assembly.

9. The device of claim 1, wherein the roller assembly further comprises guide pins

and the support further comprises corresponding guide pin holes that engage to align the support with the roller assembly.

10. The device of claim 1, wherein the one or more rollers are rotatably mounted in the roller assembly by means of a driving connection, said driving connection comprising:

a) one or more external rotary connections having a toothed surface and extending from the roller assembly; and

b) a corresponding internal rotary connection having a toothed surface and formed on each roller and engageable with the external rotary connection.

11. The device of claim 10, further comprising chamfered end profiles on the toothed surfaces of the external rotary connection and the internal rotary connection, to allow the toothed surfaces to rotate into engagement with one another.

12. The device of claim 10, wherein the external rotary connections extend at different lengths from the roller assembly such that the one or more roller key shafts engage the one or more external rotary connections in a non-simultaneous manner.

13. A mechanical roughneck system for making up or breaking out drill pipe sections, said system comprising:

a) a clamp assembly movably connected at a lower end of a frame, wherein the clamp assembly comprises a lower clamp for engaging and grasping a first drill pipe section and an upper clamp for engaging and grasping a second drill pipe section;

b) a spin wrench assembly connected to an upper end of the frame, said spin wrench assembly comprising one or more roller assemblies, each roller assembly comprising;

i. a support movably attached to the roller assembly by an attachment means;

ii. one or more rollers supported on the support; and

iii. one or more roller motors,

wherein the support can be raised and lowered relative to the roller assembly by tightening or loosening the attachment means to allow access to the one or more rollers supported on the support.

c) a hydraulic valving to actuate one or more functions of the spin wrench and clamp assembly; and

d) a console to controls the hydraulic valving.

14. The system of claim 13, wherein the clamp assembly is movable to engage the first and second drill pipe sections, and wherein the lower clamp and upper clamp are movable to define a first opening of varying size to accommodate varying drill pipe diameters.

15. The system of claim 13, wherein the upper clamp is in fixed axial alignment with the lower clamp.

16. The system of claim 13, wherein the one or more roller assemblies are spatially arranged and movable relative to one another to define a second opening of variable size for receiving drill pipe sections having varying diameters.

17. The system of claim 13, wherein the hydraulic valving operates horizontal movement of the lower clamp and the upper clamp, horizontal movement of the spin wrench assembly, roller motors and rotation of the upper clamp.

18. The system of claim 13, wherein the hydraulic console has a configuration selected from the group consisting of fixed at the mechanical roughneck, remote wireless, remote hardwired and non-fixed at the mechanical roughneck.

19. The system of claim 13, wherein the one or more rollers are removed from the

roller assembly individually.

20. The system of claim 13, wherein the device comprises two roller assemblies.

21. The system of claim 13, wherein the roller assemblies each comprise two rollers supported on the support.

22. The system of claim 13, wherein the support comprises a base plate and the attachment means comprises a jack screw.

23. The system of claim 13, wherein the jack screw is fastened through a locking collar into a bottom surface of the support.

24. The system of claim 13, further comprising one or more fully removable mounting bolts to secured through the support into the roller assembly.

25. The system of claim 13, wherein the roller assembly further comprises guide pins and the support further comprises corresponding guide pin holes that engage to align the support with the roller assembly.

26. The system of claim 13, wherein the one or more rollers are rotatably mounted in the roller assembly by means of a driving connection, said driving connection comprising:

a) one or more external rotary connections having a toothed surface and extending from the roller assembly; and

b) a corresponding internal rotary connection having a toothed surface and formed on each roller and engageable with the external rotary connection.

27. The system of claim 26, further comprising chamfered end profiles on the toothed surfaces of the external rotary connection and the internal rotary connection, to allow the toothed surfaces to rotate into engagement with one another.

28. The system of claim 26, wherein the external rotary connections extend at

different lengths from the roller assembly such that the one or more roller key shafts engage the one or more external rotary connections in a non-simultaneous manner.

29. A method for changing rollers in a spin wrench assembly, said method comprising the steps of:

a) supporting one or more rollers on a support;

b) movably attaching said support to a roller assembly of the spin wrench assembly by attachment means;

c) loosening attachment means to lower the support and the one or more rollers;

d) removing and replacing individual rollers from the support; and

e) tightening the attachment means to raise the support back into engagement with the roller assembly of spin wrench assembly.

30. The method of claim 29, further comprising:

a) removing one or more mounting bolts that affix the support to the roller assembly, prior to loosening the attachment means; and

b) re-fastening the one or more mounting bolts to affix the support to the roller assembly, after tightening the attachment means.

31. The method of claim 29, further comprising aligning the support with the roller assembly by aligning guide pins on the roller assembly and guide pin holes in the support, when tightening the attachment means to raise the support back into engagement with the roller assembly.

32. The method of claim 29, further comprising rotatably engaging the one are more rollers in the roller assembly by engaging one or more external rotary connections extending from the roller assembly with a internal rotary connection on each of the one or more rollers.

33. The method of claim 32, further comprising rotating the external rotary connection into the internal rotary connection by engaging a chamfered profile of the external rotary connection with a chamfered profile of the internal rotary connection.

34. The method of claim 32, further comprising the steps of:

a) rotatably engaging a first roller in the roller assembly by engaging a first longer external rotary connection extending from the roller assembly with an internal rotary connection on the first roller; and

b) rotatably engaging a second roller in the roller assembly by engaging a second shorter external rotary connection extending from the roller assembly with an internal rotary connection on the second roller.

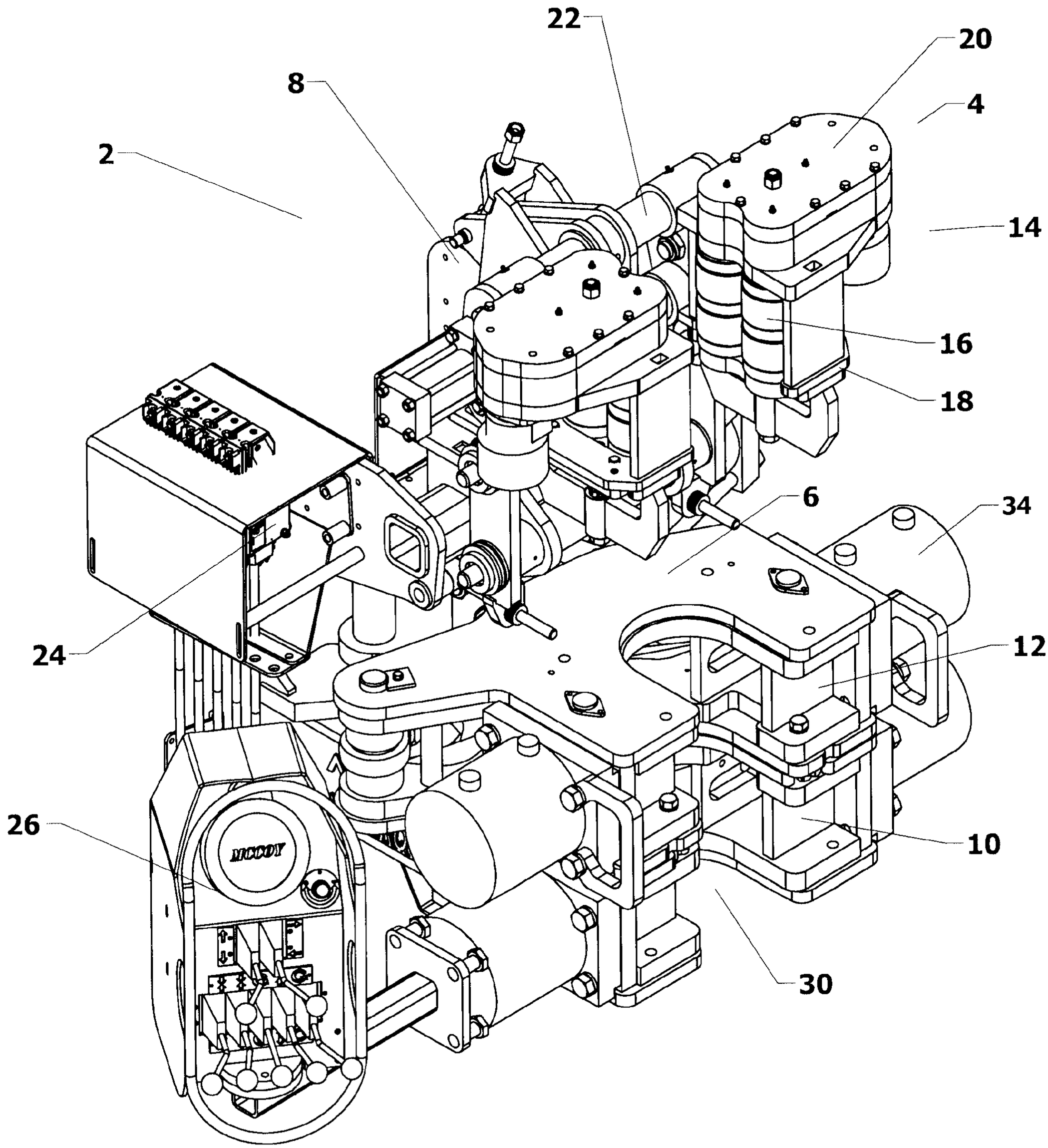


FIGURE 1

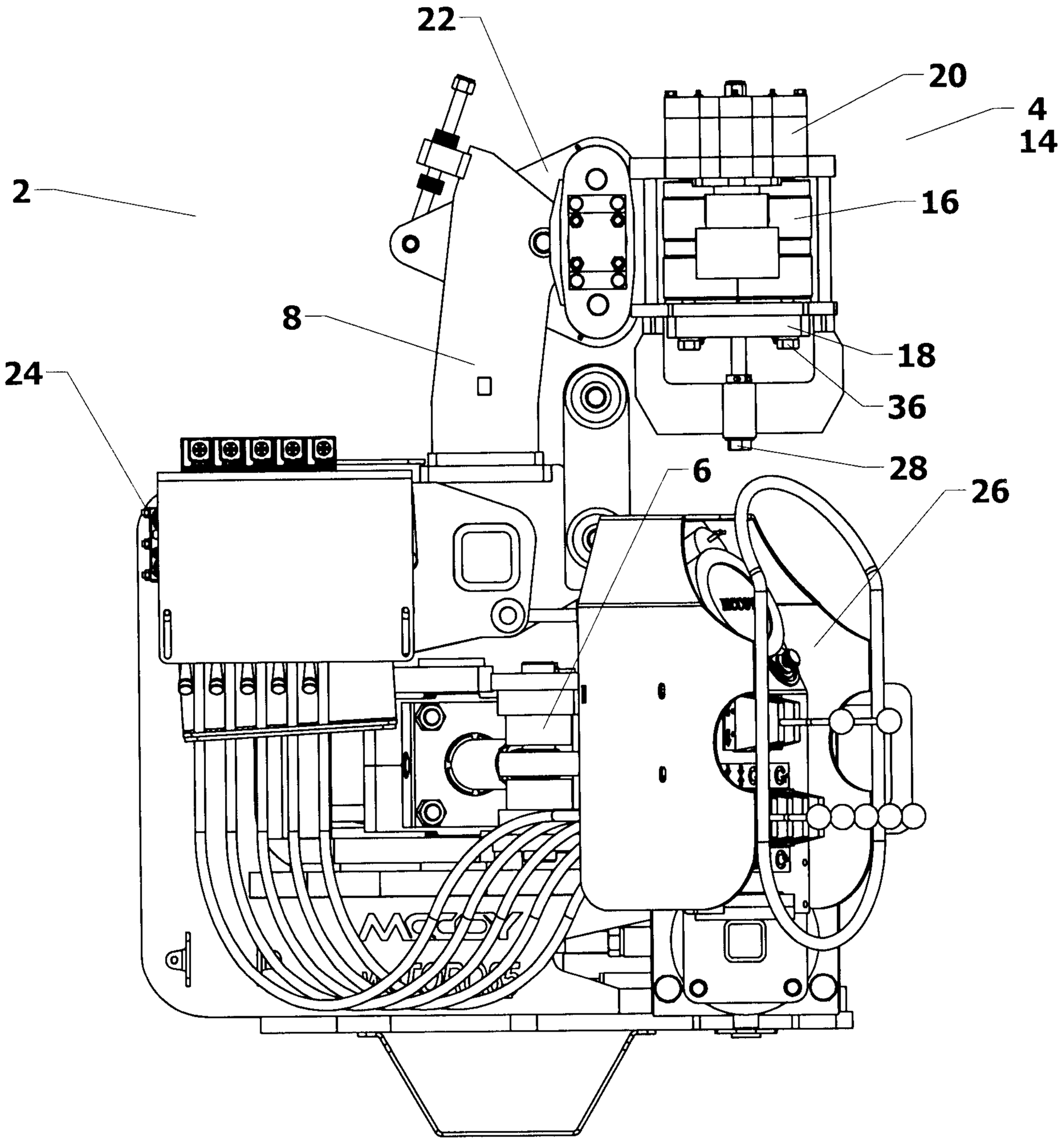


FIGURE 2

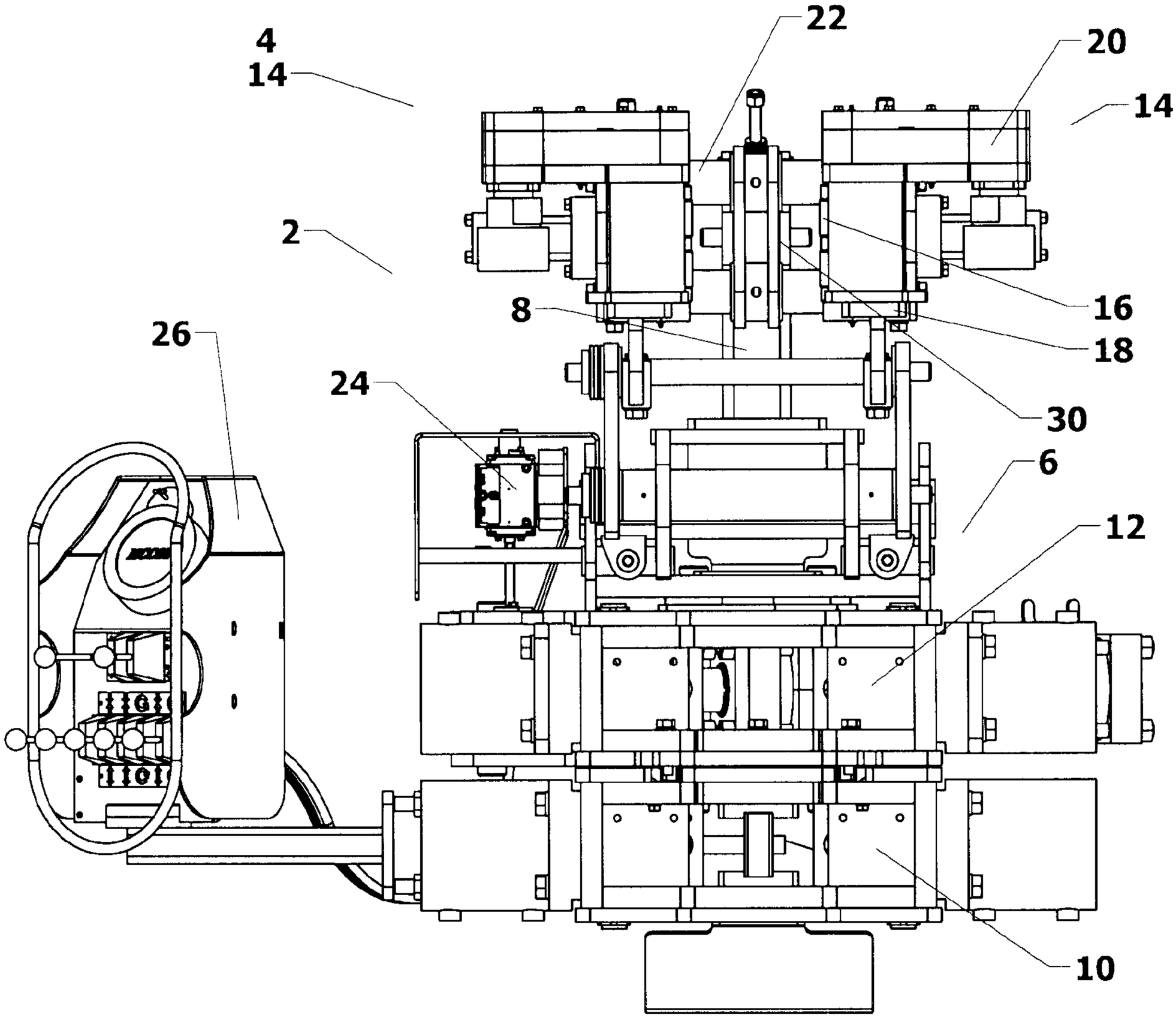


FIGURE 3

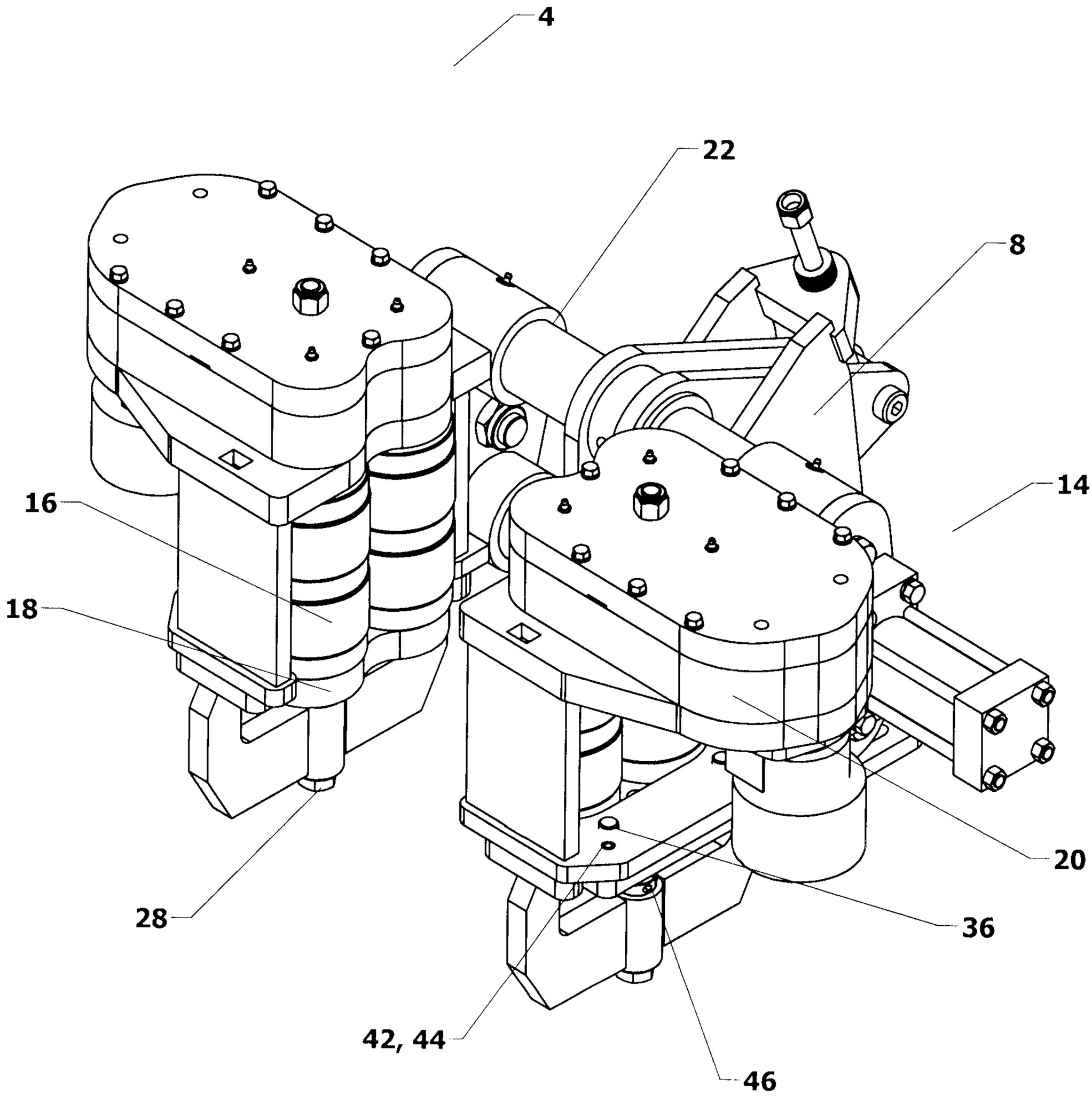


FIGURE 4

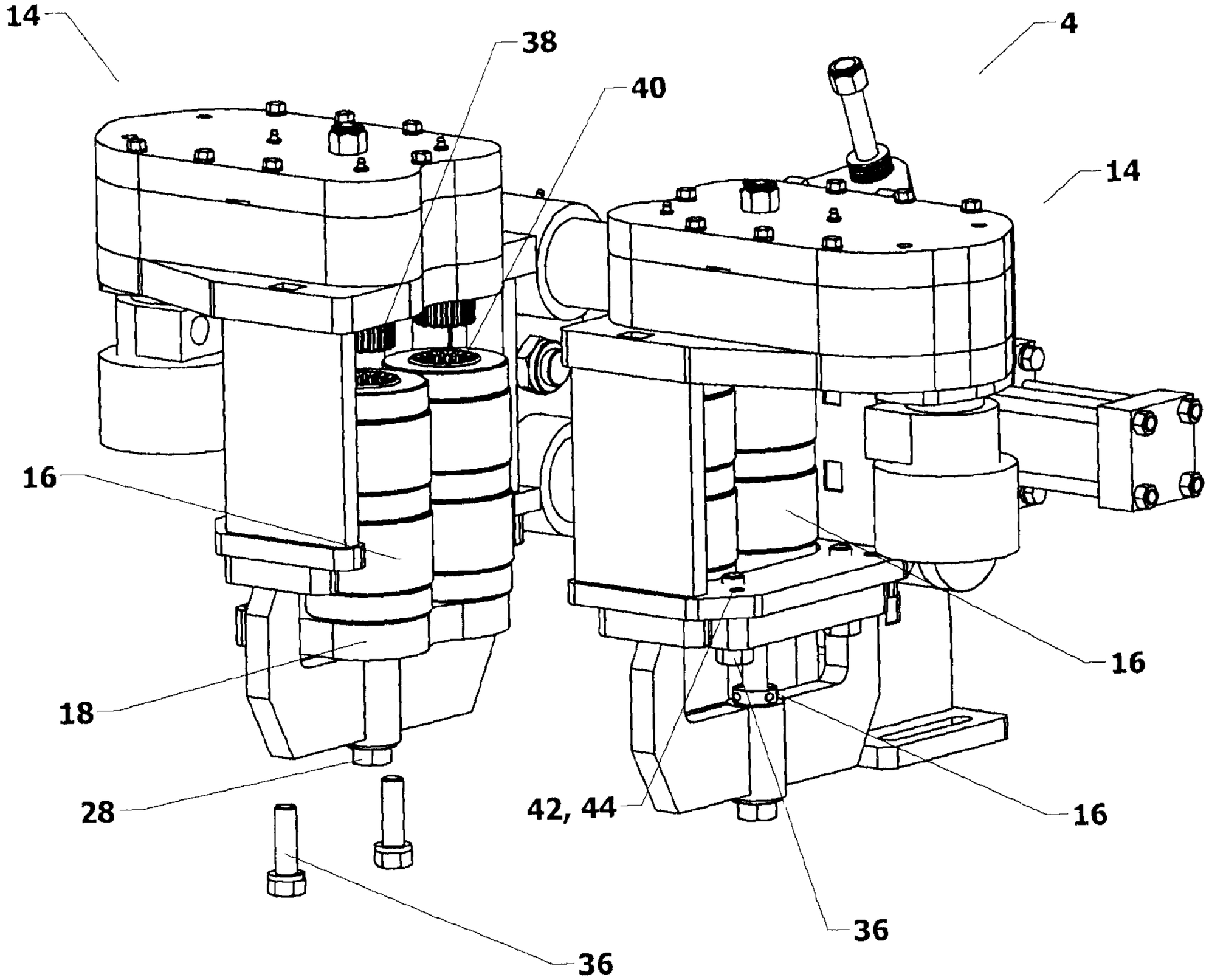
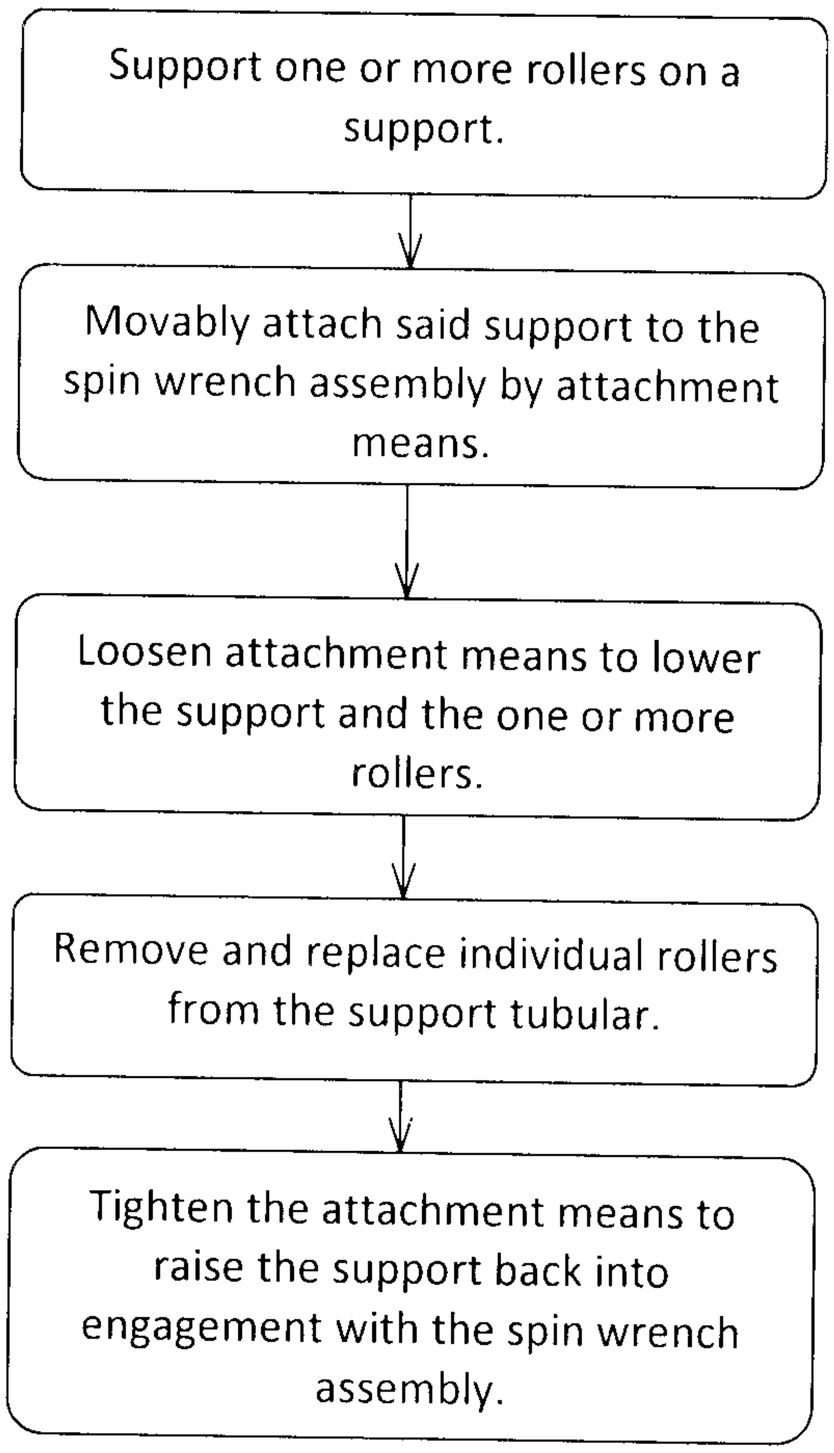
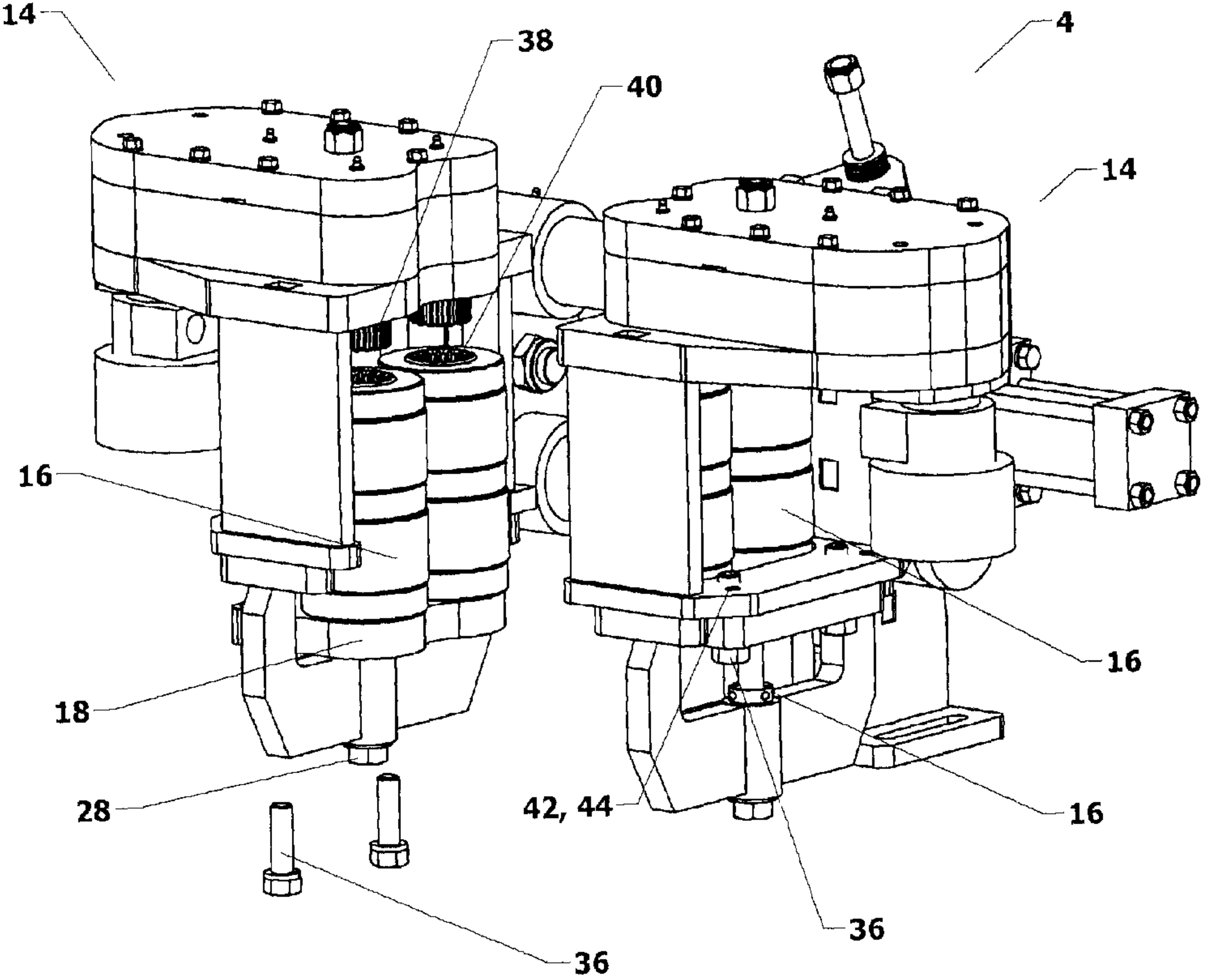


FIGURE 5

Figure 6


Support one or more rollers on a support.
Movably attach said support to the spin wrench assembly by attachment means.
Loosen attachment means to lower the support and the one or more rollers.
Remove and replace individual rollers from the support tubular.
Tighten the attachment means to raise the support back into engagement with the spin wrench assembly.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