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(54) **ROLLER CHAIN WITH CARRIER PLATES**

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(57) **ABSTRACT**

A coiled tube chain assembly is provided designed for use with a carrier gripper block to grip the coiled tubing. The roller chain assembly provides the traction system for use in the coil tubing injector head. The roller chain is comprised of center plates and cover plates that are press fit onto the chain pins. The use of such press fit center plates and cover plates increases the number of link plates holding the chain pin.

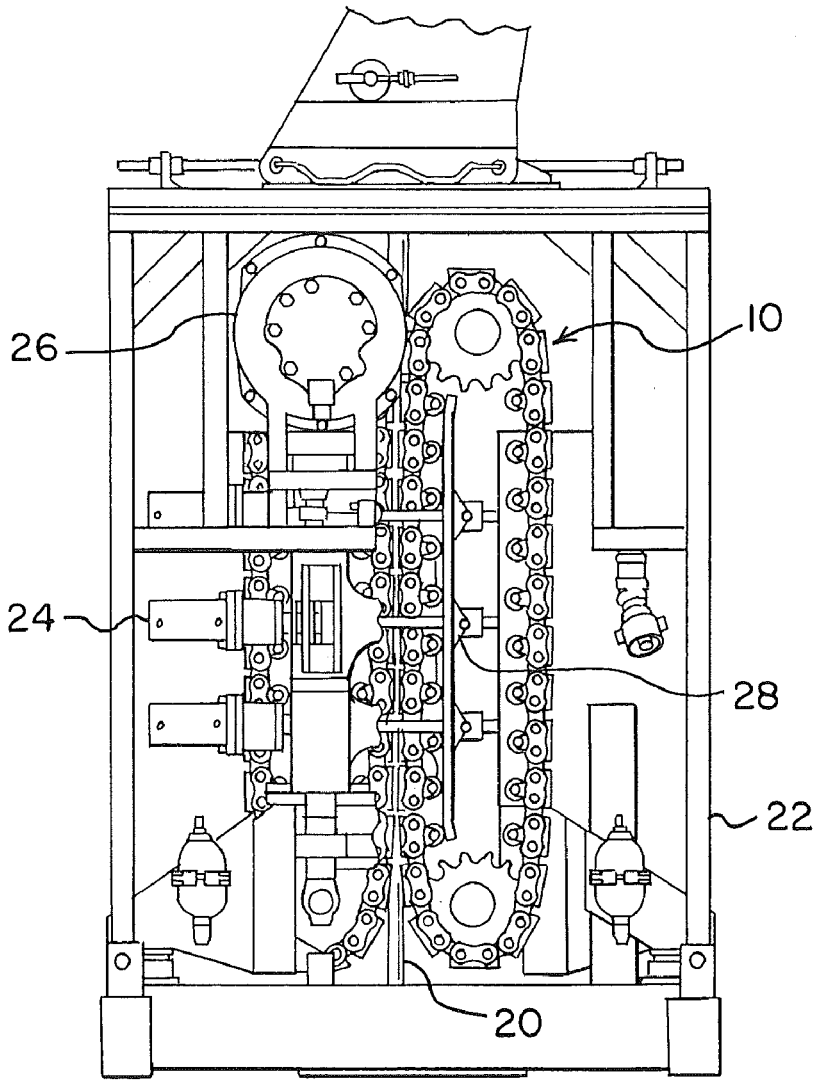


FIG. 1

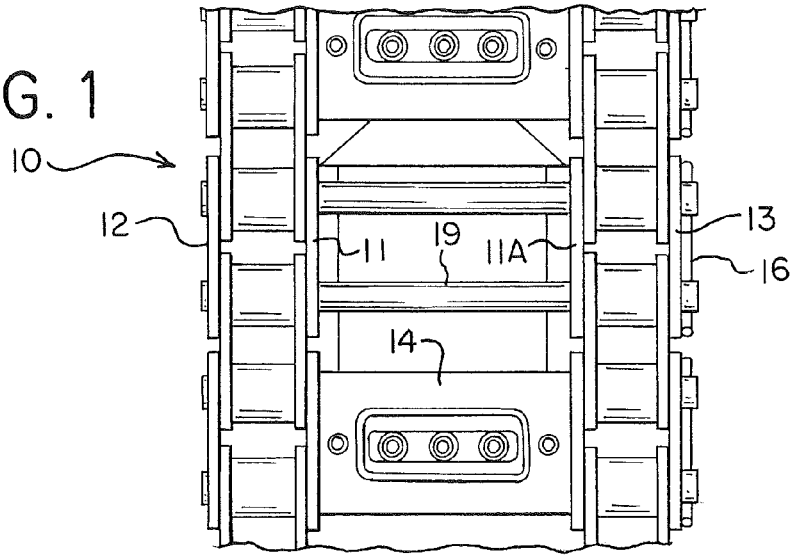


FIG. 2

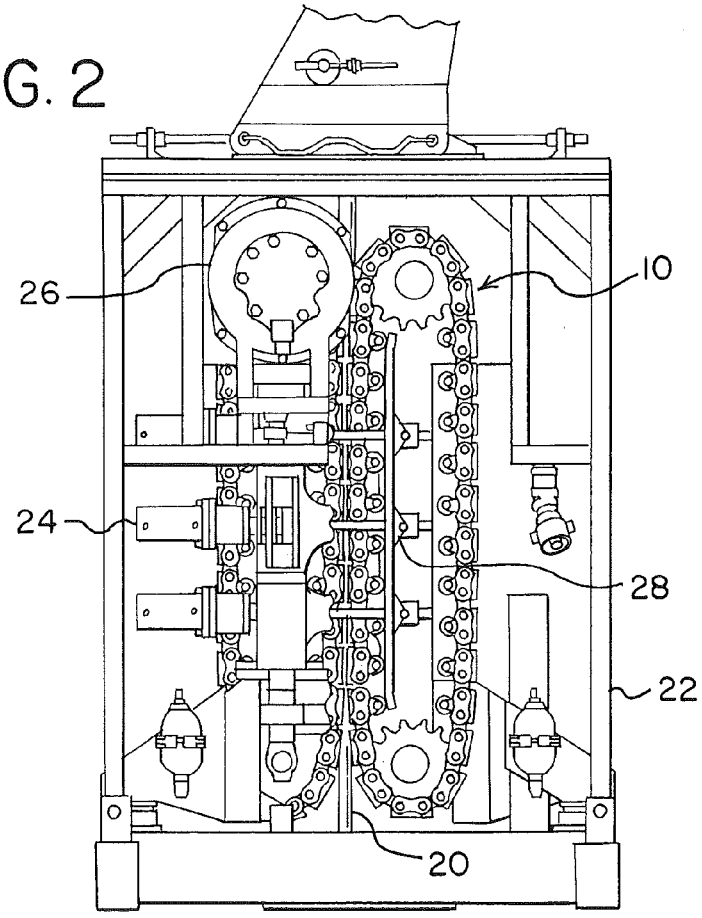


FIG. 3

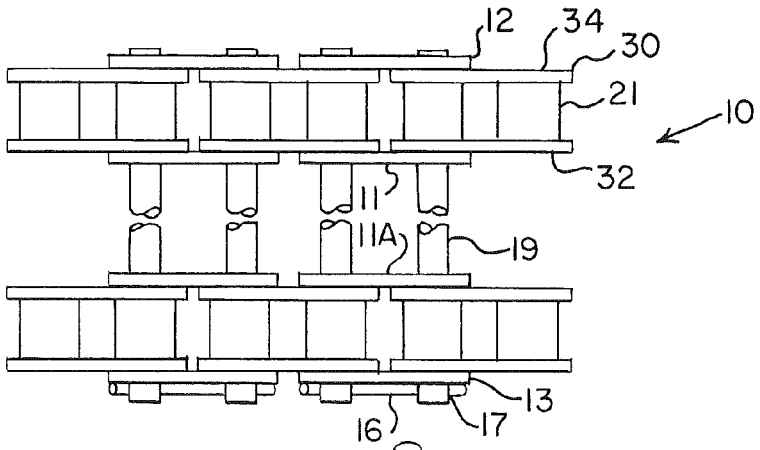


FIG. 4

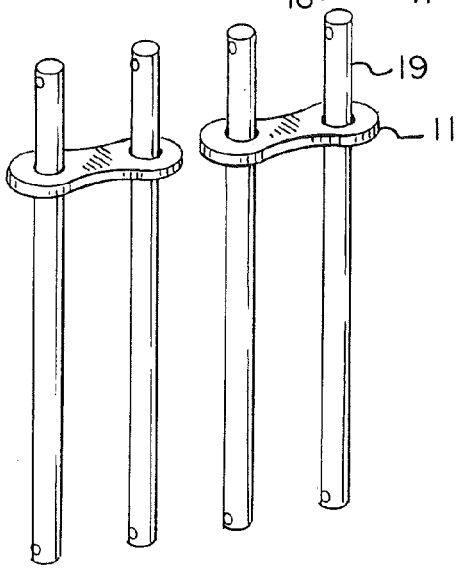


FIG. 5

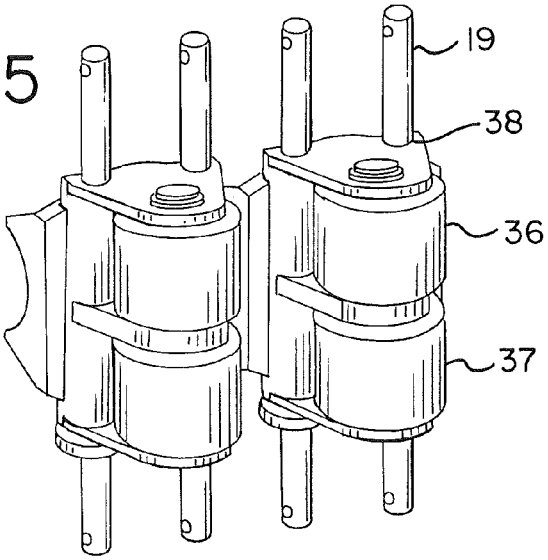


FIG. 6

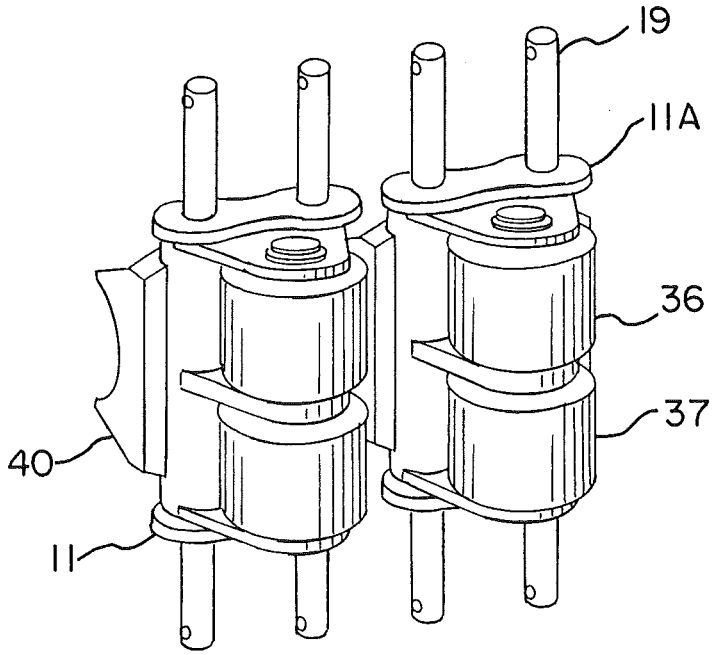


FIG. 7

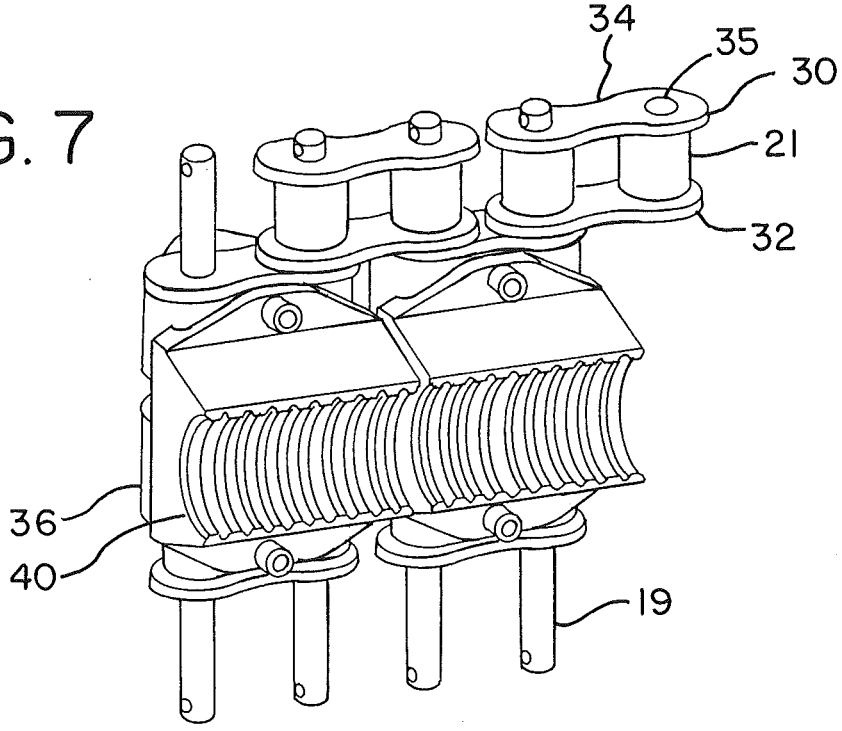


FIG. 8

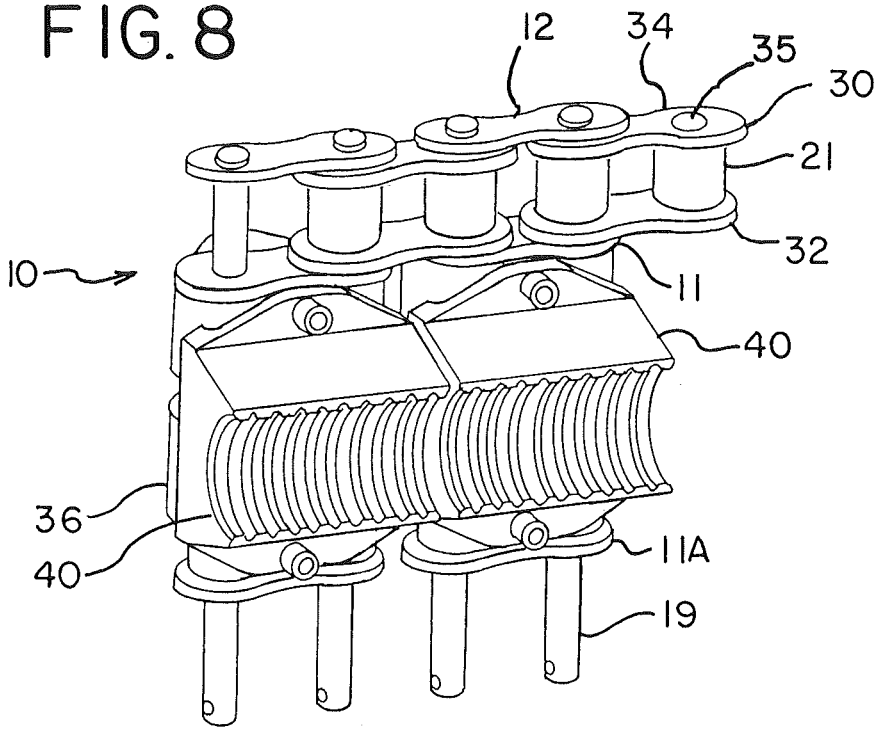

12
34
35
30
21
32
10
11
40
36
40
11A
19

FIG. 9

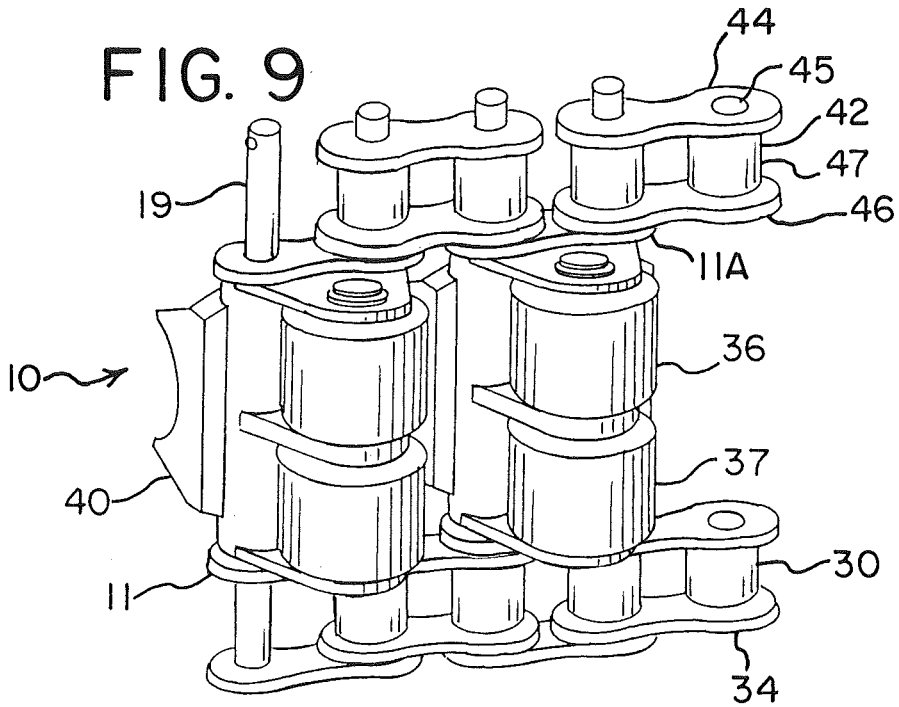

44
45
42
47
46
19
11A
36
10
37
40
30
11
34

FIG. 10

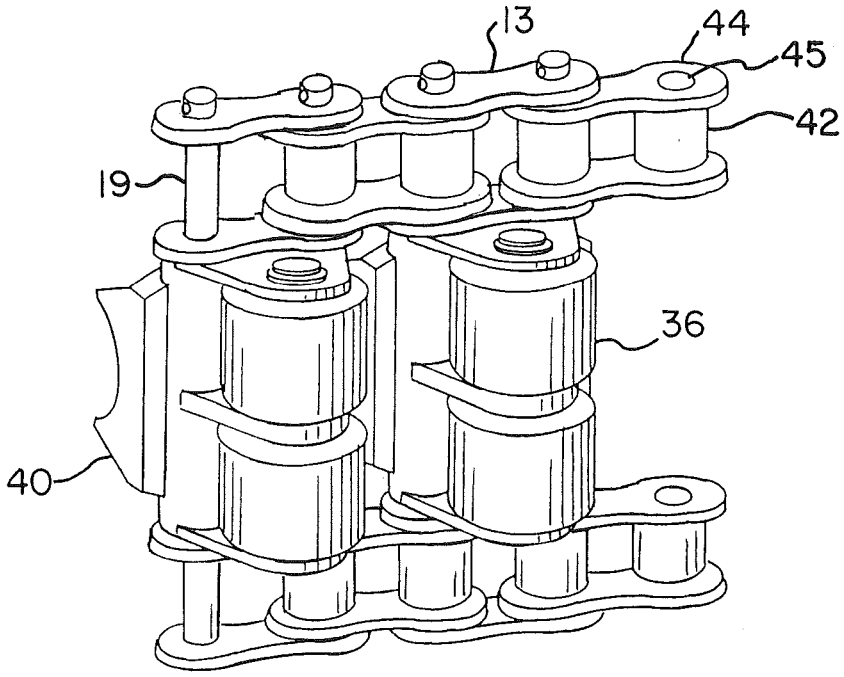
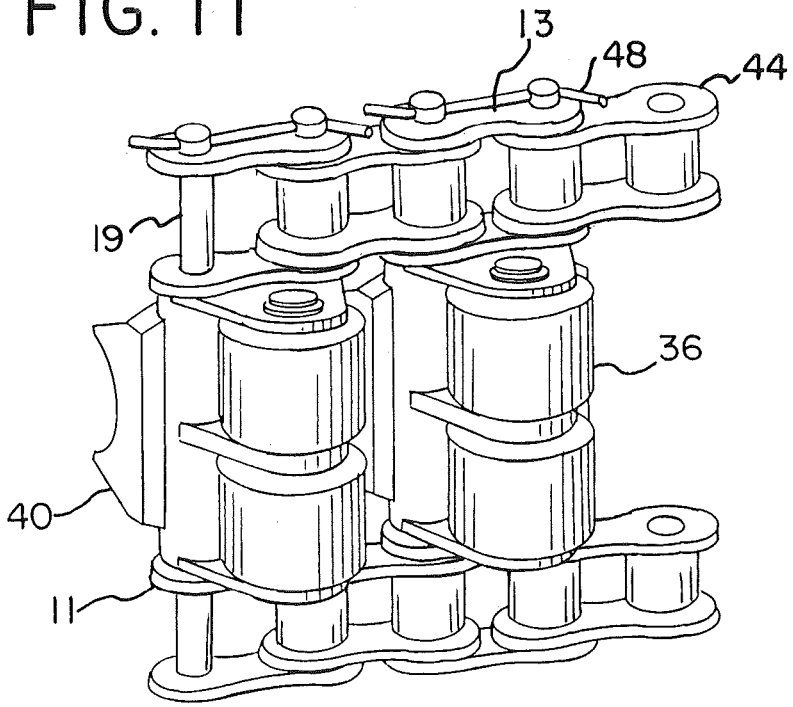


FIG. 11



ROLLER CHAIN WITH CARRIER PLATES

BACKGROUND OF THE INVENTION

[0001] The present invention relates generally to coiled tubing injector apparatus for inserting and removing coiled tubing from a well. More particularly, the present invention relates to a traction system for use in the coiled tubing injector apparatus wherein the traction system includes a roller chain and carrier gripper block assembly.

[0002] Coiled tubing operations are growing in use as compared to traditional well drilling operations. The ability to inject coiled tubing with increased diameter has added to the use of such operations. Coiled tubing injector assemblies typically comprise an injector head, a spool reel for transporting the coiled tubing, and some type of hydraulic power apparatus or other power apparatus. The injector head grips the coil tubing through a series of grippers powered by a roller chain. The roller chain includes a carrier gripper block assembly which provides force to grip and move the tubing as necessary to complete the insertion and removal.

[0003] It is an object of the present invention to provide an improved roller chain traction system for use with a carrier gripper block assembly for use in a coiled tubing injector head.

SUMMARY OF THE INVENTION

[0004] The present invention provides an improved roller chain assembly for use as part of a coiled tubing injector apparatus. The improved roller chain assembly includes a carrier gripper block to grip the tubing in the injector head.

[0005] The carrier gripper block transmits the squeezing force for the injector traction system, which is usually hydraulic but can utilize other types of force. Force is transmitted from the skate plate to the roller chain to the carrier gripper block to grip the tubing. Due to the force on the carrier gripper block in gripping the chain for injection, the roller chain pins are subjected to high forces. The roller chain pins can experience bending moments as the chain articulates around the sprockets that are part of the traction system.

[0006] The present invention utilizes roller chain with center plates and cover plates that are press fit onto the chain pins. Such press fitting better supports length of the chain pins across the width of the chain, which must be wide enough to accommodate the carrier gripper block, and thus reduces the pin bending moment by the loading from the carrier gripper blocks. This results in an increase in fatigue strength of the chain pins.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] In the drawings,

[0008] FIG. **1** is a side view of a portion of a roller chain gripper block assembly;

[0009] FIG. **2** is a side view of a injector head including the roller chain carrier/gripper block assembly;

[0010] FIG. **3** is a side view of the roller chain in accordance with a first embodiment of the present invention;

[0011] FIG. **4** is a perspective view of a roller chain with chain pins and center plates being press fit thereon;

[0012] FIG. **5** is a perspective view of a roller chain in accordance with the first embodiment of the present invention having chain pins with a carrier block and rollers;

[0013] FIG. **6** is a perspective view of a roller chain in accordance with the first embodiment of the present invention with the carrier block assembly and second center plates being press fit onto the chain pins;

[0014] FIG. **7** is a side view of a roller chain carrier block assembly in accordance with the first embodiment of the present invention further including roller links applied to the chain pins;

[0015] FIG. **8** is a side view of a roller chain gripper block assembly in accordance with the first embodiment of the present invention further including cover plates press fit onto chain pins;

[0016] FIG. **9** is a perspective view of a roller chain gripper block assembly in accordance with the first embodiment of the present invention further including a second roller link assembly being applied to chain pins;

[0017] FIG. **10** is a perspective view of a roller chain carrier block assembly in accordance with the first embodiment of the present invention further comprising cover plates press fit onto chain pins, and

[0018] FIG. **11** is a perspective view of a roller chain gripper block assembly in accordance with the first embodiment of the present invention further comprising cotter pins being placed through lateral openings in the ends of chain pins.

DETAILED DESCRIPTION OF THE INVENTION

[0019] Referring now to FIGS. **1** and **3** of the drawings, a roller chain gripper block assembly is shown generally at **10**. Such roller chain gripper block assembly is seen to comprise a plurality of chain pins **19**, with adjacent chain pins **19** joined by press fit center plates **11** and **11***a*. The press fitting of such center plates requires the use of a mechanical device, usually a hydraulic press as the openings in the center plates **11** and **11***a* are only a very small interference in diameter smaller than the diameter of chain pin **19** itself. Such interference is usually 0.0025 inch (0.064 mm).

[0020] Two identical chain assemblies are shown, with chain assembly roller link **30** comprised of laterally adjacent link plates **32** and **34**, with roller **21** there between. It should be understood that rollers **21** have openings such that chain pins **19** fit there through. Further, link plates **32** and **34** have openings such that chain pins **19** fit there through with sufficient tolerance with openings in link plates **32** and **34** to allow roller link **30** to flex about chain pins **19**. Finally, cover plate **12** is press fit onto ends of chain pins **19**. Openings in cover plate **12** are of a diameter slightly greater than the diameter of chain pin **19** such that cover plate **12** must be press fit onto the ends of chain pin **19** by a mechanical means such as a hydraulic press. Similarly, at the other side of roller chain gripper block assembly **10**, with a second roller link assembly mounted onto adjacent chain pins **19**, it can be seen that cover plate **13** is press fit onto adjacent ends of chain pins **19**. The openings in cover plate **13** are again of a smaller diameter than the chain pin **19** diameter such that the placement of cover plate **13** onto chain pins **19** requires a mechanical device such as a hydraulic press. Such interference across the diameter is usually 0.006 inch (0.152 mm). Finally, cotter pin **16** can be utilized and placed through lateral openings **17** in chain pins **19** to secure those ends of chain pin **19** outside cover plate **13**. It should be mentioned here that other ends of chain pins **19** are stamped to a larger diameter such that cover plates **12** are held in

place by such increased stamp diameter of the end chain pins **19**, which acts to secure cover plates **12** in addition to press fit of cover plate **12** onto chain pin **19** ends.

[0021] It should be here explained that the preferred material for chain pins **19** is a steel rod, usually a AISI 8640 or other medium carbon alloy steel. Further, the usual materials for center plates **11** and **11***a*, and cover plates **12** and **13** are a stamped steel, usually a AISI 5140 or another medium carbon alloy steel. Finally, rollers **21** are a section of a cylindrical tube, usually comprised of a AISI 10B21 or other low carbon high alloy steel.

[0022] Referring now to FIG. **2**, a typical roller chain gripper block assembly is shown at **10** located within a injector head frame **22**. Tubing itself is shown at **20** and is seen to be grasped by the carrier block grippers which themselves are pressed into engagement with tubing **20** by gripper block loading cylinders **24**. A hydraulic or other motor is shown at **26** to power sprockets to drive gripper block chain thereby enabling tubing **20** to be inserted or withdrawn as needed.

[0023] Referring now to FIGS. **4-11** the steps in assembling roller chain for use in roller chain gripper block assembly **10** are set forth. The initial step includes providing a plurality of chain pins **19**, and press fitting center plates over adjacent chain pins **19** in a mechanical operation usually requiring a use of a hydraulic press. The openings in center plates **11** are only very slightly smaller, to an interference of usually 0.0025 inch (0.064 mm) smaller than the diameter of chain pins **19** which requires that the center plates be press fit onto chain pins **19**. The next step is shown in FIG. **5** wherein carrier blocks **36** are places over adjacent chain pins **19**. Carrier blocks **36** include carrier block rollers **37**. Openings **38** in carrier block **36** are sufficiently larger in diameter than the diameter of chain pins **19** such that carrier blocks may be placed onto adjacent pins **19** without the use of a mechanical device.

[0024] Referring now to FIG. **6**, a second center plate **11***a* is press fit onto the other ends of adjacent chain pins **19**. Again, as with center plates **11**, the openings in center plates **11***a* are only slightly larger in diameter than the diameter of chain pins **19** whereby center plates **11***a* must be press fit using a mechanical device, usually a hydraulic press to enable the center plates to be placed onto adjacent chain pins **19**. Also shown in FIG. **6** are carrier block grippers **40**. Carrier block grippers **40** are utilized to grasp coil tubing **20** in thus inserted or withdrawn in the drilling operation.

[0025] Referring now to FIG. **7**, a first roller link **30** is placed onto ends of roller pins **19**. Roller link **30** is seen to comprise link plates **32** and **34**, with rollers **21** in between. Further openings **35** in roller link plate **34** with a similar opening in roller link plates **32** are of a diameter larger than the diameter of chain pin **19** such that roller assembly **21** can rotate about chain pins **19**.

[0026] Referring now to FIG. **8**, a cover plate **12** is seen to be press fit by a mechanical means, usually a hydraulic press, over the ends of chain pins **19**. Openings in cover plate **12** are smaller in diameter than the diameter of chain pins **19** in the order of 0.006 inch (0.152 mm), such that cover plate **12** must be press fit onto the end of chain pins **19** using a mechanical device such as a hydraulic press.

[0027] Referring now to FIG. **9**, roller chain gripper block assembly **10** is seen to have a second roller link assembly **42** placed onto the other ends of chain pins **19**. Roller link **42** is seen to be comprised of link plate **44** and **46**, with roller **47** held there between. Link plate **44** includes an opening **45** of a diameter larger than the diameter of chain pin **19** such that when roller link assembly **42** is placed on adjacent chain pins **19**, chain pins **19** can rotate therein.

[0028] Referring now to FIGS. **10** and **11**, cover plate **13** is seem to be press fit onto ends of chain pins **19**. Should be understood that cover plate **13** includes openings that are slightly larger than diameter than the diameter of chain pins **19** such that the application of cover plates **13** onto the ends of chain pins **19** requires a mechanical press fit operation, usually involving use of a hydraulic press. Finally, cotter pin **48** are placed through lateral openings in the ends of chain pins **19** to further secure cover plates **13** thereon.

[0029] It should be understood that the press fitting of center plates **11** and **11***a*, and cover plates **12** and **13** act to secure the holding of chain pins **2** for plates per chain pin thus increasing the rotational force required to turn a chain pin while in service in a roller chain gripper block assembly **10**.

[0030] A summary of the assembly of a roller chain gripper block assembly **10** will now be provided. Two chain pins **19** are placed into press fitting hydraulic press. Lubricating oil is placed on top of chain pins **19** and center plate **11** is placed over the ends of adjacent chain pins **19**. This operation is repeated for all the necessary chain pins in the length of the roller chain required for the roller chain gripper block assembly **10**. A carrier block **36** with rollers is then placed over ends of adjacent chain pins **19**. The openings in carrier block **36** are sufficient to allow rotation of chain pins **19** therein. The carrier block is slid down all the way over chain pins **19** to fit adjacent center plate **11**.

[0031] Now using gear oil lubricate the opposite top of chain pins **19**, second center plates **11***a* are press fit thereon. This is repeated for the entire length of the roller chain as necessary for the roller chain gripper block assembly **10**. A second set of roller links are then slid over the chain pin ends **19** a second set of roller links **42** is then placed over the ends of chain pins **19**.

[0032] A cover plate **12** is then press fit over the ends of chain pins **19** to secure the first carrier block **36** thereon. The second roller link is then assembled over then placed over the ends of second roller link **42** is then placed of the other ends of chain pins **19**, with cover plates **13** then press fit over the ends of chain pins to secure the roller link **42** assembly in place.

1. A method of assembling a roller chain gripper block assembly comprising the steps of:

providing a plurality of chain pins and first center plates, with each first center plates having two pin openings, and press fitting one first center plate onto two adjacent chain pins such that a portion of each chain pin extends through one of the first center plate pin openings,

providing a plurality of carrier block sections, with each carrier block section having a first side and a second side and two pin openings,

and fitting a carrier block section onto two adjacent chain pins such that a portion of each chain pin extend through one of the carrier block pin openings and a first side of the carrier block section is adjacent the first center plate,

providing a plurality of second center plates, with each second center plate having two pin openings, and press fitting one second center plate onto two adjacent chain pins to seat adjacent the second side of the carrier block

section such that a portion of each chain pin extends through one of the second center plate pin openings,

providing a plurality of first roller links, each first roller link having two pin openings, and fitting one first roller link onto two adjacent chain pins such that a portion of each chain pin extends through one of the first roller link pin openings,

providing a plurality of first plates, with each first cover plate having two pin openings, and press fitting one first cover plate onto two adjacent chain pins such that a portion of each chain pin extends through one of the first cover plate pin openings,

providing a plurality of second roller links, each second roller link having two pin openings, and fitting one second roller link onto two adjacent chain pins such that a portion of each chain pin extends through one of the second roller link pin openings,

and providing a plurality of second cover plates, with each second cover plate having two pin openings, and press fitting the second cover plate onto two adjacent chain pins such that a portion of each chain pin extends through one of the second cover plate pin openings.

2. The method of claim **1**

further comprising providing a lateral opening through each chain pin near each end of the chain pin,

and placing a cotter pin through each lateral opening after the assembly of the roller chain gripper block assembly.

3. The method of claim **1**

wherein each chain pin is shot peened prior to assembly in the roller chain gripper block assembly.

4. The method of claim **1**

wherein each press fitting operations for the center places and the cover is accomplished with the use of a mechanical press.

5. The method of claim **1** wherein

each press fitting operation for the center plates and the cover plates is accomplished with the use of a hydraulic press.

6. A method of assembling a roller chain gripper block assembly comprising the steps of:

providing a plurality of chain pins and first center plates, with each first center plates having two pin openings, and press fitting one first center plate onto two adjacent chain pins such that a portion of each chain pin extends through one of the first center plate pin openings,

providing a plurality of carrier block sections, with each carrier block section having a first side and a second side and two pin openings,

and fitting a carrier block section onto two adjacent chain pins such that a portion of each chain pin extend through one of the carrier block pin openings and a first side of the carrier block section is adjacent the first center plate,

providing a plurality of second center plates, with each second center plate having two pin openings, and press fitting one second center plate onto two adjacent chain pins to seat adjacent the second side of the carrier block section such that a portion of each chain pin extends through one of the second center plate pin openings,

providing a plurality of first roller links, each first roller link having two pin openings, and fitting one first roller link onto two chain pins in adjacent carrier block sections,

such that a portion of each chain pin extends through one of the first roller link pin openings,

providing a plurality of first plates, with each first cover plate having two pin openings, and press fitting one first cover plate onto two adjacent chain pins such that a portion of each chain pin extends through one of the first cover plate pin openings,

providing a plurality of second roller links, each second roller link having two pin openings, and fitting one second roller link onto two adjacent chain pins such that a portion of each chain pin extends through one of the second roller link pin openings,

and providing a plurality of second cover plates, with each second cover plate having two pin openings, and press fitting the second cover plate onto two adjacent chain pins such that a portion of each chain pin extends through one of the second cover plate pin openings.

7. The method of claim **6**,

further comprising providing a lateral opening through each chain pin near each end of the chain pin, and placing a cotter pin through each lateral opening after the assembly of the roller chain gripper block assembly.

8. The method of claim **6**,

wherein each chain pin is shot peened prior to assembly in the roller chain gripper block assembly.

9. The method of claim **6**,

wherein each press fitting operation for the center places and the cover is accomplished with the use of a mechanical press.

10. The method of claim **6** wherein

each press fitting operation for the center plates and the cover plates is accomplished with the use of a hydraulic press.

11. A roller chain gripper block assembly comprising:

a plurality of chain pins and first center plates, with each first center plates having two pin openings, wherein one first center plate is press fitted onto two adjacent chain pins such that a portion of each chain pin extends through one of the first center plate pin openings,

a plurality of carrier block sections, with each carrier block section having a first side and a second side and two pin openings,

and wherein a carrier block section is fitted onto two adjacent chain pins such that a portion of each chain pin extends through one of the carrier block pin openings and a first side of the carrier block section is adjacent the first center plate,

a plurality of second center plates, with each second center plate having two pin openings, and wherein one second center plate is press fitted onto two adjacent chain pins to seat adjacent the second side of the carrier block section such that a portion of each chain pin extends through one of the second center plate pin openings,

a plurality of first roller links, each first roller link having two pin opening, and wherein one first roller link is fitted onto two chain pins in adjacent carrier block sections, such that a portion of each chain pin extends through one of the first roller link pin openings,

a plurality of first cover plates, with each first cover plate having two pin openings, and wherein one first cover plate is press fitted onto two adjacent chain pins such that a portion of each chain pin extends through one of the first cover plate pin openings,

a plurality of second roller links, each second roller link having two pin openings, and wherein one second roller link is fitted onto two adjacent chain pins such that a portion of each chain pin extends through one of the second roller link pin openings,

and a plurality of second cover plates, with each second cover plate having two pin openings, and wherein one second cover plate is press fitted onto two adjacent chain pins such that a portion of each chain pin extends through one of the second cover plate pin openings.

12. The assembly of claim **11**

further comprising a lateral opening through each chain pin near each end of the chain pin,

and a cotter pin through each transverse opening.

13. The assembly of claim **11**,

wherein each chain pin is shot peened prior to assembly in the roller chain gripper block assembly.

14. The method of claim **11**,

wherein each press fitting for the center plates and the cover is accomplished with the use of a mechanical press.

15. The method of claim **11** wherein

each press fitting for the center plates and the cover plates is accomplished with the use of a hydraulic press.

* * * * *