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(54) APPARATUS FOR HANDLING TUBULARS

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(57) **ABSTRACT**

A tubular handling tool is taught for use as an elevator, comprising one or more slips movably retained by one or more upper and lower rings, wherein the upper and lower rings provide constraint against radial expansion forces. A frame is taught for an elevator comprising one or more upper and lower rings and one or more removable means for connecting the upper and lower rings and attaching the frame to a top drive. A tubular handling tool is taught for use as a top mount spider comprising one or more slips movably retained by one or more upper and lower rings, wherein the upper and lower rings provide constraint against radial expansion forces. A tubular handling tool is taught for use as a flush mount spider comprising one or more slips movably retained on an upper ring and a lower ring. A slip is taught comprising a movable sliphead.

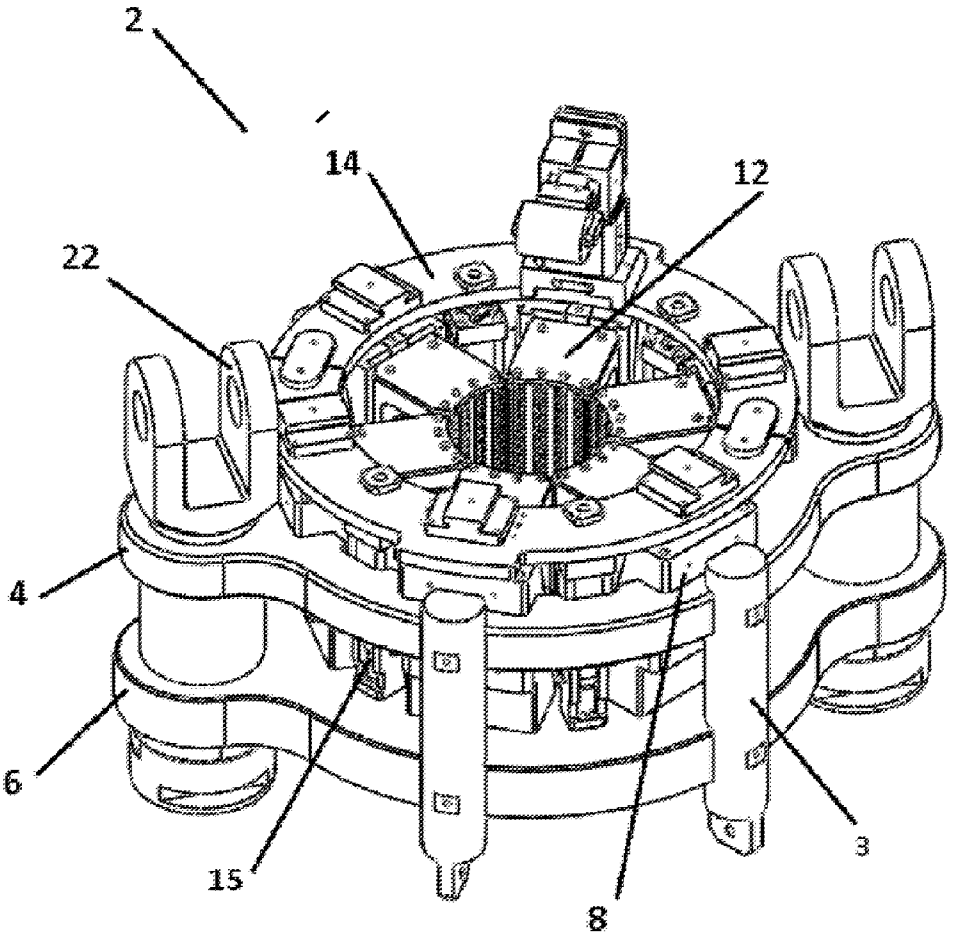


FIG. 1

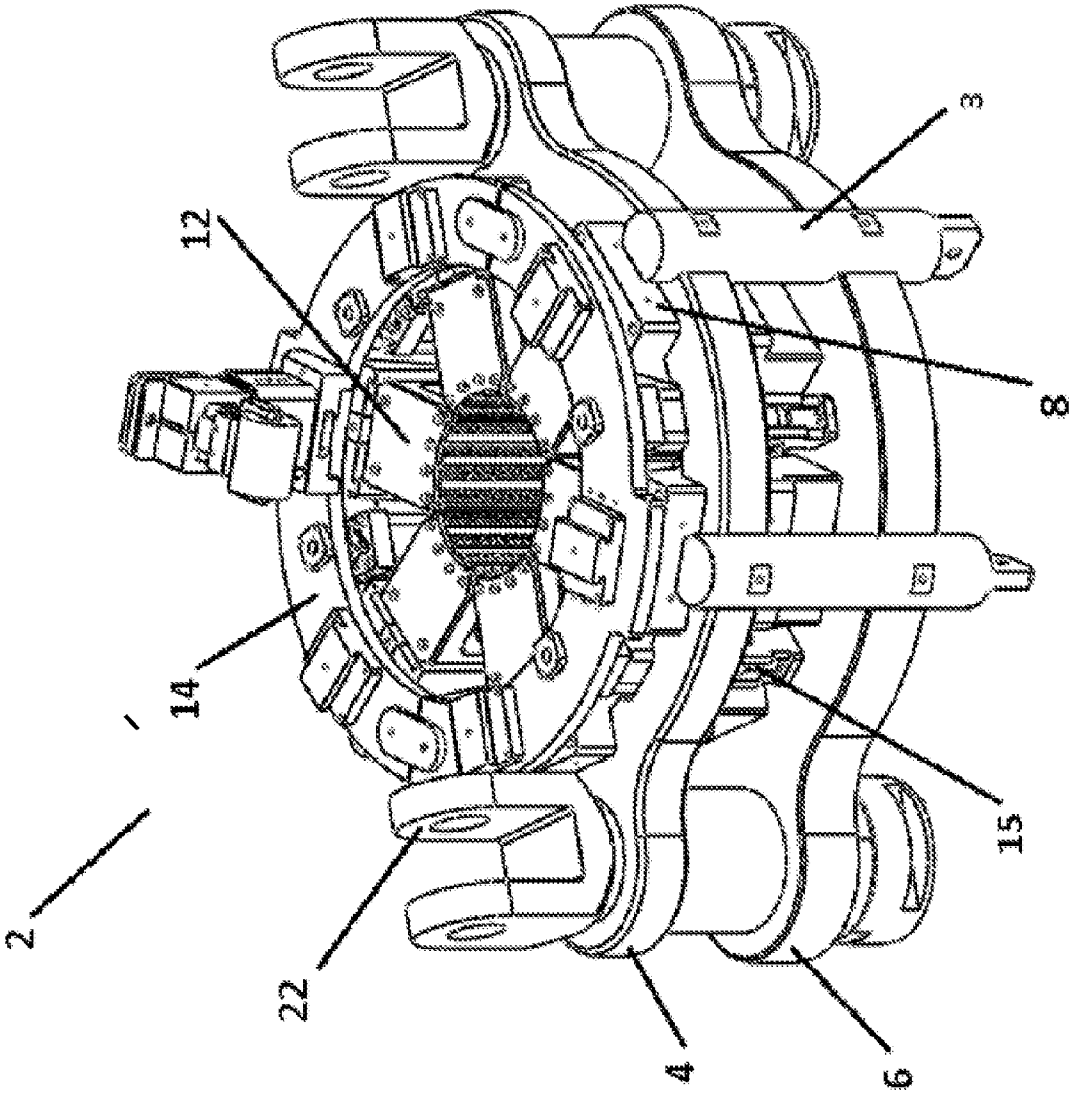
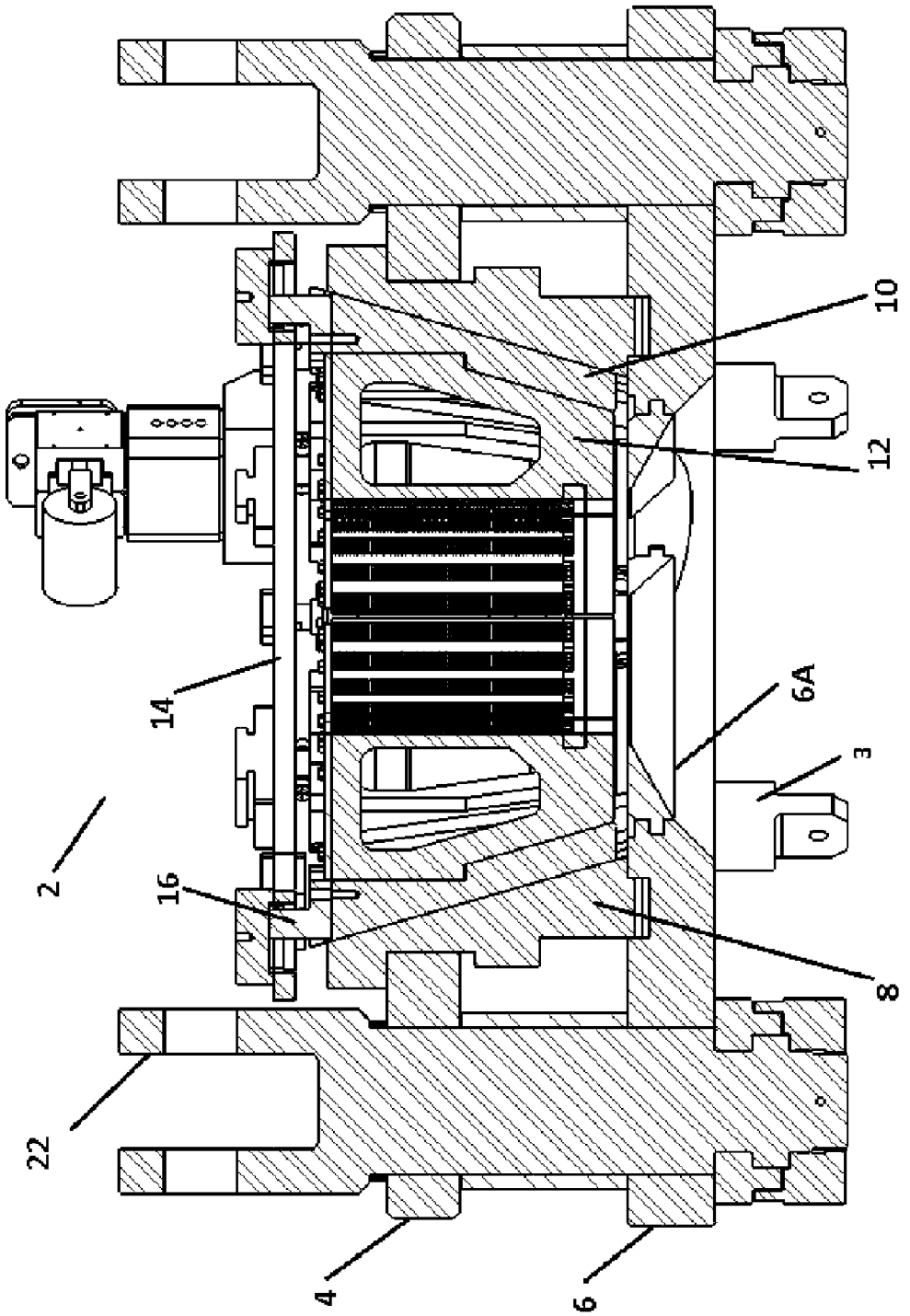


FIG. 2



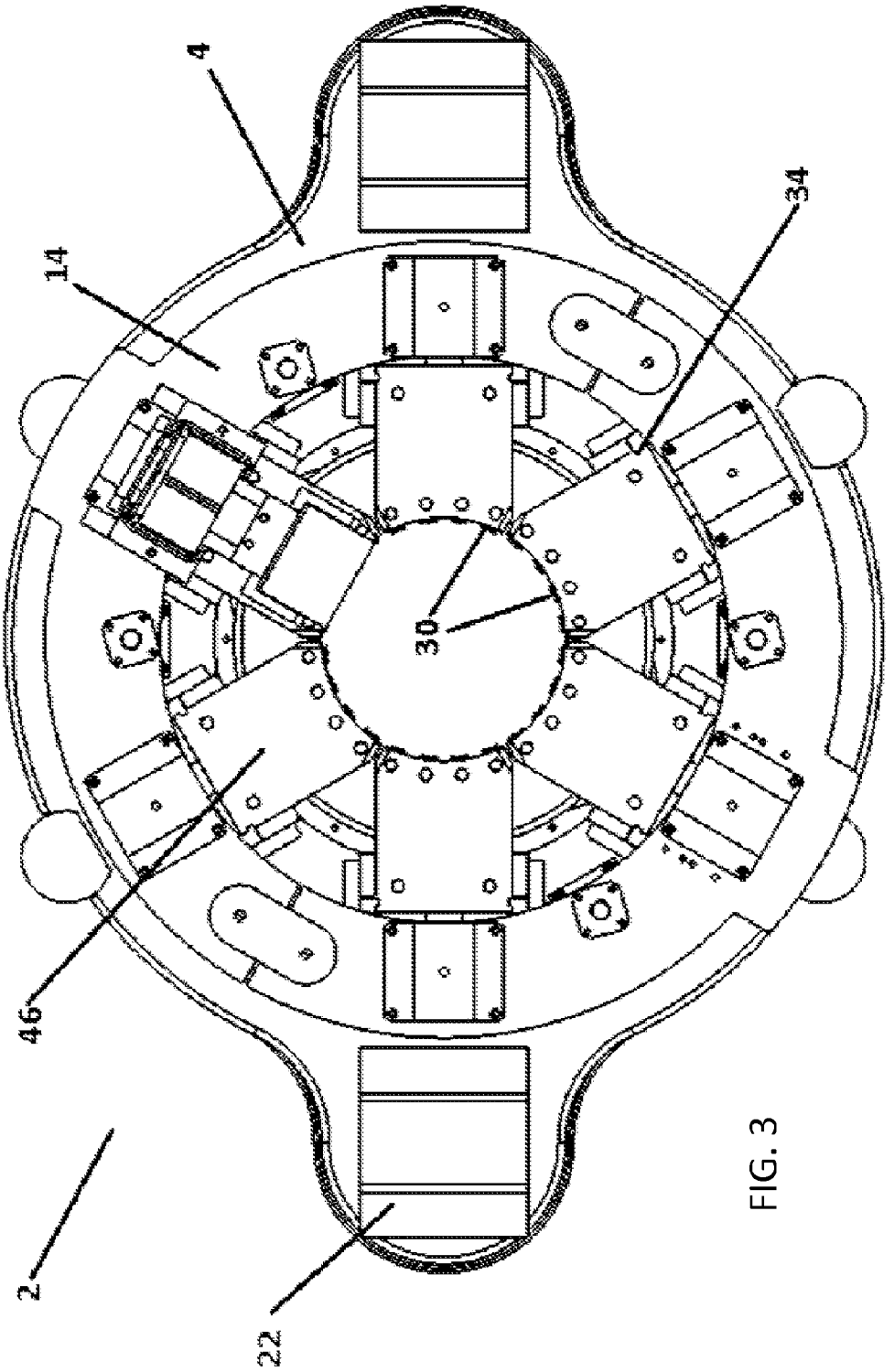


FIG. 3

FIG. 4

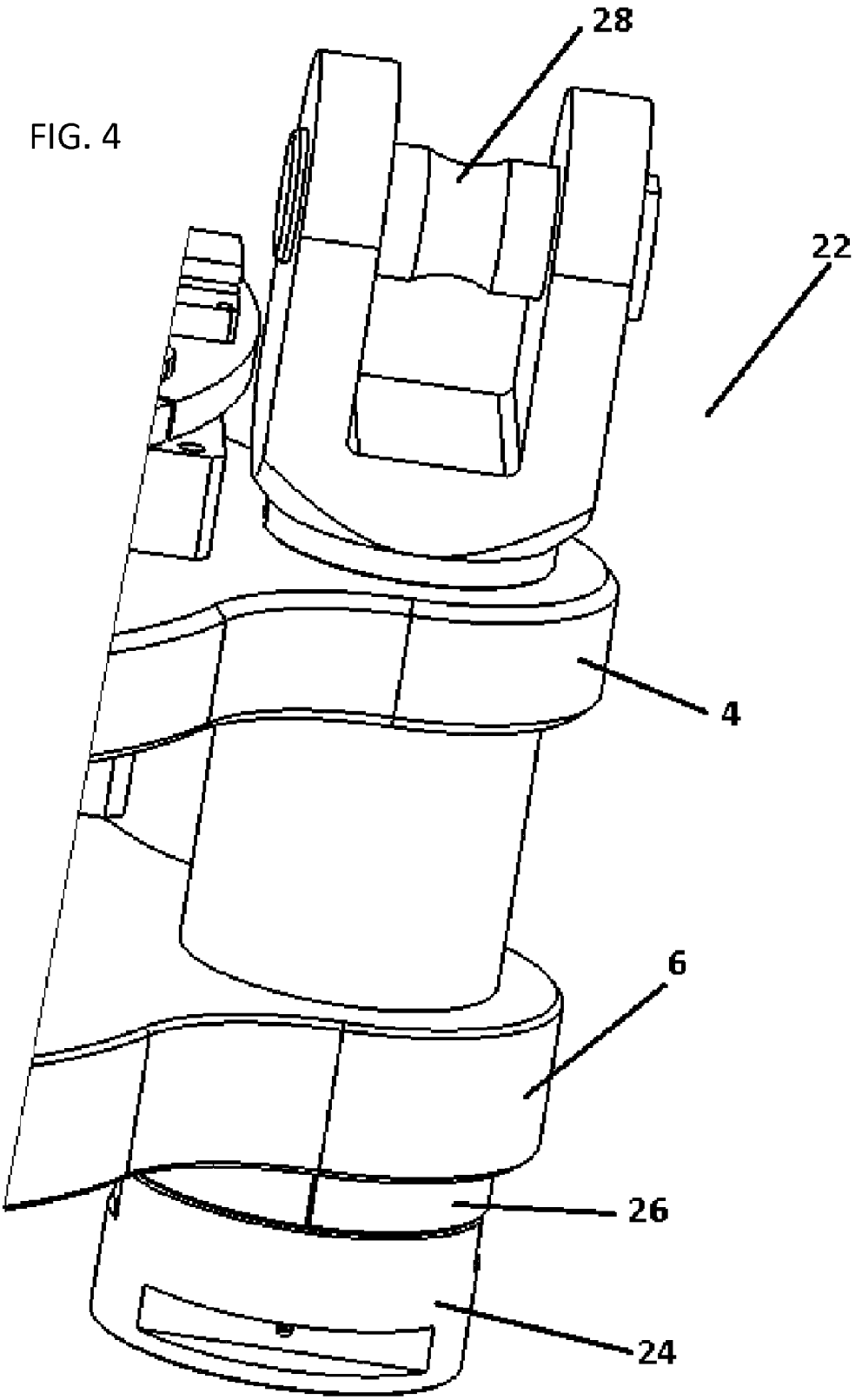


FIG. 5

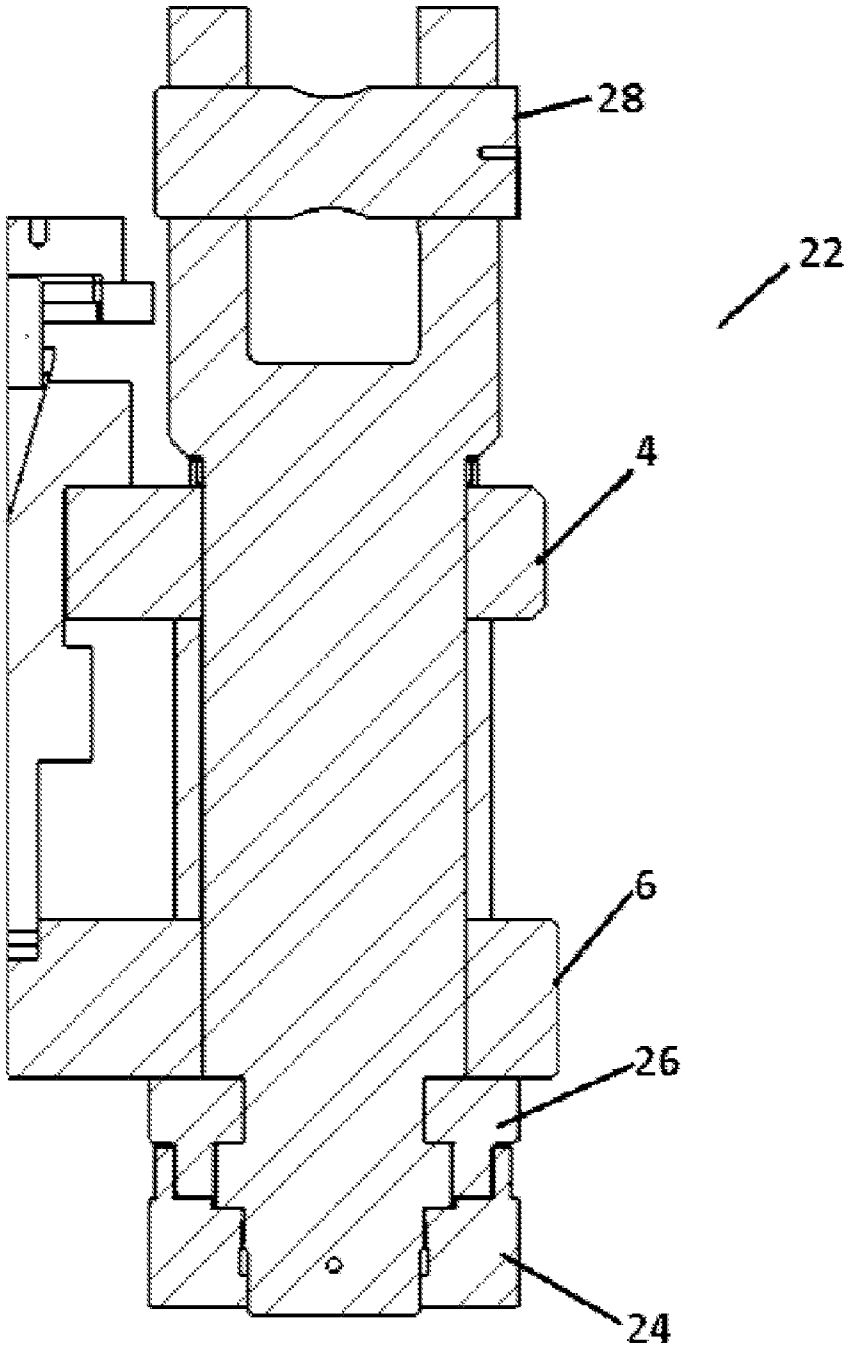
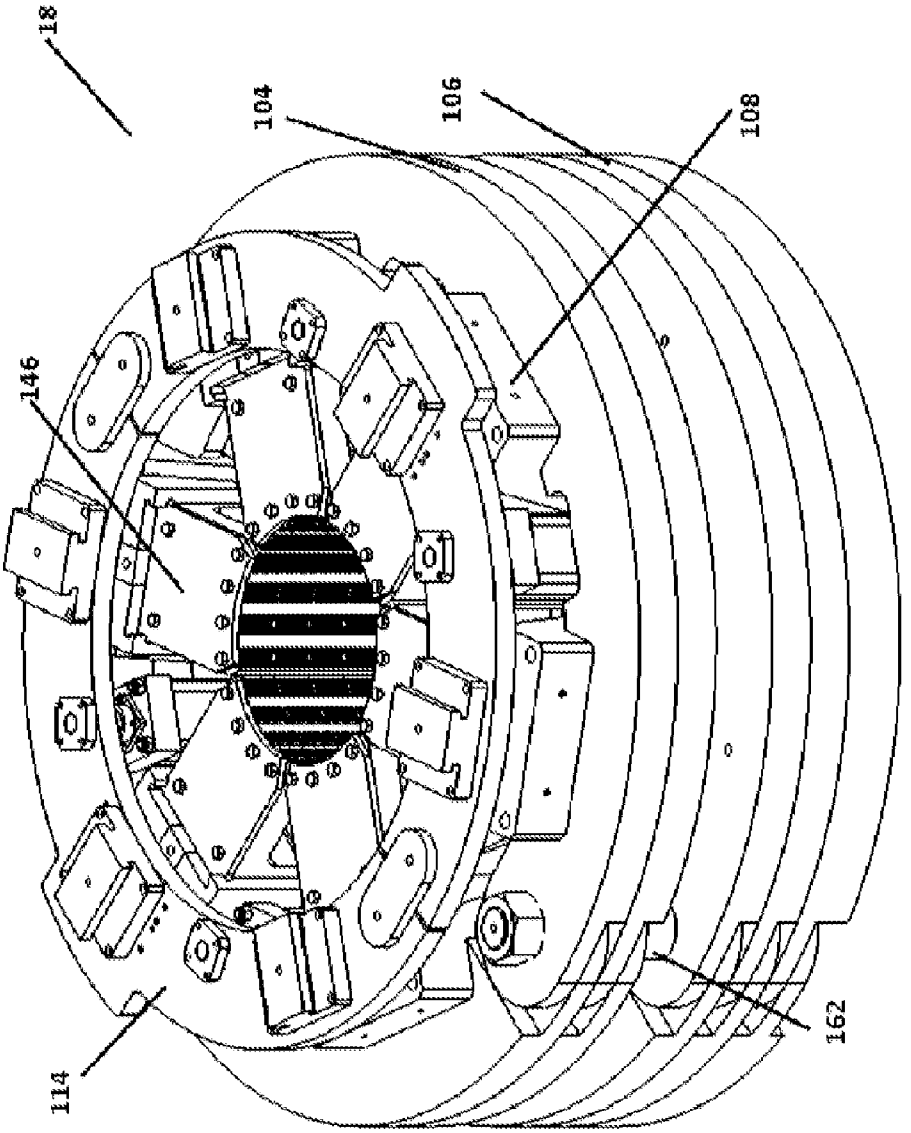


FIG. 6



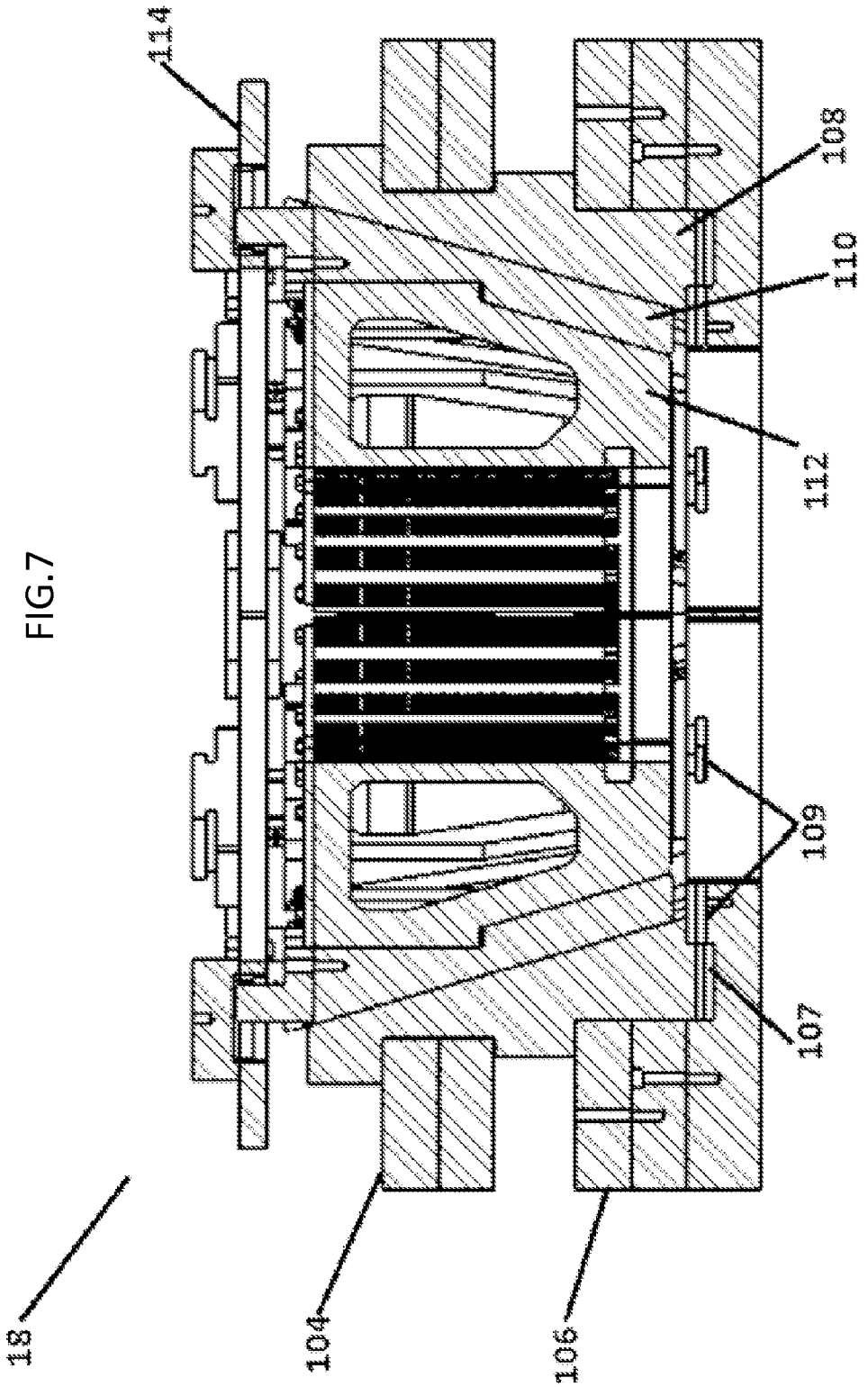


FIG.7

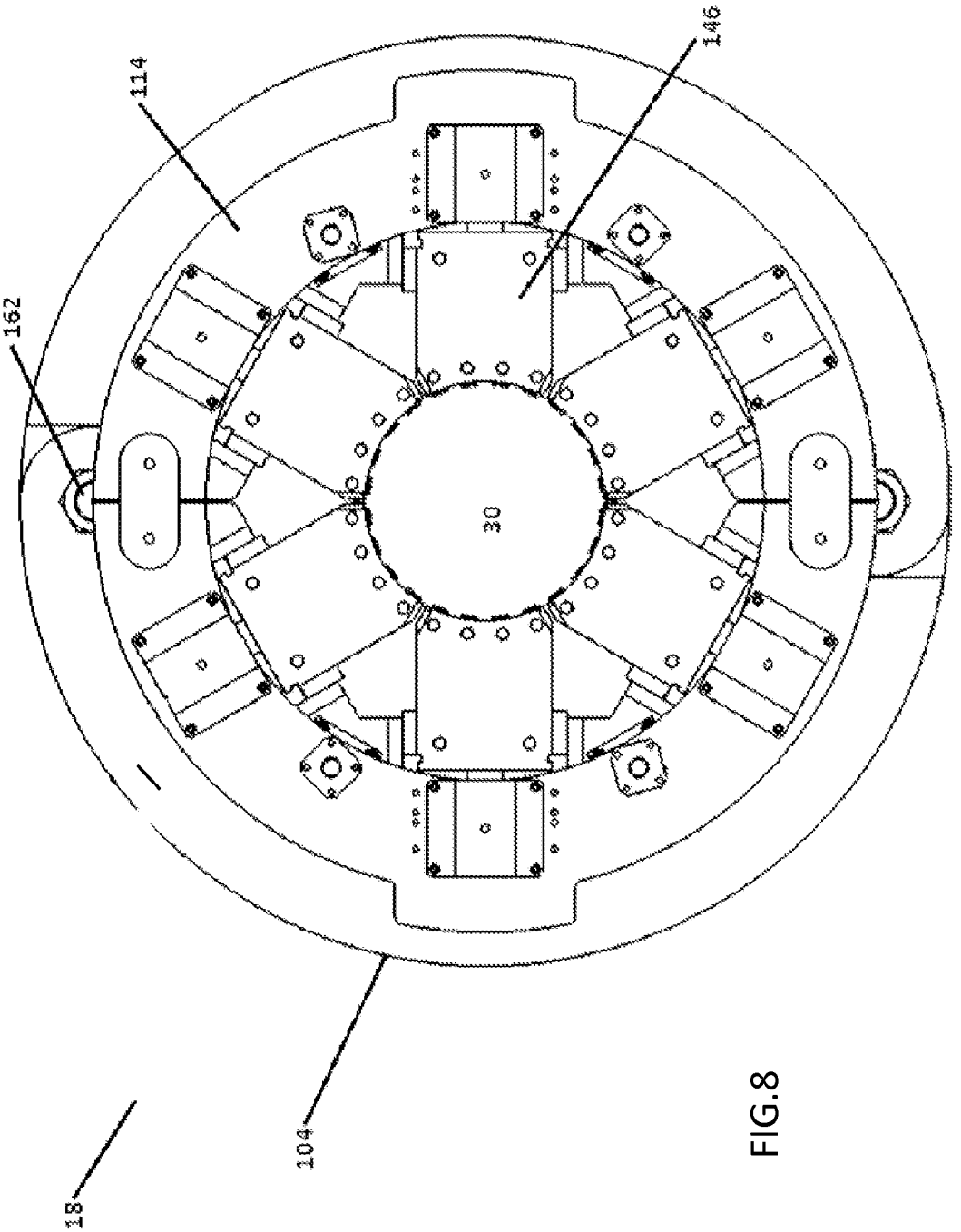


FIG.8

FIG. 9

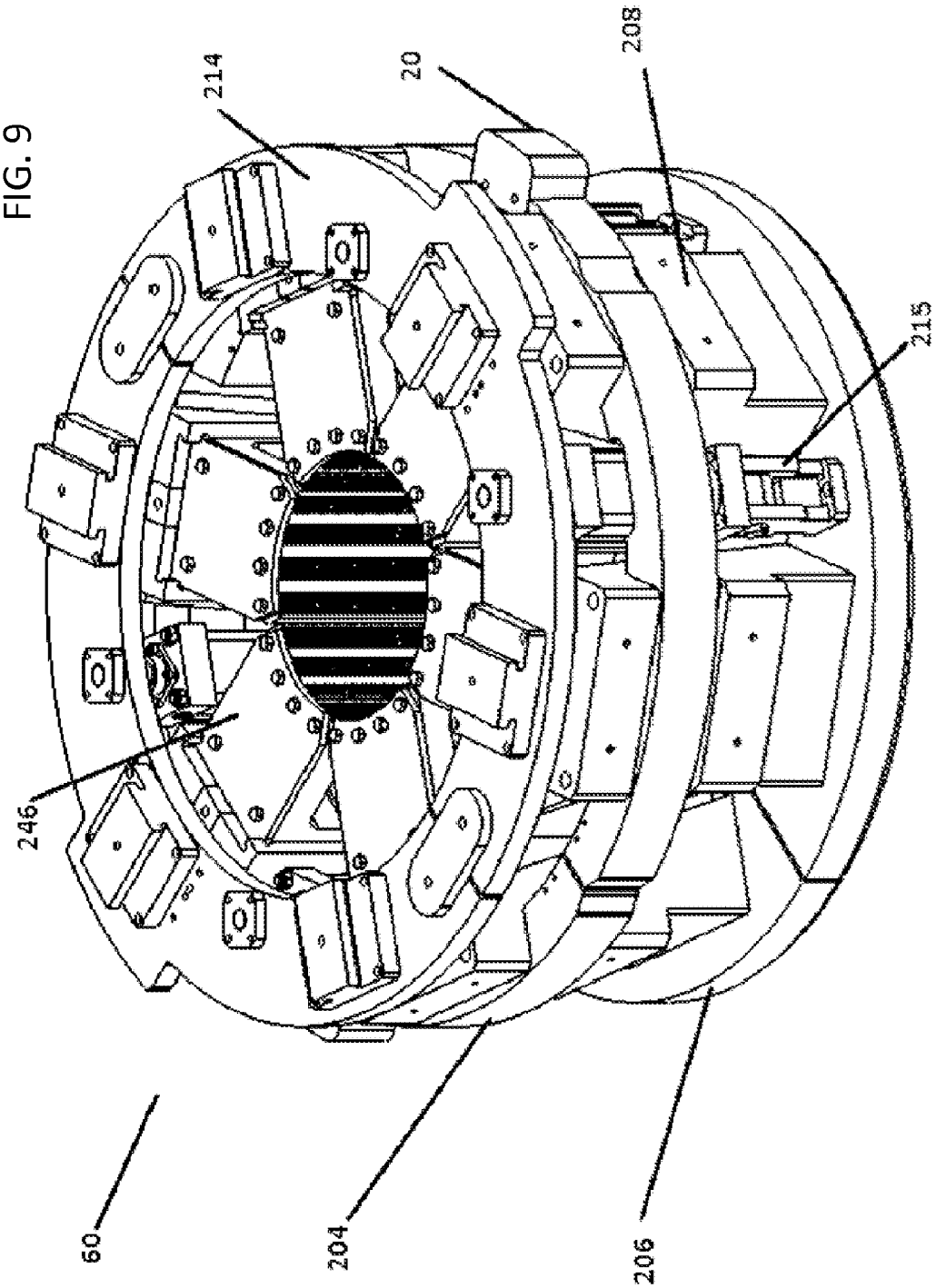
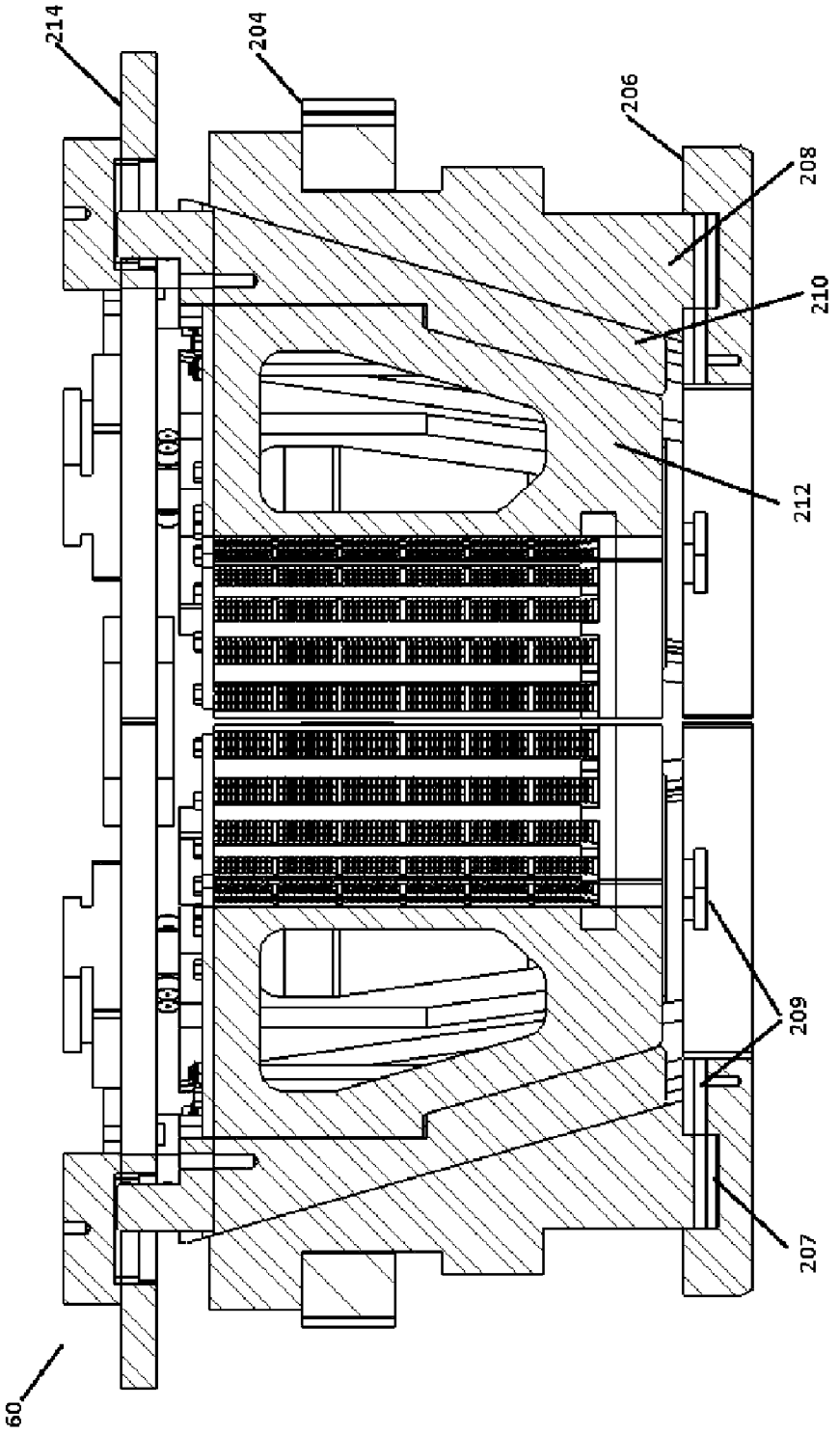


FIG. 10



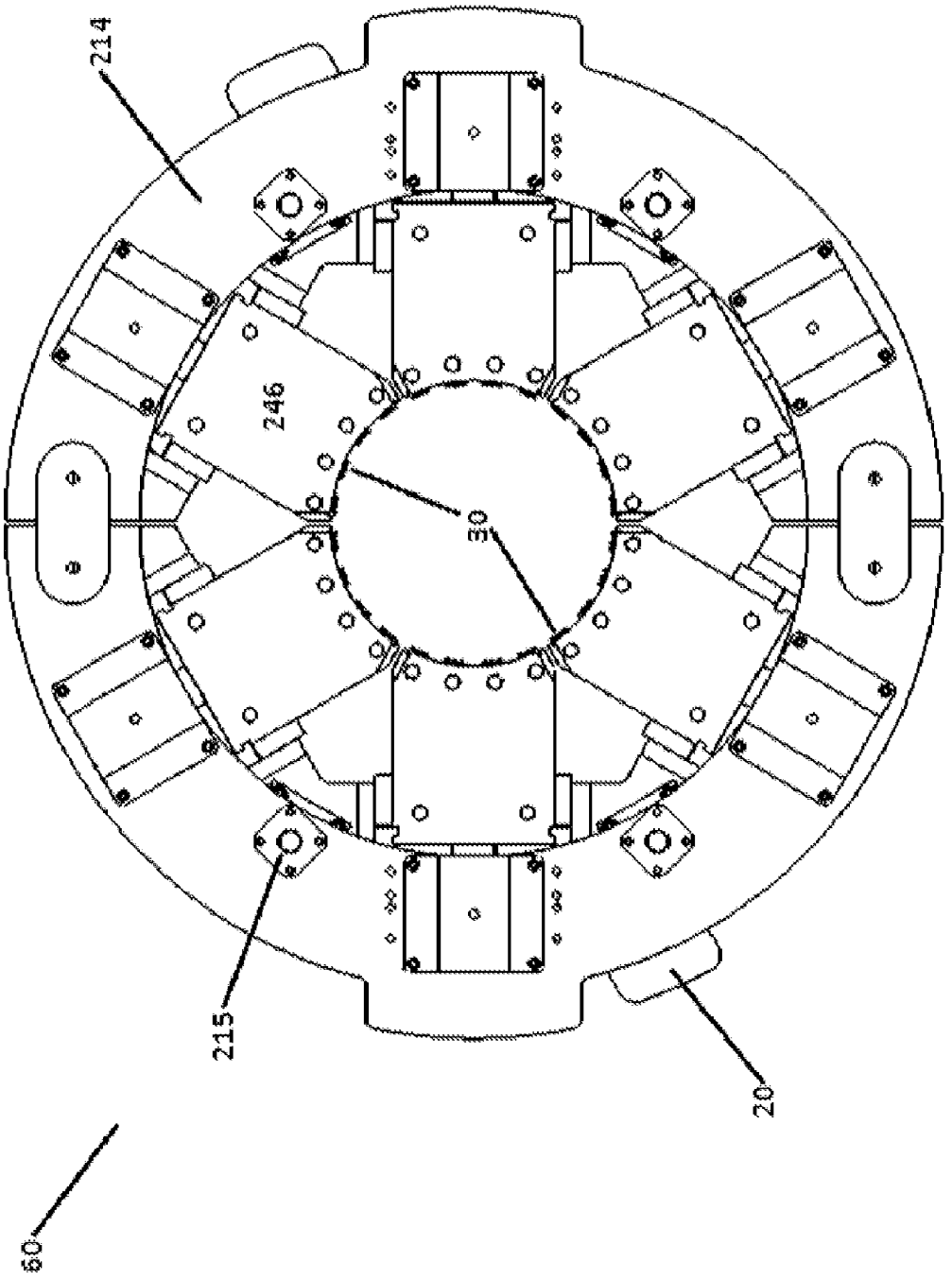
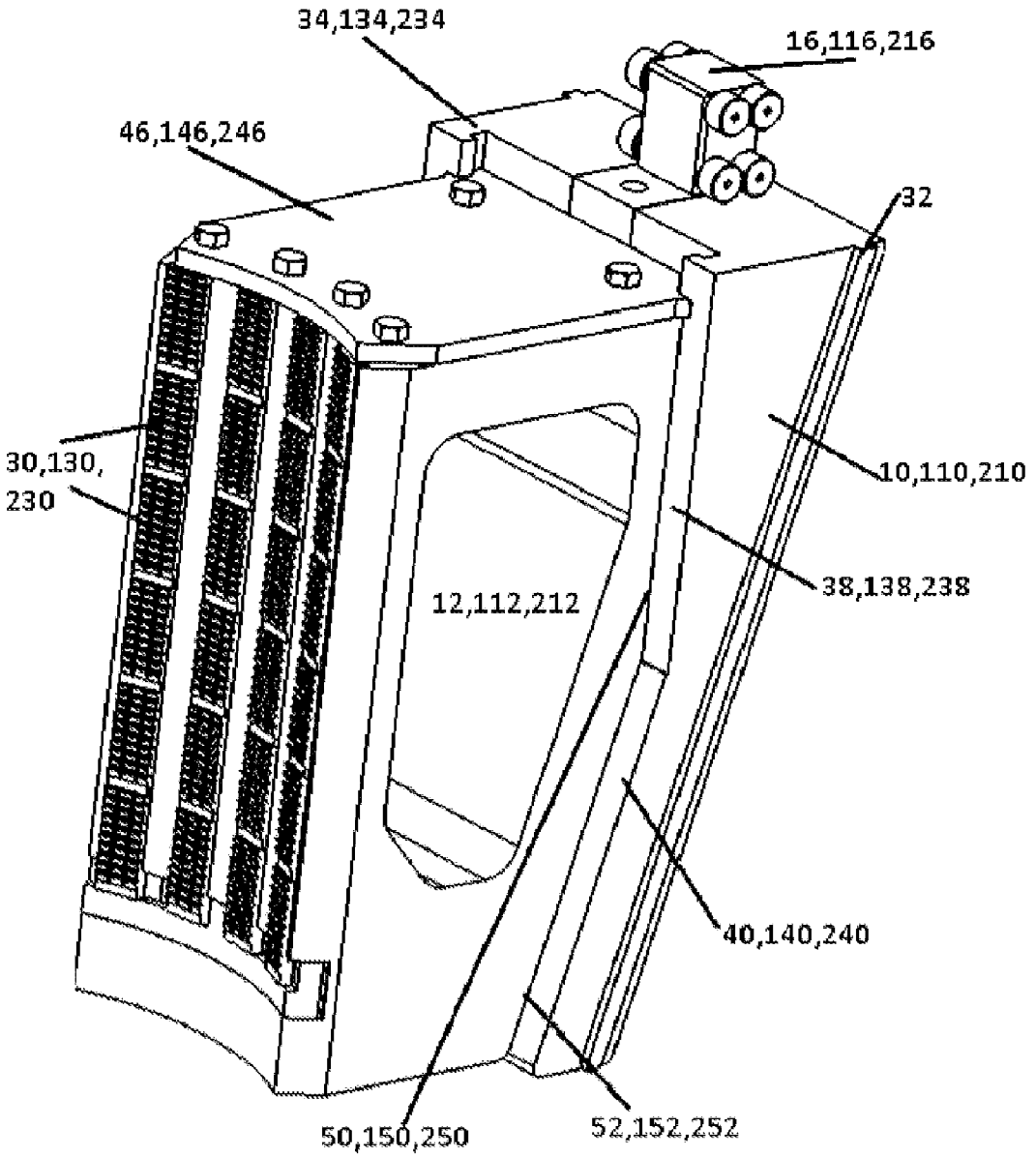


FIG. 11

FIG. 12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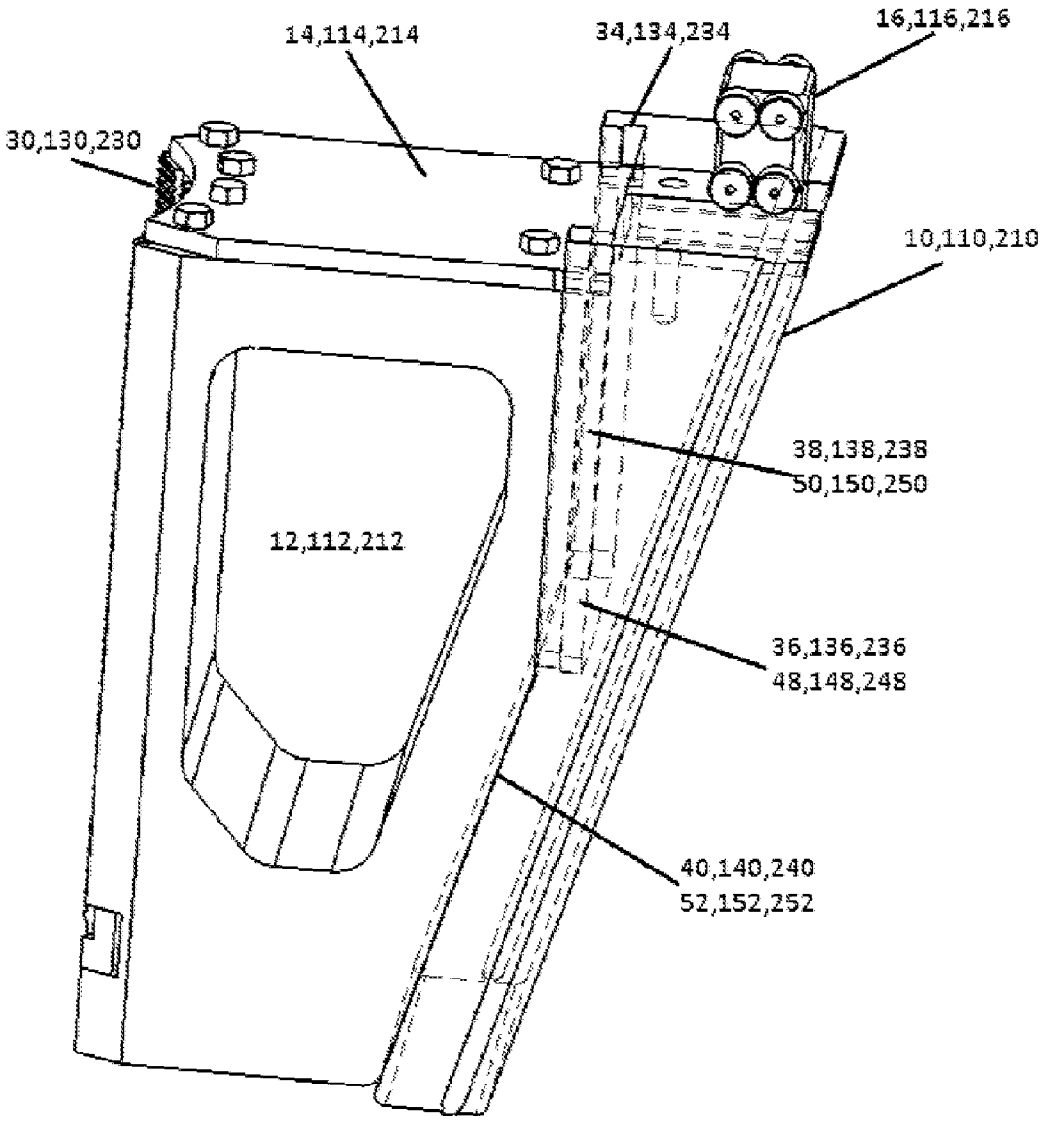
16,116,216
46,146,246
32
30,130,
230
10,110,210
12,112,212
38,138,238
40,140,240
50,150,250
52,152,252

FIG. 13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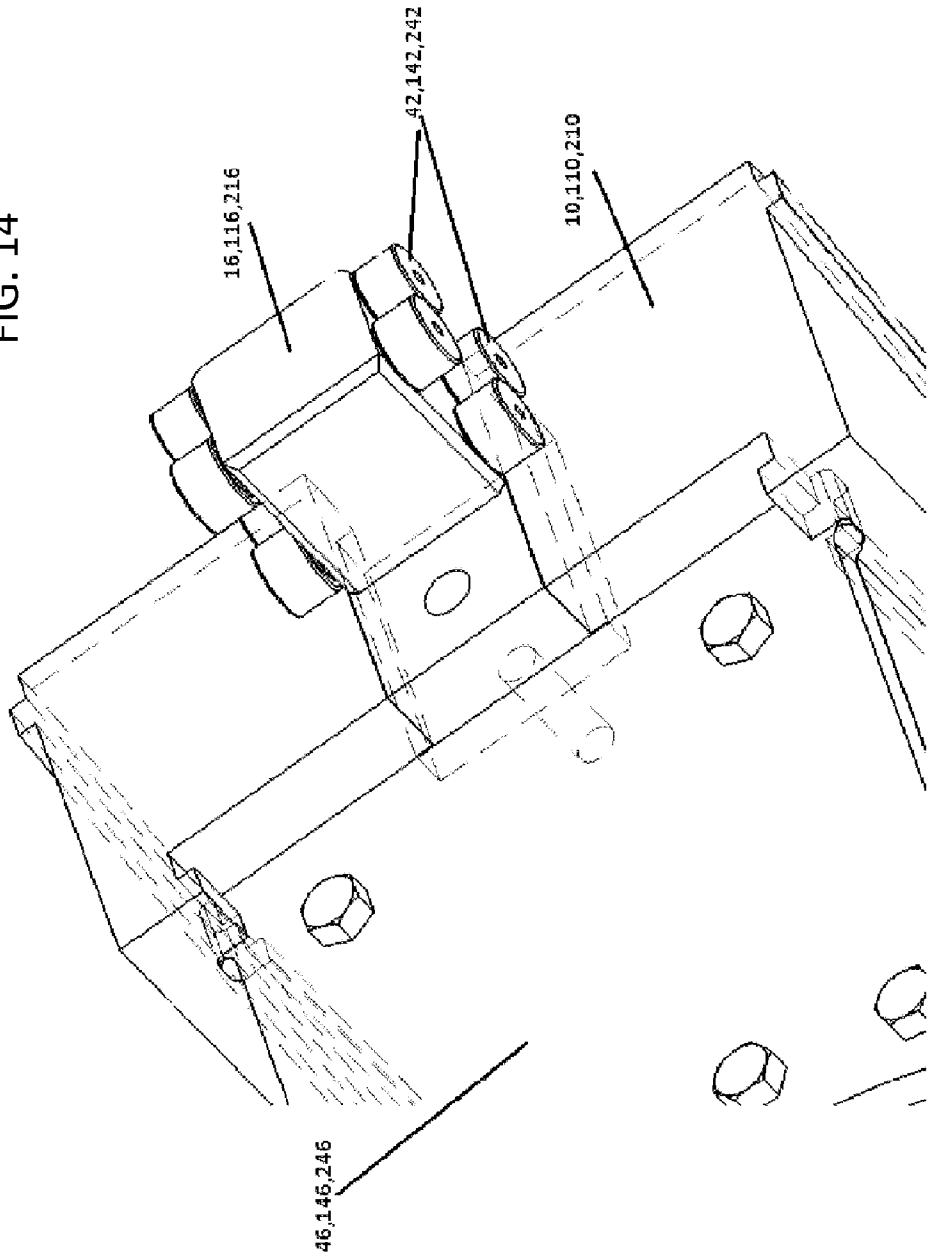
40,140,240
52,152,252

FIG. 14



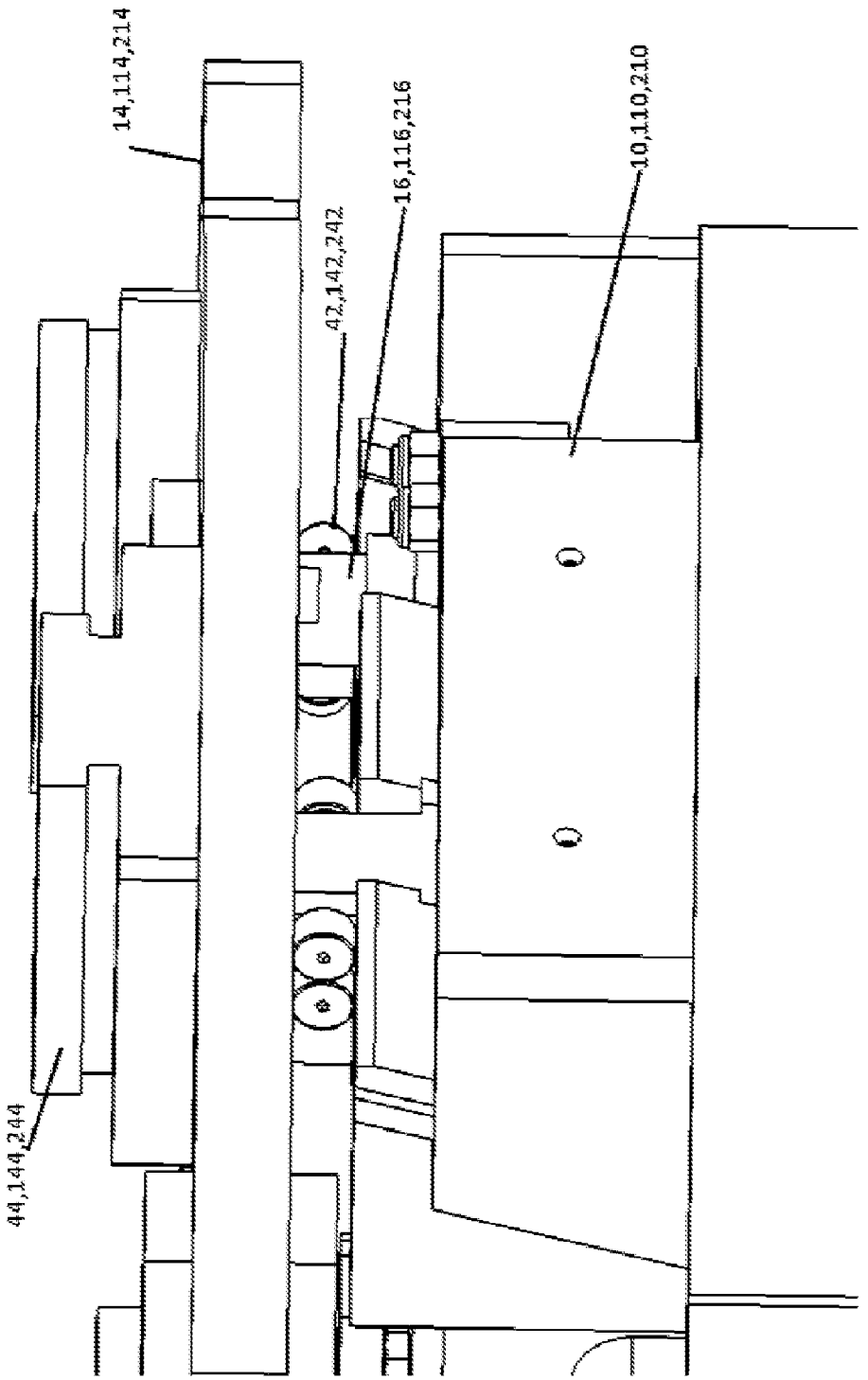


FIG. 15A

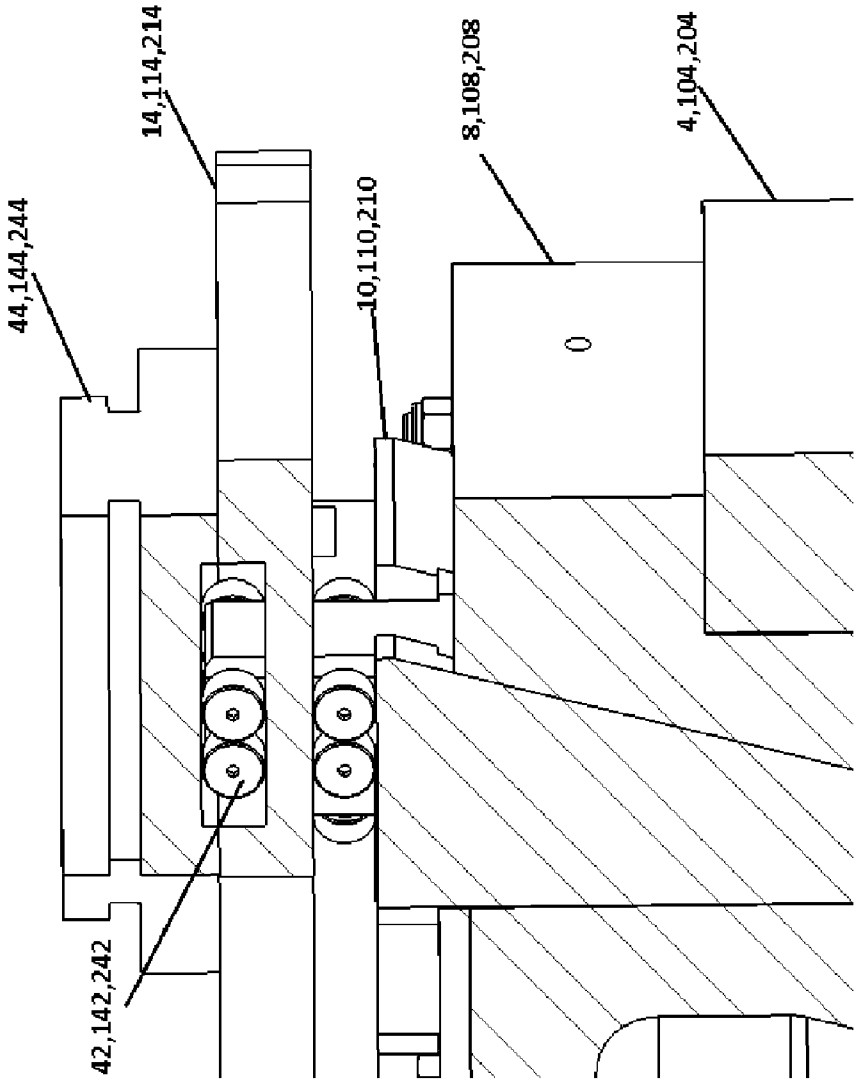
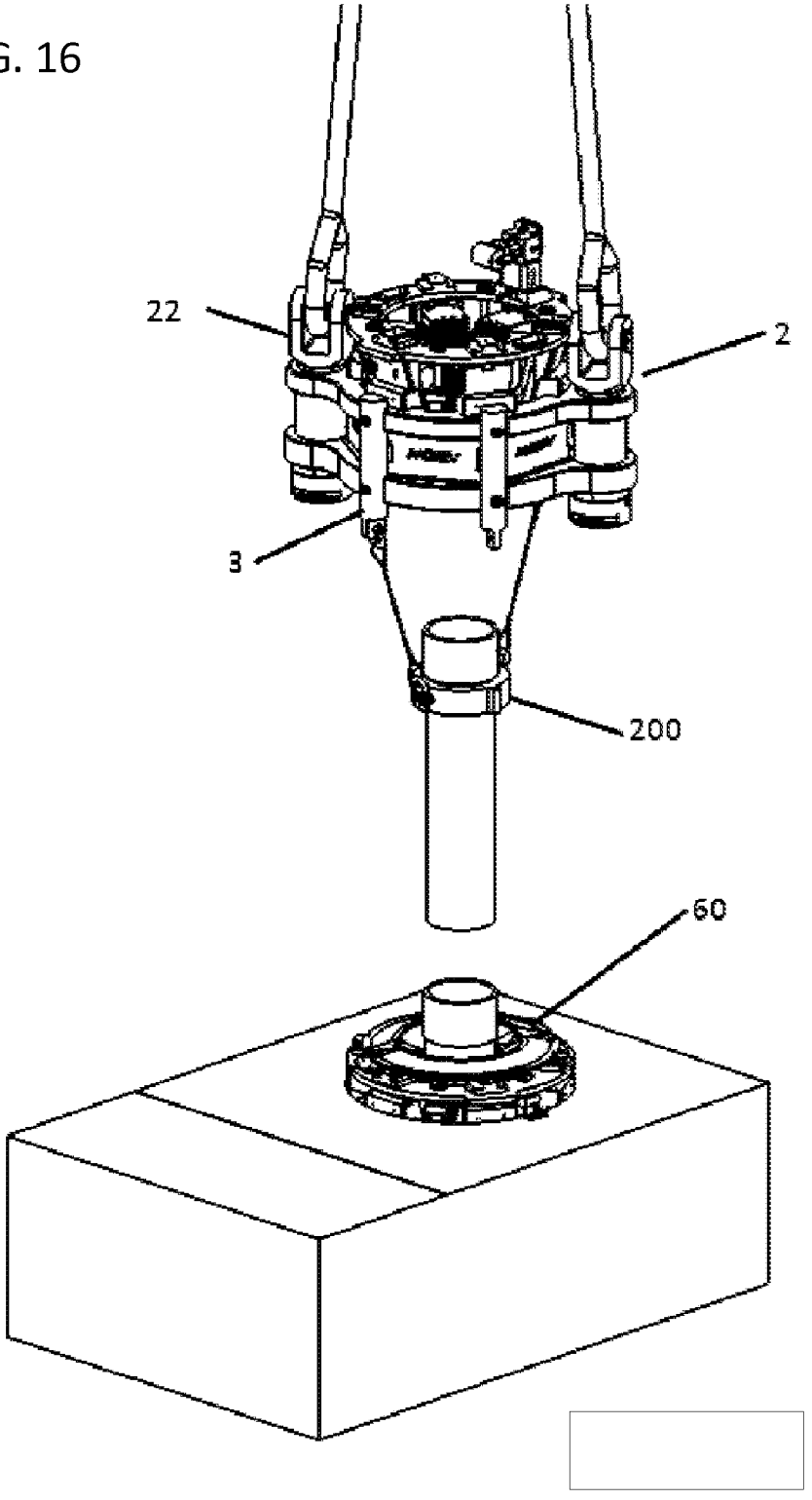


FIG. 15B

FIG. 16



APPARATUS FOR HANDLING TUBULARS

FIELD OF THE INVENTION

[0001] The present invention relates to a device and a system for lifting holding and lowering casing joints and assembled casing strings.

BACKGROUND

[0002] In down-hole drilling and extraction processes, casing, also called tubulars or piping, is run down the wellbore for the purposes of drilling, performing operations or producing oil from the well. Casing is made up by connecting multiple threaded casing sections together and feeding them into the wellbore. Typically, casing sections have a tapered female thread at one end and a tapered male thread at the other end. The male end of a first casing section is threaded into the female end of a second casing section to makeup the casing string. Rotation of the first casing into the second casing is conducted until the tapered ends engage one another.

[0003] A typical system making up casing strings includes an elevator assembly housing a related gripping assembly and connected directly or indirectly to a travelling block, a flush mount or top mount spider, each having its own dedicated gripping assembly, connected directly or indirectly at the rig floor.

[0004] A typical procedure for making up casing strings involves picking up a new joint of casing to be made up by the elevator assembly. The elevator assembly is raised to raise the casing joint into position above a casing string to be made up, the casing string being gripped in place by a flush mount or top mount spider. The elevator assembly is then lowered so that the male thread of the casing joint is engaged with the female thread of the uppermost casing of the casing string.

[0005] The threads between the new casing joint and the uppermost casing of the casing string are then made up. The elevator then grips the new casing joint and is picked up to transfer the weight of the newly made up connection from the flush mount or top mount spider, so that the spider can be released. The elevator assembly then lowers the newly made up connection to the rig floor, which is then gripped again by the spider. The elevator assembly is then lowered, transferring the load to the spider, then the elevator is released and is prepared to pick up the next casing joint to be made up.

[0006] A reverse procedure is practiced for breaking out casing joints from a casing string. Elevators and spiders conduct a number of complex operations and are typically made up of numerous moving and working parts. These tools must be able to carry large loads while gripping the casing joint to be made up, and the casing string. It must be easily operated and rapidly maintainable during wellbore operations.

[0007] A constant need and interest therefore exists in the art to develop improved casing handling tools.

SUMMARY

[0008] A tubular handling tool is provided for use as an elevator, comprising one or more slips movably retained by an upper ring and a lower ring, wherein the one or more upper rings and the one or more lower rings provide constraint against radial expansion forces.

[0009] A frame for a tubular handling tool is further provided for use as an elevator comprising an upper ring and a lower ring in a vertically spaced relationship to one another and each having a central opening for receiving a casing section; and one or more removable means for connecting the upper ring and the lower ring and attaching the frame to a top drive or travelling block.

[0010] A tubular handling tool is further provided for use as a top mount spider comprising one or more slips movably retained by one or more upper rings and one or more lower rings, wherein the one or more upper rings and the one or more lower rings provide constraint against radial expansion forces.

[0011] A tubular handling tool is further provided for use as a flush mount spider comprising one or more slips movably retained by one or more upper rings and one or more lower rings.

[0012] A slip is further provided comprising a removable sliphead.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present invention will now be described in greater detail, with reference to the following drawings, in which:

[0014] FIG. **1** is an isometric view of one example of the elevator of the present invention;

[0015] FIG. **2** is a cross-sectional view of one example of the elevator of the present invention;

[0016] FIG. **3** is a top plan view of one example of the elevator of the present invention;

[0017] FIG. **4** is an isometric view of a clevis pin of a present invention;

[0018] FIG. **5** is a cross-sectional elevation view of a clevis pin of the present invention;

[0019] FIG. **6** is an isometric of one example of the top mount spider of the present invention;

[0020] FIG. **7** is a cross-sectional view of one example of the top mount spider of the present invention;

[0021] FIG. **8** is a top plan view of one example of the top mount spider of the present invention;

[0022] FIG. **9** is an isometric view of one example of the flush mount spider of the present invention;

[0023] FIG. **10** is a cross section view of one example of the flush mount spider of the present invention;

[0024] FIG. **11** is a top plan view of one example of the flush mount spider of the present invention;

[0025] FIG. **12** is a first isometric view of one example of a slip and a die carrier of the present invention;

[0026] FIG. **13** is a second isometric view of one example of a slip and a die carrier of the present invention;

[0027] FIG. **14** is an isometric view one example of a slip-head of the present invention.

[0028] FIG. **15***a* is a first detailed view of a segment of the present modular gripping assembly, showing the actuator timing plate and slip head;

[0029] FIG. **15***b* is a second cross sectional detailed view of a segment of the present modular gripping assembly, showing the actuator timing plate and slip head; and

[0030] FIG. **16** is a perspective view of one embodiment of a typical operational setup using a number of tools of the present invention.

DESCRIPTION OF THE INVENTION

[0031] The present invention relates to device and a system for supporting, raising and lowering casing strings. The

present invention more specifically relates to an elevator, a top mount spider and a flush mount spider (FMS) and their related gripping assemblies.

[0032] With reference to FIGS. **1**, **2** and **3**, the present elevator **2** comprises one or more upper rings **4** and one or more lower rings **6** having multiple slip frames **8** supported by the upper rings **4** and lower rings **6** and arranged around the elevator **2**. The upper rings **4** and lower rings **6** also preferably provide radial constraint to the components inside the elevator **2**, such that the elevator **2** can withstand the radially expanding forces typically seen due to the axial loads experience by the elevator when lifting and lowering the casing string.

[0033] A slip **10** may be slidingly received into each of said slip frames **8**. An insert carrier **12** may then be attached to each of said slips **10**. An actuator timing plate **14** connects to a sliphead **16** at an upper end of each slip **10**, and further connects to one or more cylinders **15** that are raised or lowered to actuate setting and releasing of the elevator **2** on the casing sections.

[0034] A lowermost of the present lower rings **6**, preferably serves two purposes. It bears the load of elevator **2** including the casing string weight and preferably also it acts as a stabbing bell **6**A, which partially guides and aligns the casing section into the elevator **2**. The present design avoids the need of including an additional set of stabbing bells that then must be separately mounted on the elevator **2**. A reducer may further be used in conjunction with the stabbing bell **6**A, to accommodate smaller diameter casing.

[0035] Optionally, removable lifting ears can be connectable to the elevator **2** to connect indirectly with a travelling block.

[0036] With reference to FIGS. **4** and **5**, more preferably, the lifting ears of the elevator **2** are in the form of a clevis assembly with pins **22**. The clevis assembly **22** of the present invention are preferably non-integral to the elevator **2** and are preferably made from a plate or bar material. The clevis assembly **22** is removably attached to the elevator **2** by inserting a lower end of the clevis pin through the upper rings **4** and lower rings **6** and locking the lower end in place by a retaining means **24** preferably in the form of a retaining nut or any other suitable and well known means of securing the lower end of the clevis assembly **22** to the elevator **2**. Further preferably the lower end of the clevis assembly **22** is machined with a profile to accommodate a split load ring **26** between a lower face of the lower ring **6** and the retaining nut **24**. The split load ring **26** acts to absorb and distribute a portion of the load from the casing string, to lessen wear on the lower end of the clevis assembly **22**.

[0037] An upper end of the clevis assembly **22** is preferably forked with a bail retainer pin **28** that can be locked onto the bails of a top drive or to a travelling block.

[0038] FIGS. **6**, **7** and **8** illustrate one embodiment of a top mount spider **18** of the present invention. It has a series of upper rings **104** and lower rings **106** that provide radial constraint to the components inside the top mount spider **18**, such that the top mount spider **18** can withstand the radially expanding forces typically seen during make up and break out operations. More preferably, the upper rings **104** and lower rings **106** each take the form of one or more split rings, rotatably connected at a first end by a hinge **162** and secured together at a second end to form full rings.

[0039] Multiple slip frames **108** supported by the upper rings **104** and lower rings **106** and arranged around the top mount spider **18**. A slip **110** is slidingly received into each of said slip frames **108**, and an insert carrier **112** is supported on each of said slips **110**. An actuator timing plate **114** connects to a sliphead **116** at an upper end of each slip **110**, and further connects to one or more cylinders **115** to actuate setting and releasing of the top mount spider **18** on the casing string at the well floor.

[0040] More preferably a lowermost ring of lower ring **106** is formed with one or more key slots **107** that align matching key slots **109** at a lower end of slip frames **108**.

[0041] Preferably, a locking plate (not shown) slides through these key slots **107**, **109** and holds the slip frame **108** to the lower rings **106**.

[0042] With reference to FIGS. **9**, **10** and **11**, a flush mount spider **60** of the present invention is shown. The flushmount spider **60** has a singular upper ring **204** and a lower ring **206** having multiple slip frames **208** supported by the upper ring **204** and lower ring **206** and arranged around the flush mount spider **60**. A slip **210** is slidingly received into each of said slip frames **208**, and an insert carrier **212** is supported on each of said slips **210**. An actuator timing plate **214** connects to a sliphead **216** at an upper end of each slip **210**, and further connects to one or more cylinders **215** to actuate setting and releasing of the flush mount spider **60** on the casing string at the well floor.

[0043] More preferably the lower ring **206** is formed with one or more key slots **207** that align matching key slots **209** at a lower end of slip frames **208**. Preferably, a locking plate (not shown) slides through these key slots **207**, **209** and holds the slip frame **208** to the lower rings **206**.

[0044] One or more support shoulders or lugs **20** extend radially from the upper ring **204**, to engage with a rotary table, such that the flush mount spider **60** can be seated into the rotary table (not shown).

[0045] With reference to FIGS. **12** and **13**, the slips **10**, **110**, **210** of the present invention are preferably slidingly received in the slip frames **8**, **108**, **208** and rotationally constrained by engagement of the side edges of the slips **10**,**110**,**210** with shoulders of the slip frames **8**,**108**,**208**.

[0046] Guide means **32**, preferably in the form of a mating profiles formed on the side edges of the slip **10**,**110**,**210** and the slip frames **8**,**108**,**208**, guide the slips radially outwardly when raised and radially inwardly when lowered by actuation of the cylinders **15**,**115**,**215**. Most preferably, guide means **32** take the form of a tongue and groove system that comprises either a tongue formed on the side edges of the slip **10**, **110**, **210** and a groove formed on the shoulders of the slip frame **8**, **108**, **208** or vice versa

[0047] The insert carrier **12**, **112**, **212** of the present invention provides a unique means of carrying one or more dies **30**, **130**,**230** on the insert carrier **12**, **112**, **212**, which can in turn be easily removed from the slip **10**, **110**, **210** and replaced. This allows for rapid change out of the dies **30**, **130**, **230** should they be come worn or damaged, and eliminates the need for removing individual dies from a slip **10**, **110**, **210**. A slot and tab profile **34**, **134**, **234** on the slip **10**, **110**, **210** and die carrier **12**, **112**, **212** acts as a means to radially retain the insert carrier **12**, **112**, **212** within the slip **10**, **110**, **210**.

[0048] The inner face of slips **8**,**108**,**208** of the present invention are most preferably formed with a vertical upper surface **38**, **138**, **238** and an inclined lower surface **40**, **140**, **240** on the inner face of the slip **10**, **110**, **210**. A shoulder **36**, **136**, **236** exists between the vertical upper surface **38**, **138**, **238** and the inclined lower surface **40**, **140**, **240**. The outer

face of the insert carrier **12**, **112**, **212** of the present invention are most preferably formed with a vertical upper surface **50**, **150**, **250** and an inclined lower surface **52**, **152**, **252** of. A ledge **48**, **148**, **248** is formed at the intersection of the vertical upper surface **50**, **150**, **250** and the inclined lower surface **52**, **152**, **252**.

[0049] Axial loads from the casing section or casing string are preferably transferred into the mating inclined lower surfaces **40**, **140**, **240** of slip **10**,**110**, **210** and inclined lower surfaces **52**, **152**, **252** of the insert carrier **12**, **112**, **212**. These mating lower inclined surfaces serve to support a portion of the axial load of the casing section or string and transfer some of the load bearing burden away from a thinner toe end of the slip **10**, **110**, **210** to a thicker upper portion of the slip **10**, **110**, **210**. A portion of the axial load is also preferably carried in the shoulder **36**,**136**,**236** of the upper surface of the **38**,**138**,**238** of the slip. This advantageously transfers some load away from a somewhat thinner lower inclined surface **40**,**140**,**240** to the somewhat thicker upper surface **38**,**138**,**238**.

[0050] A singular retaining means **46**,**146**,**246** serves to retain the dies **30** to the insert carrier. Most preferably the singular retaining means takes the form of a singular die and insert carrier retainer plate **46**, **146**, **246** that is screwed, bolted or otherwise suitably removably attached to a top surface of the insert carrier **12**, **112**, **212**. The retainer plate **46**, **146**, **246** can be easily removed for inspection or replacement of the die **30**, **130**, **230** or insert carrier **12**, **112**, **212** without the need for removing separate plates for the die carrier and for the die.

[0051] With reference to FIG. **14**, a sliphead **16**, **116**, **216** is preferably separately machined and bolted to the slip **10**, **110**, **210**. Unlike slip heads that are traditionally casted or welded to a slip, the present sliphead **16**, **116**, **216** can easily be disconnected to service the slip **10**, **110**, **210** or insert carrier **12**, **112**, **212**.

[0052] FIGS. **15***a* and **15***b* show further details of a preferred embodiment of the present actuator timing plate **14**, **114**, **214** and sliphead **16**, **116**, **216**. Each sliphead **16**,**116**, **216** is preferably machined separately to the slip **10**, **110**, **210** itself and removably affixed to an upper end of each slip **10**,**110**, **210**. The sliphead **16**,**116**, **216** preferably comprises one or more rollers or cam followers **42**, **142**, **242** or more preferably one or more pairs of rollers or cam followers **42**,**142**, **242** in an axially spaced arrangement with one another. The cam followers **42**, **142**,**242** are rollably received in one or more cam follower caps **44**,**144**, **244** located around the actuator timing plate **14**, **114**, **214**. The actuator timing plate **14**, **114**, **214** is further connected to one or more cylinders (not shown) to actuate setting and releasing of the slips **10**, **110**, **210** on the casing sections or the casing string. To set the slips **10**, **110**, **210** on the casing sections or casing string, the cylinders push the actuator timing plate **14**, **114**, **214** down. This in turn leads the slips **10**, **110**, **210** to travel both downwardly and radially inwardly along slip frames **8**, **108**, **208**. Radial movement of the slips **10**, **110**, **210** is accommodated in the actuator timing plate **14**, **114**, **214** by corresponding radial movement of the cam followers **42**, **142**, **242** inside the cam follower caps **44**, **144**, **244**.

[0053] In a typical operation, as illustrated in FIG. **16**, the present elevator assembly **2** and other optional devices are attached directly or indirectly to a travelling block. The elevator **2** is then lowered to a position near the rig floor to permit single joint elevator **200** to pick up a new joint of casing that has been raised from a pipe rack adjacent to the rig.

[0054] The elevator **2** is raised, coupled to the single joint elevator **200** by two of the four elevator support bars **3** to thereby pull the casing joint up and along the rig's v-door ramp until it is raised above the existing casing string, set in a flush mount spider **60** or a top mount spider **18**.

[0055] The elevator **2** is lowered to allow the male thread of the casing joint to engage the female thread of the uppermost casing of the casing string.

[0056] The threads are then made up between the new casing joint and the uppermost casing of the casing string, set in the flush mount spider **60** or top mount spider **18**.

[0057] Once made up, the single joint elevator **200** is released and the slips **10** in elevator **2** are set. The weight of the entire casing string, previously supported by a flush mount spider **60** or top mount spider **18**, will now be transferred to the elevator **2**, once the flush mount spider **60** or top mount spider **18** has been opened. The newly connected casing and casing string is then lowered into the well bore until the uppermost casing of the casing string reaches the rig floor. The flush mount spider **60** or top mount spider **18** is then set on the new uppermost casing, thereby taking over the load of the entire casing string. Once the flushmount spider **60** or top mount spider **18** is set, the elevator assembly **2** can be released, allowing the single joint elevator **200** to prepare to pick-up a new joint of casing.

[0058] In the foregoing specification, the inventions have been described with a specific embodiments thereof; however, it will be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of the invention.

1. A tubular handling tool for use as an elevator, comprising one or more slips movably retained by one or more upper rings and one or more lower rings, wherein the one or more upper rings and the one or more lower rings provide constraint against radial expansion forces.

2. The tubular handling tool of claim **1**, wherein the one or more slips are movably retained by one or more slip frames.

3. The tubular handling tool of claim **2**, wherein the one or more slip frames are supported on the upper ring and the lower ring.

4. The tubular handling tool of claim **1**, further comprising an insert carrier insertable into each of said one or more slips and accommodating a plurality of dies.

5. The tubular handling tool of claim **4**, further comprising a singular, removable retaining means for retaining the dies on the insert carrier.

6. The tubular handling tool of claim **5**, wherein the retaining means comprises a singular retainer plate removably affixed to an upper surface of the insert carrier.

7. The tubular handling tool of claim **4**, wherein a front slip face defines a lower inclined surface and a rear insert carrier face defines a corresponding lower inclined surface.

8. The tubular handling tool of claim **7**, wherein the mating lower inclined surfaces support a portion of the axial load of a tubular section or tubular string.

9. The tubular handling tool of claim **2**, wherein axial movement of the slips in the slip frames is guided by a guide means.

10. The tubular handling tool of claim **9**, wherein the guide means comprise mating profiles formed on side edges of the slip and on side edges of the slip frame.

11. The tubular handling tool of claim **10**, wherein the mating profile comprise a tongue and groove profile.

12. The tubular handling tool of claim **1**, further comprising a slot and tab profile on the slip and on the insert carrier that radially retains the insert carrier within the slip.

13. The tubular handling tool of claim **1**, wherein the lower ring acts as a stabbing bell to guide a tubular into the elevator.

14. A frame for a tubular handling tool for use as an elevator comprising:

a. one or more upper rings and one or more lower rings in a vertically spaced relationship to each other another and each having a central opening for receiving a casing section; and

b. one or more removable means for connecting the upper rings and the lower rings and for attaching the frame to a top drive.

15. The frame of claim **14**, wherein the removable means for connecting the upper rings and the lower rings comprise one or more clevis assemblies with pins.

16. The tubular handling tool of claim **15**, wherein said clevis assemblies further comprise a bail retainer above said upper rings for attachment to a top drive and having a grooved profile located below said lower ring to accommodate a split load ring and engage with a retaining means, wherein said split load ring serves to absorb and distribute a load from the elevator.

17. A tubular handling tool for use as a top mount spider, comprising one or more slips movably retained by one or more upper rings and one or more lower rings, wherein the one or more upper rings and the one or more lower rings provide constraint against radial expansion forces.

18. The tubular handling tool of claim **17**, wherein the one or more slips are moveably retained by one or more slip frames.

19. The tubular handling tool of claim **18**, wherein the one or more slip frames are supported on the upper ring and the lower ring.

20. The tubular handling tool of claim **17**, further comprising an insert carrier insertable into each of said one or more slips, and accommodating a plurality of dies.

21. The tubular handling tool of claim **20**, further comprising a singular removable retaining means for retaining the dies on the insert carrier.

22. The tubular handling tool of claim **21**, wherein the retaining means comprises a singular retainer plate removably affixed to an upper surface of the insert carrier.

23. The tubular handling tool of claim **20**, wherein a front slip face defines a lower inclined surface and a rear insert carrier face defines a corresponding lower inclined surface.

24. The tubular handling tool of claim **23**, wherein the mating lower inclined surfaces support a portion of the axial load of a tubular section or tubular string.

25. The tubular handling tool of claim **18**, wherein axial movement of the slips in the slip frames is guided by a guide means.

26. The tubular handling tool of claim **25**, wherein the guide means comprises a mating profile formed on side edges of the slip and on side edges of the slip frame.

27. The tubular handling tool of claim **26**, where the mating profile comprises a tongue and groove profile.

28. The tubular handling tool of claim **17**, further comprising a slot and tab profile on the slip and on the insert carrier that radially retains the insert carrier within the slip.

29. The tubular handling tool of claim **19**, further comprising one or more key slots formed in a lowermost ring of lower rings and one or more matching key slots formed in a lower end of the slip frames, wherein the one or more key slots are connectable to hold the slip frames to the lower rings.

30. A tubular handling tool for use as a flush mount spider comprising one or more slips movably retained by one or more upper rings and one or more lower rings.

31. The tubular handling tool of claim **30**, wherein the one or more slips are movably retained by one or more slip frames

32. The tubular handling tool of claim **31**, wherein the one or more slip frames are supported on the upper ring and the lower ring.

33. The tubular handling tool of claim **30**, further comprising an insert carrier insertable into each of said one or more slips, and accommodating a plurality of dies.

34. The tubular handling tool of claim **33**, further comprising a singular removable retaining means of retaining the dies on the insert carrier.

35. The tubular handling tool of claim **34**, wherein the retaining means comprises a singular retainer plate removably affixed to an upper surface of the insert carrier.

36. The tubular handling tool of claim **33**, wherein a front slip face defines a lower inclined surface and a rear insert carrier face defines a corresponding lower inclined surface.

37. The tubular handling tool of claim **36**, wherein the mating lower inclined surfaces support a portion of the axial load of a tubular section or tubular string.

38. The tubular handling tool of claim **31**, wherein axial movement of the slips in the slip frames is guided by a guide means

39. The tubular handling tool of claim **38**, wherein the guide means comprises a mating profile formed on side edges of the slip and on side edges of the slip frame.

40. The tubular handling tool of claim **39**, wherein the mating profile comprises a tongue and groove profile.

41. The tubular handling tool of claim **33**, further comprising a slot and tab profile on the slip and on the insert carrier that radially retains the insert carrier within the slip.

42. The tubular handling tool of claim **30**, further comprising one or more support lugs extending radially from the upper ring to engage with a rotary table when the flush mount spider is seated in a rotary table.

43. The tubular handling tool of claim **31**, further comprising one or more key slots formed in a lowermost ring of lower rings and one or more matching key slots formed in a lower end of the slip frames, wherein the one or more key slots are connectable to hold the slip frames to the lower rings.

44. A slip comprising a removable sliphead.

45. The slip of claim **44**, wherein the sliphead is removably affixed to the slip, for slidable engagement with an actuator timing plate for accommodating radial movement of the slip.

46. The tubular handling tool of claim **45**, wherein the sliphead comprises one or more rollers rollably received into one or more cam follower caps located on the actuator timing plate.

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