中国石油装备
CNPC Equipment

YOTFJ750／875固定导管调速型
液力偶合器反车减速箱使用维护说明书

Operation and Maintenance Instruction for Model YOTFJ 750/875
Hydraulic Coupling Reverse Reducing Gear Box

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前　言

欢迎您使用“济柴”牌YOTFJ750/875 型液力偶合器反车减速箱，我们有幸为您服务！

本说明书着重介绍了YOTFJ750/875偶合器反车箱的性能参数、工作原理、结构特点等，并就液力偶合器反车箱与各规格泥浆泵的匹配、安装和偶合器在使用维护保养等方面的一些原则要求做了说明。为了正确使用本产品，充分发挥产品的效能，请您在使用前仔细阅读本说明书！

警　示

1、请操作者在使用本产品前，必须仔细阅读本《说明书》，并按书中的有关规定和要求进行安装、调试、操作和维护保养。

2、用户应严格按照本说明书中规定的品种、牌号选用工作油。特别注意：工作油的使用期限和换油。

3、旋转件、高温油：操作时注意安全，避免旋转件碰伤；偶合器运行时，工作油温应小于110℃，注意高温烫伤。

4、务必选用本公司生产或认可的正品零配件，本公司对使用伪劣零部件导致的故障不承担责任。

5、吊装偶合器。偶合器吊装孔仅可用于吊装偶合器本身，吊装时仅可用偶合器箱体上的吊装孔吊装，起重工具、吊索吊具必须有足够的承载能力。

6、旋转物品使用防护罩防护。防护罩必须有效阻止有害异物侵入，承受意外撞击而不过度损伤，保证足够的通风和适当的安全距离。

7、检修偶合器时，必须保证动力机、偶合器、工作机均处于停止状态，并且任何情况下，都不会启动。

8、设备运行必须配备耳塞或者耳罩，声音超过85dB(A)时,可能造成听力损伤。

9、人员在检修过程中有可能因传动介质泄露而引起滑倒或跌伤，应注意及时清理。

目 录

第一章 概 述

一、 概况

现代石油钻机普遍采用液力传动装置，其典型的传动系统为柴油机+液力传动装置+链条并车统一驱动工作机（绞车、转盘、泥浆泵），这种液力传动方案，不仅使动力机组利用率高，而且可提升各机组运行的可靠性。随着钻井技术的快速发展，全自动电驱钻机、液压顶驱钻机、电液复合驱动钻机、车载自行钻机等各种新型钻机不断出现。它们的总体传动设计新颖，性能优良，有着很强的时代特征，一般都采用泥浆泵与绞车、转盘分开独立驱动形式，由柴油机（电动机）驱动泥浆泵的单独机泵组。传统的单机泵组是由柴油机经减速箱、离合器、联组窄V带驱动泥浆泵，体积庞大，系统复杂，而且只能通过调节柴油机的油门或更换泵的缸套来调节排量和泵压，但泥浆泵的缸套不宜常换，柴油机也不宜长期工作在低速区，只能在有限的范围内调节泥浆泵的排量和泵压，不能很好满足钻井工艺的要求。为了解决上述问题，适应新型钻机发展的要求，我公司研制开发了固定导管调速型液力偶合器反车减速箱。

二、 型号

1、型号表示

YOTFJ □ — □ □ □ □

- 变型序号：A、B、C…
- 冷却方式：Lsh — 联合水冷却；Df — 单独风冷却
- 安装方式：F — 用法兰与柴油机连接；D — 单独安装
- 减速比10倍数
- 工作腔直径 — 750/875mm
- 液（Ye）力偶（Ou）合器调（Tiao）速型反（Fan）车减（Jian）速箱

2、偶合器基本参数

表1 YOTFJ750/875固定导管调速型液力偶合器反车减速箱技术参数

规格参数	工作腔直径（mm）	
	750	875
输入转速（r/min）	1000-1500	1000-1500
传递功率范围（kW）	440～1300	950～1500
齿轮减速比	1.8～3.3	1.8～3.3
额定滑差率	3%～5%	

调速范围	1～1/3	
离合反映灵敏度	25～35	
工作油温（℃）	≤110℃	
使用油品	6号或8号（环境温度在-20℃以上使用6号液力传动油，环境温度在-20℃以下使用8号液力传动油）	
冷却方式	联合水冷却/单独风冷却	
外型尺寸（长×宽×高）	1600×1300×1970	1700×1300×2100

三、 工作原理

液力偶合器反车箱工作原理如附图1 所示，当动力机（柴油机或电动机）驱动输入轴（1）和泵轮（4）旋转时，在泵轮（4）叶片的作用下，工作油形成高速高压液流，自轴心向外周流动，然后向心地流入涡轮（2）并使其旋转。从涡轮（2）流出的液流，回到泵轮（4），在泵轮（4）—涡轮（2）—泵轮（4）之间不断循环。泵轮（4）将动力机输出的机械能转换成工作液体的动能和压能，涡轮则把工作液体的动能和压能转换成机械能，并通过偶合器后面的减速箱传递给万向轴、泥浆泵。如果当泵轮（4）转速恒定时，工作机通过钻机的机械元件和减速箱施加于偶合器涡轮的负荷增加时，涡轮（2）转速下降；反之，当工作机施加于涡轮（2）的负荷减小时，涡轮（2）的转速增加。

当泵轮（4）旋转时，通过齿轮对（16）带动供油泵（13）旋转，将工作油经滤油器（15）、管路（101），从油箱（即下箱体）（17）内抽出，通过油滤器（8）滤清后,由油冷器（7）进行冷却，再经管路（103）从P 口进入控制阀（9）。当压缩空气从控制阀（9）上部的Z1/4″接口进入时，气动活塞（10）和液动活塞（11）被压下，弹簧（12）被压下，工作油经控制阀（9）的A 口、管路（104）进入偶合器的工作腔中进行能量转换，然后从偶合器O1口回到油箱（17），偶合器处于全充满（即〝合〝的状态）。此时，动力机的功率通过偶合器和输出轴（6）输出；当压缩空气从控制阀（9）上部的Z1/4″接口泄掉时，气动活塞（10）和液动活塞（11）在弹簧的作用下，向上移动，工作油经控制阀（9）的O2 口和管路（105）回到油箱（17），同时偶合器工作腔的A 口关闭，即没有工作油经管路（104）进入偶合器工作腔，而偶合器工作腔中残存的工作油，经偶合器固 6定导管（5）排回油箱（17）。此时，动力机驱动偶合器减速箱的主动部分旋转时，偶合器减速箱的从动部分停止旋转，液力偶合器处于全排空（即〝离〞）的状态。

偶合器减速箱具有离合器的功能。

四、特性曲线

1、功率容量

偶合器反车箱的功率容量如图1.1所示，按其输入功率P1(即柴油机的标定功率PC减去风扇功率消耗PCF)和偶合器减速箱的输入转速n1(即柴油机的标定转速C)，可确定偶合器减速箱的型号。

例如，当PC=1100kW，PCF=40kW， P1=1100-40=1060kW，而n1=nC=1300r/min时，应选用YOTFJ750型液力偶合器反车减速箱，其减速比可在1.8～3.3范围内选择。

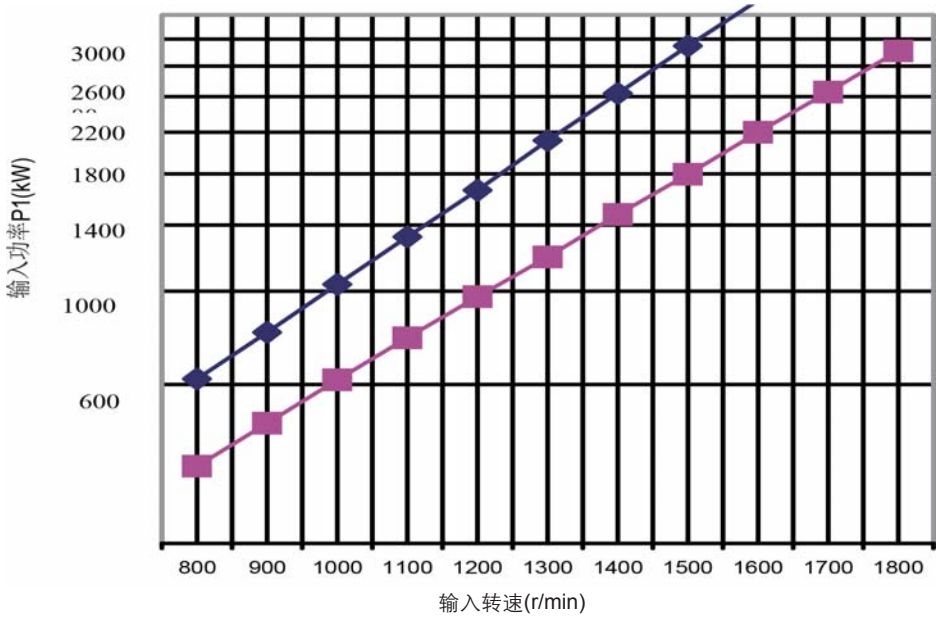


图1.1 YOTFJ750/875型偶合器功率容量图

2、输出特性

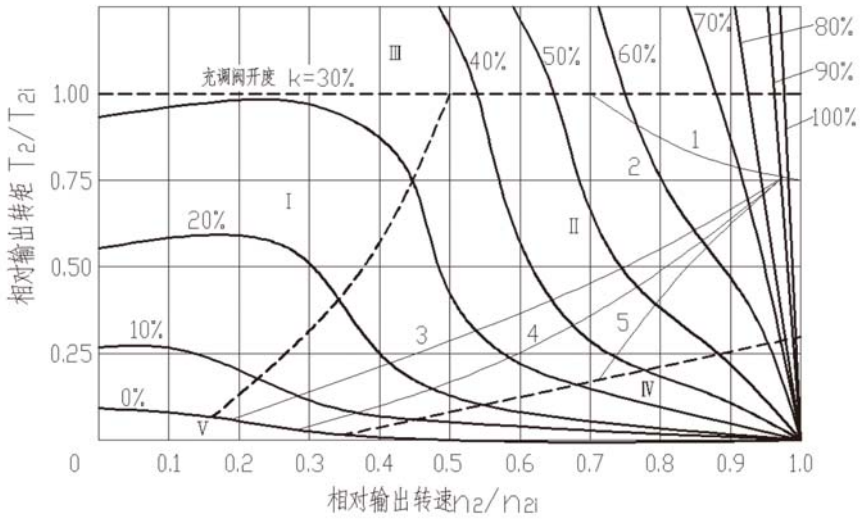


图1.2 YOTFJ750/875型偶合器无因次输出特性曲线

（图中充调阀开度k值依次分别为10%，20%，30%，……，100%）

1-递减力矩工作机特性曲线 2-恒力矩工作机特性曲线 3-直线型力矩工作机 特性曲线
4-抛物线型力矩工作机特性曲线 5-陡升力矩工作机特性曲线

五、结构特点

液力偶合器反车减速箱具有以下结构特点

1.偶合器反车箱采用固定导管调速技术，该技术属国内首创，结构新颖，调速、离合控制灵敏可靠，系统的功能和配置独具自己的特点。

2.偶合器反车箱的输出轴在输入轴中心线上方，比输入轴中心高出425mm，与泥浆泵输入轴中心高比较接近，这样柴油机偶合器反车箱机组可采用万向轴与泥浆泵直联方式进行连接。

3.采用偶合器反车箱比正车箱少了一组齿轮，传动效率要提高1%左右。

4.改进设计了偶合器反车箱的润滑系统，确保偶合器反车箱在叶轮工作腔完全排空时（即泵轮与涡轮完全脱开时），都能够满足轴承系的润滑强度要求。

六、性能特点

（一）液力偶合器反车减速箱性能特点

1.安装方便，柴油机偶合器机组和钻井泵可分别实现整体吊装。

2.与传统单机泵组配置相比，取消了皮带传动，避免了因为皮带拉伸而经常调整皮带弦紧度的弊病。

3.具有离合器功能。当柴油机不停机时，且在任何转速下，通过偶合器的充油和排油，可以在没有任何冲击和磨损的情况下，平稳的进行离合，可以取代气囊离合器，简化传动部件。

4.防止动力过载。当输出轴力矩突然增加时，偶合器的滑差会自行增加，从而保护柴油机、泥浆泵和偶合器反车箱不至于损坏。

5.运行可靠、使用寿命长 偶合器反车箱是一种以矿物油为介质的柔性传动装置，在运转和离合过程中无任何冲击和磨损，同时还能吸收来自柴油机和泥浆泵的振动。因此，其运行可靠性和寿命明显高于不带偶合器的机械传动装置。提高柴油机及传动系统的寿命40～60%，减弱泥浆泵泵压脉动振幅50%。

6.轴承齿轮采用强制飞溅润滑。在箱体上设计有油道，分别对齿轮端面、轴承进行润滑冷却，保证其正常工作。

7.偶合器反车箱齿轮系的涡轮轴、输出轴与齿轮内孔的联接，采用油压锥度过盈配合。其特点是：传递力矩大、使用寿命长，安全可靠。

8.输入轴和输出轴的轴端采用无接触式离心密封，永无磨损，具有很长的使用寿命。

（二）安装方式

方案一：联合水冷、法兰连接

偶合器反车箱采用联合水冷却，与柴油机安装在一个公用底座（4）上，其输入端与柴油机通过高弹联轴器（3）相连，具有性能可靠，结构紧凑，移运方便等特点，为柴油机偶合器反车箱机组标准配置形式，是我公司推荐的主导偶合器反车箱机组。

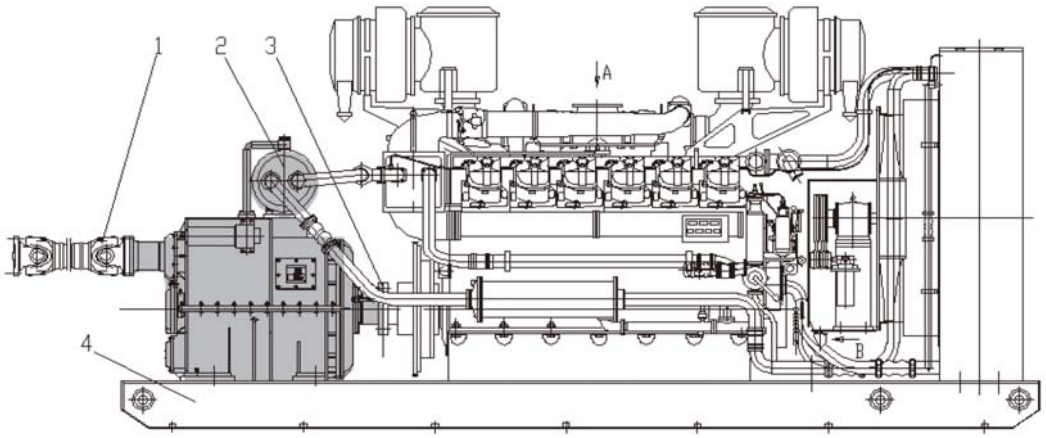


图1.3 联合水冷、法兰连接（公用底座安装）

1-万向轴 2-油冷器 3-高弹联轴器 4-公用底座

方案二：单独风冷、独立安装

偶合器反车箱采用单独风冷却，它独立安装在单独底座（4）上，通过万向轴（3）与柴油机联接并通过万向轴（1）与泥浆泵输入端相连。此方案较为灵活，可与不同类型、多种型号的动力机相匹配，也非常适合对单机泵组原配置系统实行改造。只需根据现场工况设计制作一共用橇座，将偶合器反车箱与柴油机连接固定在上面，组成一个模块单元，便于移运安装。

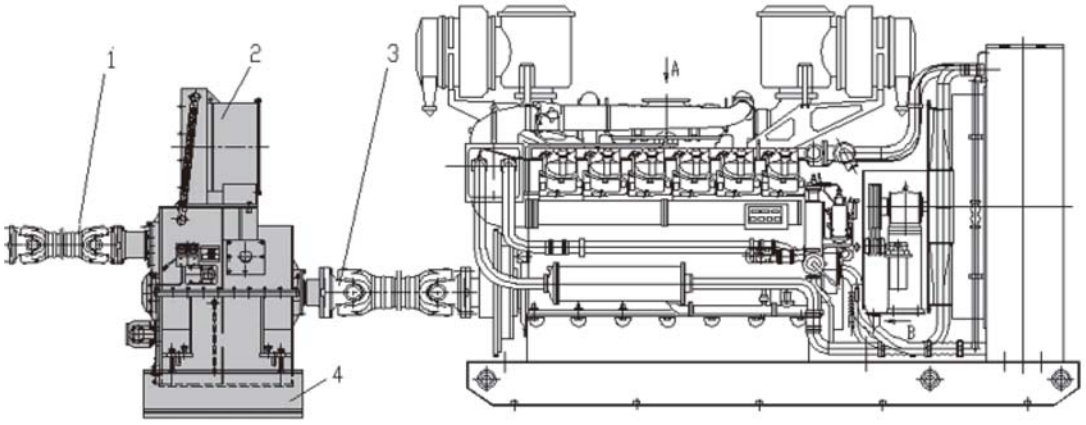


图1.4 单独风冷、独立安装

1-万向轴 2-风扇散热器 3-万向轴 4-单独底座

第二章 使用与维护保养

一、使用注意事项

用户应按本说明书的规定，正确对偶合器反车箱进行维护保养。

使用时，操作者应严格遵守以下注意事项：

（1）认真阅读本说明书，掌握偶合器反车箱的构造特点及使用操作方法。

（2）严格按照本说明书中规定的品种、牌号选用工作油。存放油料的容器应清洁，油料使用前应经沉淀和过滤。

（3）注意观察偶合器反车箱仪表数值，在额定工况下运行时，工作油压应在0.15～0.45MPa，工作油温应小于100℃，在与工作机（泥浆泵）分离状态下，偶合器反车箱在额定转速下工作油压应在0.05～0.15MPa。

（4）严格执行有关技术保养的规定，按规定认真进行各项技术保养工作。

（5）使用过程中应注意柴油机运行状况，运行中如发现异常现象时，应立即查找原因并及时排除。

（6）新机超出封存期或老机长期封存重新启用时，不得直接安装使用。启用前，必须全面进行检查。

二、工作油

1、液力传动油是一种纯度很高的油品，当环境温度高于-20℃时，应使用6 号液力传动油，它是一种浅黄色透明的液体；当环境温度低于-20℃时，应使用8 号液力传动油，它是一种红色透明的液体。偶合器工作油在储存和使用中要严格管理，置于库房内或干燥通风处，严防杂质、水分混入，以免乳化变质。

2、工作油的使用期限和换油

（1） 在偶合器减速箱新产品的使用初期，使用在50～100 小时后，应进行第一次换油；再次使用300～500 小时左右后，进行第二次换油（此时换下的油一般经过滤后仍可使用）。

（2） 每隔3 个月对工作油的状况进行一次检查，有条件的，可送化验室进行取样检查，属于下列情况之一的，必须换油：

a、含水量＞0.2%

b、在50℃时的黏度比新油高出6厘泊（工程单位制）

c、总杂质量（标准苯不溶解物）达到0.2%

d、总盐值比新油低5%以上

e、有高的盐酸值

f、泡沫过多

在没有条件的地方，也要按时取油样，检查外观，看是否有乳化现象。若嗅有臭味或颜色变黑，需做腐蚀试验，即在油样内放入铝片、铁片及铜片，在100℃下煮3 小时，若发现其中一种金属片腐蚀，该工作油必须更换。

需要换油时，最好在偶合器工作油液循环流动停止一段时间后换油，换油时，需同时清洗供油泵进油口的滤网。还要注意是否有磨屑和零件的断裂碎块等，必要时需拆箱做进一步检查。

（1）、使用2000 小时后，必须换成新油，旧油作废。

（2）、新机使用5000 小时后，需解体检查，进行中修。

3、换油方法

（1）、打开观察孔盖；

（2）、盘动偶合器输入轴，将泵轮罩外圆放油孔螺钉处，旋转到最下方，放空偶合器工作腔中的工作油。然后打开位于输出端箱体外下部的放油阀和全部放油堵，放净工作油。

（3）、关闭放油阀，安装好观察孔盖。

（4）、拧下呼吸器，从该处注入新的工作油。

（5） 箱体上装有油尺，用于检查箱体内的油面高度，方法是：先将油尺抽出，用干净棉纱擦净尺面。然后重新插入油尺座内，再抽出观察尺面上着油位置。在油尺尺面上刻有三条刻线，柴油机正常使用过程中，箱体内油液面应位于下面两刻线之间。新机起动前，油液面应位于上刻线附近。正常运行后，液面不得低于下刻线。注意：偶合器使用过程中，应密切监视油液面变化。偶合器使用过程中，若发现油液面出现异常升高现象时，应及时查找原因，检查是否有冷却水漏入油中，待故障排除后，必须重新更换合格油。若发现液面迅速下降时，应检查是否有泄漏现象，待故障排除后，应重新添加工作油。

三、保养

偶合器减速箱出厂后，有效封存期为半年。如长期存放或停用，应及时检查封存保养。严禁露天存放。存放时，必须排空工作油。

维护保养规程

1 级保养：每个工作日保养一次。

2 级保养：每1000～2000 小时，保养一次。

3 级保养：每5000 小时，保养一次。

维护保养项目

序 号	项 目	级 别		
		1	2	3
1	清洁外部	▲		
2	检查油面高度	▲		
3	检查工作油有无渗漏	▲		
4	检查地脚螺栓有无松动	▲		
5	检查有无异常声响和振动	▲		
6	监控油温和油压表显示数值是否正常	▲		
7	检查输入和输出法兰联接螺栓有无松动		▲	
8	打开盖板，观察齿轮啮合情况		▲	
9	清洗控制阀		▲	
10	检查工作油中有无大量水分		▲	
11	检查油滤器进、出油差		▲	
12	更换工作油，清洗油泵吸入口滤油器		▲	
13	拆检清洗机油冷却器			▲
14	按《大修规程》进行大修			▲

注：“▲”号为必须进行的项目；

第三章 故障及排除方法

偶合器反车箱在运用中，可能产生的一般故障及原因和处理方法：

项 目	可能原因	排除方法
振 动	安装精度低	重新找正
	地脚螺钉或输入、输出法兰联接螺栓松动	拧紧各处螺栓、螺钉
	机组扭振	按扭振计算情况采取消振措施
工作油压无或太低	压力表损坏	更换压力表
	油面太低	加油
	控制阀卡死在〝泄油〞位置	清洗或维修控制阀
	油泵进口滤油器堵塞	清洗或更换滤网
工作油温过高（＞110℃）	油冷器堵塞	清洗导通油冷器
	油面过高	降低油面
异常声响	轴承、齿轮等机械元件损坏	解体大修
与泥浆泵分离不开	控制阀控制手柄位置不对	将手轮左旋至零位

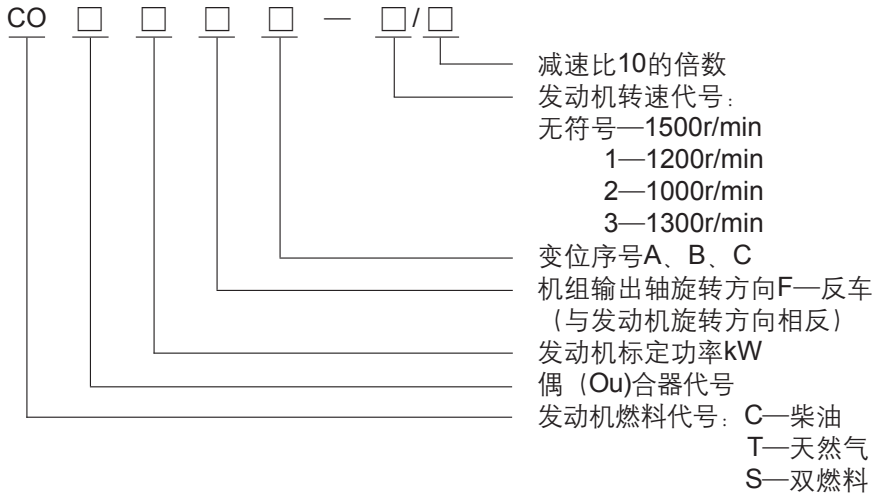
第四章 配套机组

一、匹配型式

偶合器反车减速箱可与2000系列，3000系列，4012系列柴油机配套成偶合器反车箱动力机组。

二、机组型号

机组型号表示方法



示例：CO810F-3/20

C：柴油机

O：偶合器

810：柴油机标定功率为810kW

F：反车

—3：柴油机标定转速为1300r/min

20：齿轮减速比为2.0

三、 安装匹配

（一）匹配形式

偶合器与柴油机用高弹联轴器相连并安装在同一共用底盘上，柴油机偶合器机组采用联合水冷却，机组输出端用万向轴与泥浆泵直接相连，如图4.1所示，这是采用偶合器反车箱机组与泥浆泵配套，组成新的单体泵组配置形式，虽然偶合器反车箱输入端与输出端旋向相反，但泥浆泵可以从两端输入，只需将泥浆泵动力端向左摆（从偶合器反车箱机组方向看）仍可确保泥浆泵正转，如果现场工况有特殊需求，用户可选用宝石生产的反转泥浆泵（R系列），可保持泥浆泵常规安装位置（即泥浆泵动力端向右摆）。鉴于目前钻井泥浆泵制造厂家繁多，性能指标、接口尺寸各有不同，我公司可根据用户的不同需要和工况要求，为你精心设计匹配，选择最优配套方案，并可提供单机泵组整体配置系统的设计、制作、安装与调试。

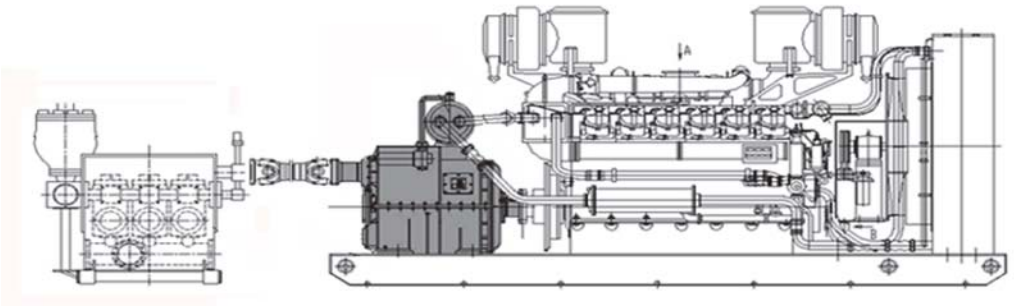


图4.1 单机泵组偶合器反车箱安装外形图

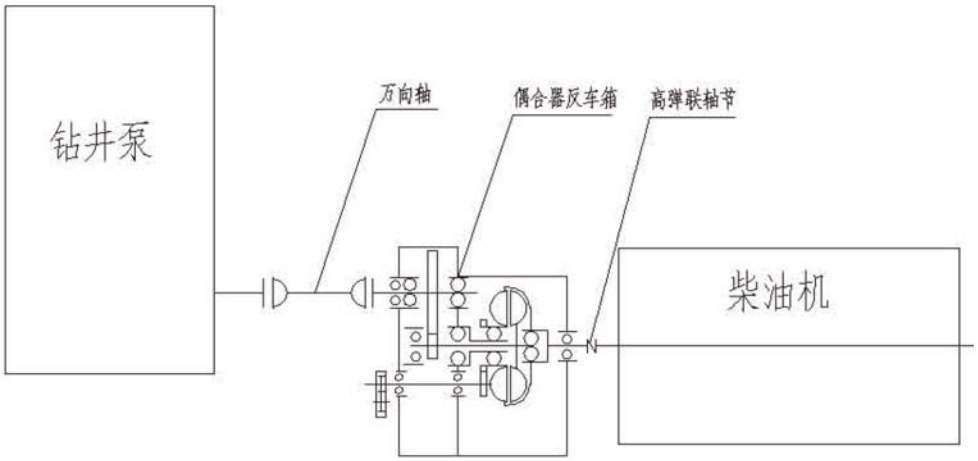


图4.2 单机泵组偶合器反车箱传动示意图

（二）推荐匹配

序 号	机组型号	泥 浆 泵 型 号	泥浆泵生产厂家	泥浆泵泵冲
1	CO470F-1/33	3NB500C	兰石	95
2	CO810F-3/30	3NB1000C	兰石	110
3	CO1000F/33	3NB1300C	兰石	120
4	CO1300F-3/30	3NB1600	兰石	115
5	CO510F-3/20	F-500	宝石	150
6	CO810F-3/25	F-800	宝石	120
7	CO900F/25	F-1000	宝石	140
8	CO1000F/30	F-1300	宝石	120
9	CO1300F-3/25	F-1600	宝石	120

以上表中所列是目前油田采用较多的两大系列（F、3NB）泥浆泵与偶合器反车箱机组配套型号系列，仅供参考。用户可根据实际工况需求，提出新的建议和要求，我们将竭诚为您提供最优良的服务。

四、安装要求

（一）首先接通偶合器控制阀气源，气源压力为0.5～0.8MPa。

（二）机组对中安装要求

在运输过程中，或机组经过一段时间运行后，其相互位置精度会发生变化，故需进行检查调整。调整时，机组应充满油和水。要求柴油机与联轴器输入端、偶合器输入端与联轴器输出端之间的轴向偏差为±2mm，径向偏差为±0.20mm，角度偏差为±0.5°。

其具体检查调整方法如下：

1、将1 只磁力百分表（径向调整百分表A）的磁力表座安放在偶合器反车箱输入法兰上，表的触头对准柴油机飞轮的外圆；将另一只磁力百分表（端面调整百分表B）的磁力表座也安放在偶合器反车箱的输入法兰上（2 只百分表在圆周方向相隔90°），表的触头对准柴油机飞轮的端面。

2、盘动偶合器输入法兰，要求径向和端面调整百分表的跳动偏差均不得大于±0.2 mm，否则，通过调整顶起螺栓以及增加或减少调整垫的厚度，进行调整；若端面跳动偏差大于±0.2 mm，则通过左右调整螺栓进行调整。

特别提醒：在用百分表找正时，务必要在拧紧4-M24 地脚螺栓和松开顶起螺栓的情况下进行。

（三）连接要求

偶合器与柴油机对中位置调好后，应将各联接部分螺栓固紧。连接螺栓的旋紧力矩应符合下表所示要求。

尺 寸	预紧力N	拧紧力矩N.m
M8	16500	25
M12	38500	86
M16	73000	215
M20	113000	400

五、机组操作与控制

机组启动前，柴油机按其说明书规范要求进行检查操作，偶合器反车箱控制阀应处于关闭位置（关闭压缩空气源开关阀，手动轮应左旋至零位即手轮丝杠旋退至最长位置）。

启动柴油机，使其在怠速下运转5分钟，然后将柴油机转速提高到1000r/min，运转5分钟，观察偶合器反车箱压力表及温度表的读数。工作油压应为0.05～0.15MPa，工作油温应低于60℃。将泥浆泵循环系统按规范检查操作完毕，接通偶合器反车箱控制阀气源或右旋控制阀手轮（手轮丝杠旋进至最短），偶合器反车箱控制阀全部打开，偶合器工作腔全充油：输出轴缓慢转动并加速至对应转速，此时泥浆泵的泵速也应达到相应冲数。

运转5分钟，观察偶合器反车箱压力表及温度表的读数，工作油压力应为0.1～0.2MPa，工作油温应≤80℃。

将柴油机转速调至标定转速，在额定工况下，工作油压应为0.15～0.45MPa，工作油温≤100℃。

特别提示：当使用压缩空气开关阀控制偶合器控制阀的开度时，一定要将控制阀手动轮左旋至零位。当使用手动轮调整控制阀开度时，必须将压缩气源关闭。

附表1：2000系列柴油机偶合器反车箱机组匹配一览表

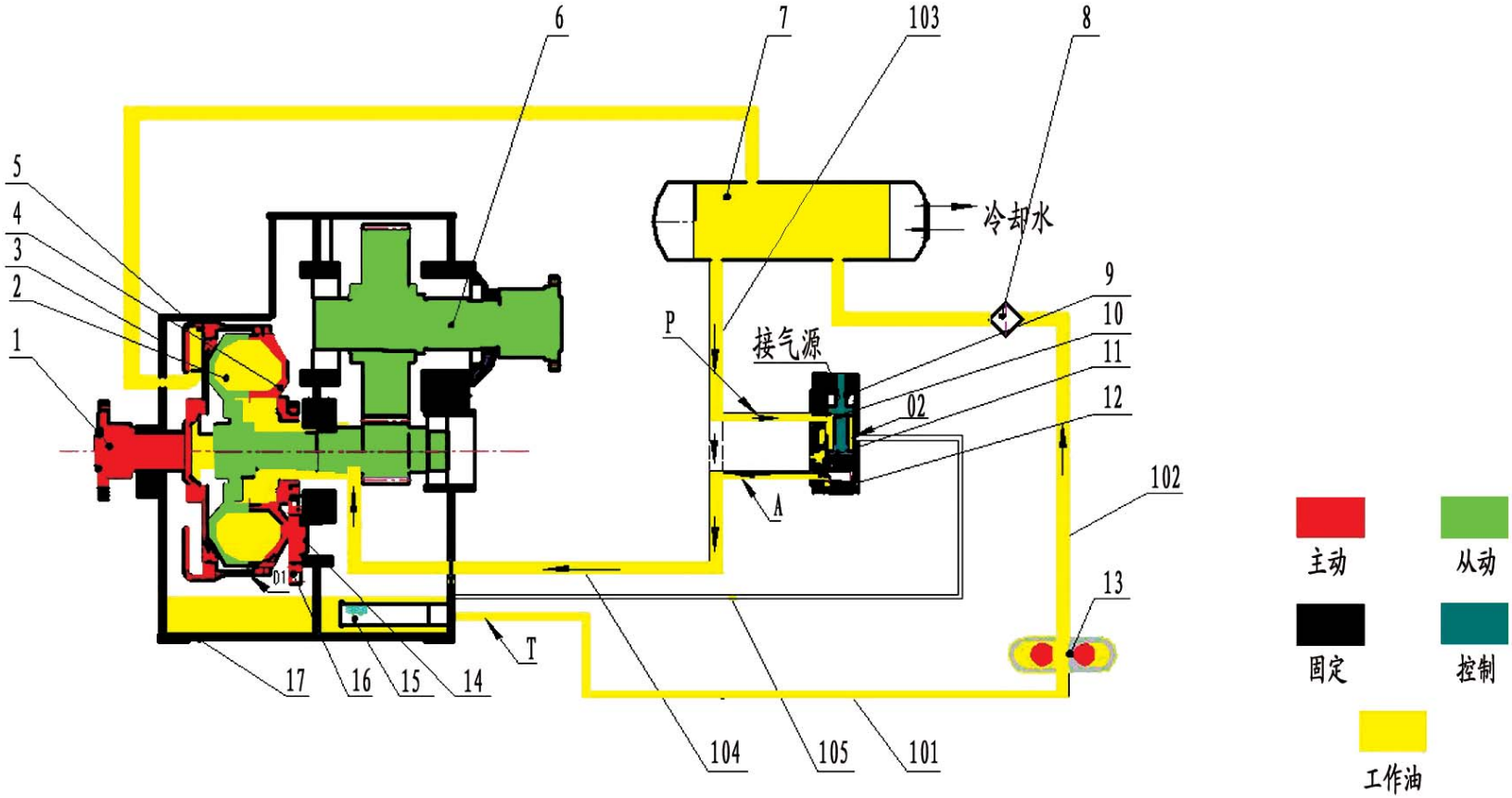
系列	柴油机参数			柴油机型号	偶合器型号	机组型号	偶合器输入功率（kW）	偶合器效率（%）
	ge(g/k W.h)	N(r/min)	Ne(kW)					
2012系列	209	1200	735	G12V190Z_L-1	YOTFJ750-22FlshA	CO735F-1/22	695	95
		1300	810	G12V190Z_L-3	YOTFJ750-25FlshA	CO810F-3/25	770	
		1500	900	G12V190Z_L	YOTFJ750-33FlshA	CO900F/33	860	
2008系列	209	1300	510	G8V190PZ_L-3	YOTFJ750-20Flsh	CO510F-3/20	470	

附表2：3000系列柴油机偶合器反车箱机组匹配一览表

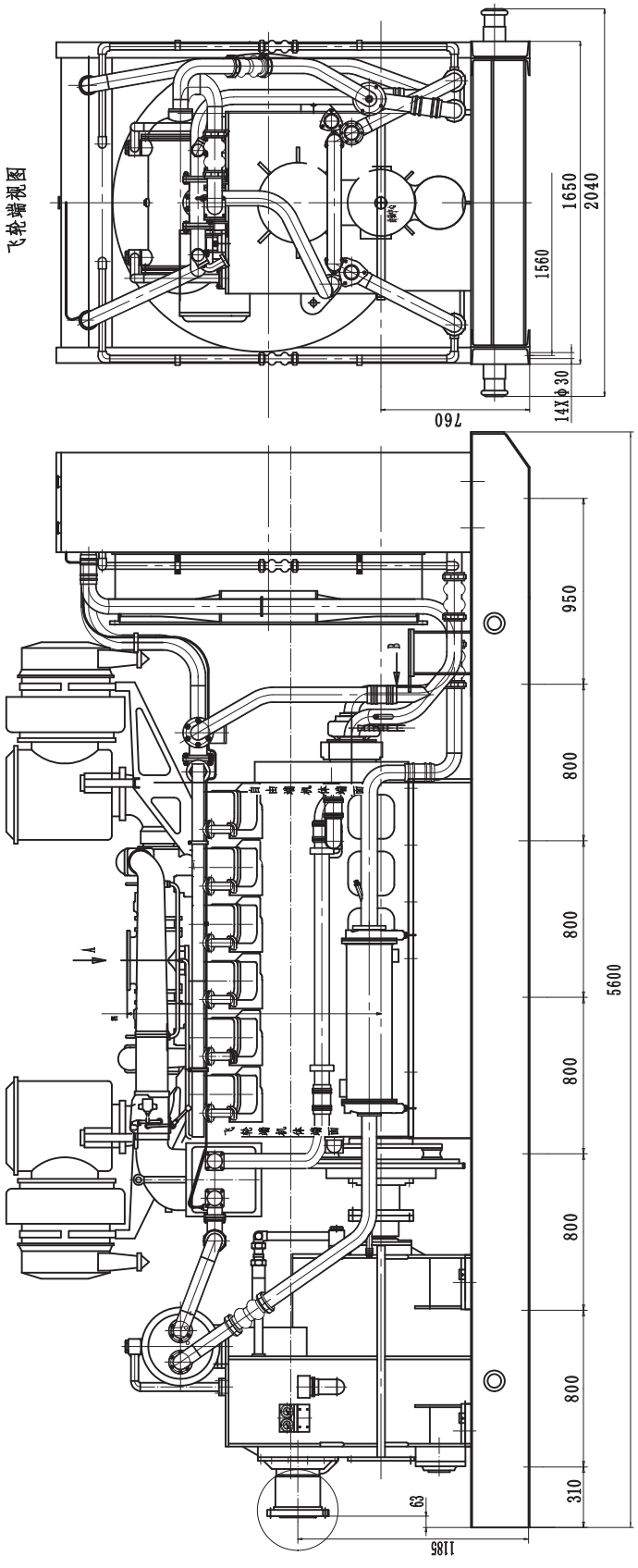
系列	柴油机参数			柴油机型号	偶合器型号	机组型号	偶合器输入功率（kW）	偶合器效率（%）
	ge(g/k W.h)	N(r/min)	Ne(kW)					
3012系列	205	1500	1200	A12V190Z_L	YOTFJ750-22FlshA	CO735F-1/22	695	95
		1300	1100	A12V190Z_L-3	YOTFJ750-25FlshA	CO810F-3/25	770	
		1200	1000	A12V190Z_L-1	YOTFJ750-33FlshA	CO900F/33	860	
B3012系列	202	1300	1210	BHV120PZ_L-3	YOTFJ750-20Flsh	CO510F-3/20	470	
		1500	1360	BH12V190Z_L	YOTFJ750-33FlshB1	CO1360F/33	1300	
4012系列	202	1200	1200	L12V190Z_L-1	YOTFJ875-22FlshA	CO1200F-1/22	1200	
		1300	1300	L12V190Z_L-3	YOTFJ875-25FlshA	CO1300F-3/25	1300	

注：减速比可根据不同需要在2.0~3.3范围内选定。

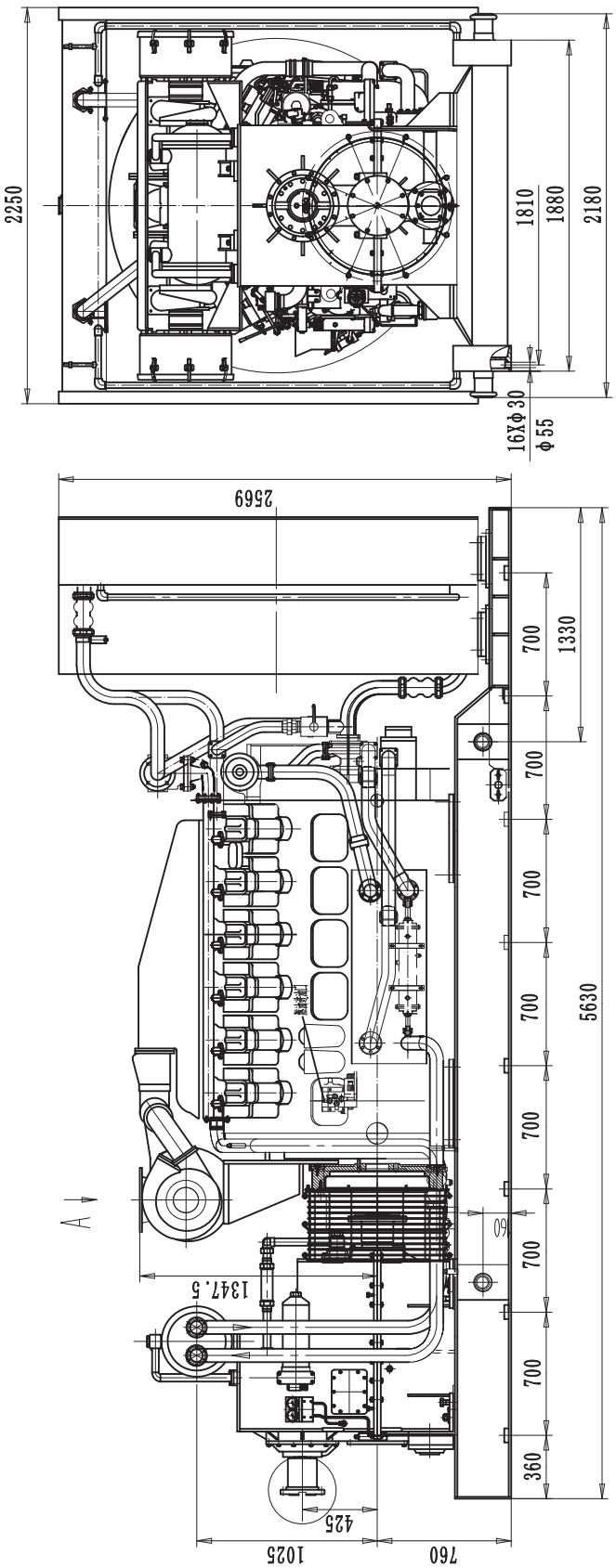
附图1：液力偶合器反车减速箱工作原理图



1—输入轴　2—涡轮　3—箱体　4—泵轮　5—固定导管　6—输出轴　7—油冷器　8—油滤器　9—控制阀
10—气动活塞　11—液动活塞　12—弹簧　13—机油泵　14—油泵轴　15—滤油器　16—油泵齿轮　17—油箱



附图2：2000系列柴油机偶合器反车箱机组外型及安装尺寸图



附图3：3000系列柴油机偶合器反车箱机组外型及安装尺寸图

Preface

Thank you for selecting ″Jichai″ YOTFJ 750/875 hydraulic coupling reverse reducing gear box and it is a pleasure for us to provide service for you.

This instruction mainly presents the performance data, operating principle and structure features, and describes the requirements for packaging with various mud pumps and for operation and maintenance of YOTFJ 750/875 coupling reverse reducing gear box. Read the instruction carefully before operating it so that you can correctly use it and achieve its full potential.

Cautions

1. The operator shall carefully read the ″Instruction″ before using the product, and install, debug, operate and maintain it according to the relevant regulations and requirements in the book.

2. The user shall select the working oil in strict accordance with the varieties and grades specified in this manual. Special attention shall be given to the working period of the working oil and oil change.

3. About rotating parts and high temperature oil: pay attention to safety during operation and avoid being hurt by the rotating parts; when the coupling is running, the working oil temperature should be less than 110 ° C, take care to avoid high temperature burns.

4. Be sure to use genuine spare parts produced or approved by the company. The company is not responsible for the failure caused by the use of counterfeit parts.

5. The coupling hoisting hole on the coupling box can only be used to hoist the coupling itself. The lifting tool, sling and spreader must have sufficient carrying capacity.

6. Rotating items shall be equipped with a protective cover. The protective cover must be able to prevent the invasion of harmful foreign matter, withstand unexpected impact while without over damage of itself. Ensure adequate ventilation and proper safety distance.

7. When repairing the coupling, it must be ensured that the power machine, coupling, and working machine are all stopped, and will not start under any circumstances at that time.

8. The working personnel shall be equipped with earplugs or earmuffs when the machine is working. If the sound level exceeds 85dB(A), hearing damage may be caused.

9. During the maintenance, the working personnel may slip or fall due to leakage of the transmission medium. Clean the leakage timely if possible.

Contents

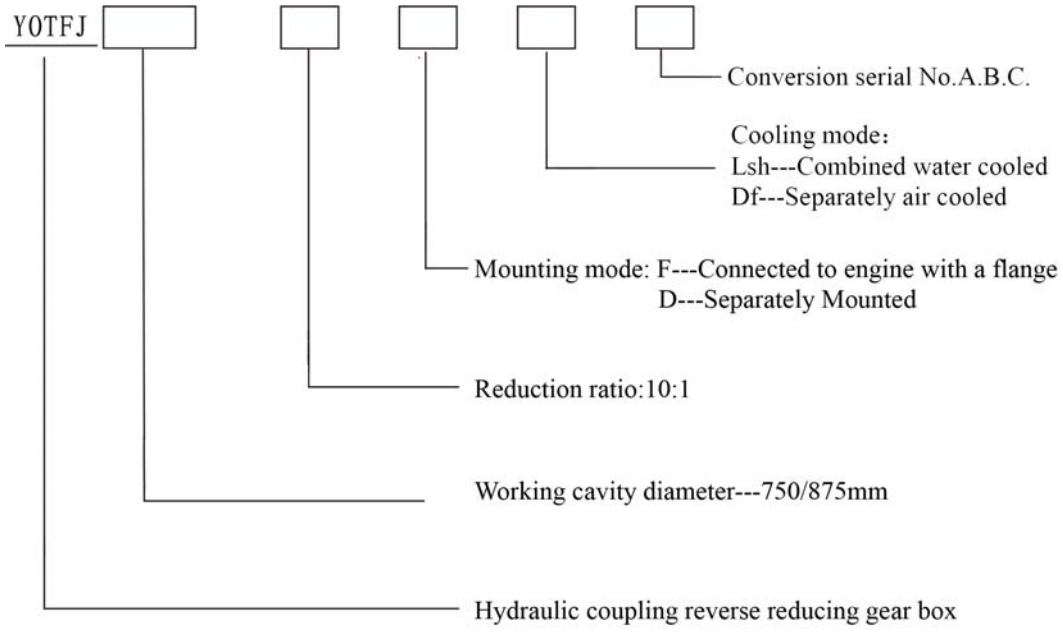
Chapter I Outlines

1. Brief Introduction

Hydraulic transmission device is widely used for modern oil drilling rig. Its typical transmission system is diesel engine + hydraulic transmission device + parallel chain which drive the working machine (winch, rotary table and mud pump) together. This hydraulic transmission system not only makes a high utilization rate of the power set, but also increase the operation reliability of all the sets. With the rapid development of drilling technology, various new drilling rigs have been developed and produced such as fully automatic electrically driven drilling rig, hydraulic top driven drilling rig, hydro-electric driven drilling rig and truck-mounted drilling rig. The new design and good performance of their overall drive mechanism embodies strong characteristic of times. Generally, the transmission of the mud pump is separated with that of the winch and the rotary table, using diesel engine (motor) to drive the mud pump set. The conventional mud pump set is that diesel engine drives the mud pump through a gear box, clutch and combined V belt, which is large in size and complex in system, and also pump displacement and pressure can only be adjusted by regulating the throttle of engine or replacing cylinder liner of mud pump. It´ s no good for frequent change of the pump liner and no good for diesel engine working at low speed range for long time, so the displacement and pressure of mud pump can only adjusted at a limited range, therefore, the requirement of drilling technology can not be met. In order to solve the above-mentioned problems and meet the development requirement of new drilling rig, our company has developed the fixed-guide speed-governing hydraulic coupling reverse reducing gear box.

2. Model

2.1 Model indication



2.3 Basic data of coupling

Table 1 Technical data for YOTFJ750/875 fixed-guide speed-governing type hydraulic coupling reverse reducing gear box

ata	Диаметр рабочей полости（mm）	
	750	875
Input speed(r/min)	1000~1500	1000~1500
Transferred power range(kW)	440~1300	950~1500
Reduction ratio	1.8~3.3	1.8~3.3
Rated slip	3%~5%	
Speed governing range	1~1/3	
Reaction sensitivity of clutching	25~35	
Temperature of working oil( )	≤110℃	
Oil grade	6# or 8#(6# hydraulic driving oil is used under the condition of ambient temperature of above -20 ， and 8# oil is used below -20	
Cooling mode	Combined water cooled/Separately air cooled	
Overall dimension(LxWxH mm)	1600×1300×1970	1700×1300×2100

3. Working Principle

The working principle of the hydraulic coupling reverse reducing gear box is shown as attached Fig.1.When prime mover (diesel engine or motor) drives the input shaft (1) and pump wheel (4) to rotate, the working oil forms high speed and high pressure liquid flow under the action of pump wheel vane, and flows from shaft center to its outside, then radial inflow into the turbine (2) and make it rotate. The liquid flow coming out from the turbine returns to pump wheel (4), forming continuous circulation between pump wheel (4)-turbine (2)-pump wheel (4).The pump wheel(4) converts the mechanical energy transferred by the prime mover into the dynamic energy and pressure energy of working fluid, while the turbine converts the latter into the former, finally transfer it to universal coupling and mud pump through the reducing gear box behind the coupling. When pump wheel（4）rotates at a constant speed and working machine applies increasing load to the coupling turbine through the mechanical parts of drilling rig and the gear box, the turbine speed will go down; Whereas when working machine applies decreasing load to the turbine, the turbine speed will go up.

When pump wheel(4) rotates, it drives oil supply pump(13) to rotate through gear(16) and working oil is drown out from oil tank(lower casing)(17) through rough filter(15) and oil piping(101),then is filtered in the filter(8) and cooled in oil cooler(7),finally enters into control valve(9) from port P through piping(103).When compressed air enters into control valve(9)from its Z 1/4〃port, the pneumatic piston(10) and hydraulic piston(11) and spring（12）are pressed down， working oil flows into working cavity of coupling through port A of the control valve and piping(104) for energy conversion, and then returns to oil tank(17) from port 01 of the

coupling, and the working cavity of coupling is in fully filled (i.e. ″On″) state. At this time, the prime mover transmits power out through coupling and output shaft (6)；When compressed air is drained out from the Z 1/4〃port of the control valve, the pneumatic piston（10）and hydraulic piston（11）move upward under the action of spring, the working oil flows back to oil tank through port 02 of the control valve and piping (105)，meanwhile, port A of coupling working cavity closes, i.e. there is no working oil passing through piping(104) or entering into coupling working cavity, while the working oil remaining in the working cavity flows back to oil tank(17) through the fixed guide (5) of the coupling. At this time, the prime mover drives the pump wheel of coupling reducing gear box to rotate , while the turbine of it stops rotating, the working cavity of hydraulic coupling is in fully drained-off (i.e. ″Off″) state.

The coupling reducing gear box has the function of clutch.

4. Characteristic Curve

4.1 Power capacity

The power capacity of coupling reverse reducing gear box is shown as Fig1.1 .The model of the coupling gear box can be defined according to its input power P1(i.e. engine rated power PC minus fan power consumption PCF) and its input speed n1(i.e. engine rated speed nc).

For example, when PC=1100kw, PCF=40kw, then P1=1100-40=1060kw;

While when n1=nc=1300r/min, then YOTFJ 750 hydraulic coupling reverse gear box should be chosen. Its reduction ratio can be selected in the range of 1.8~3.3.

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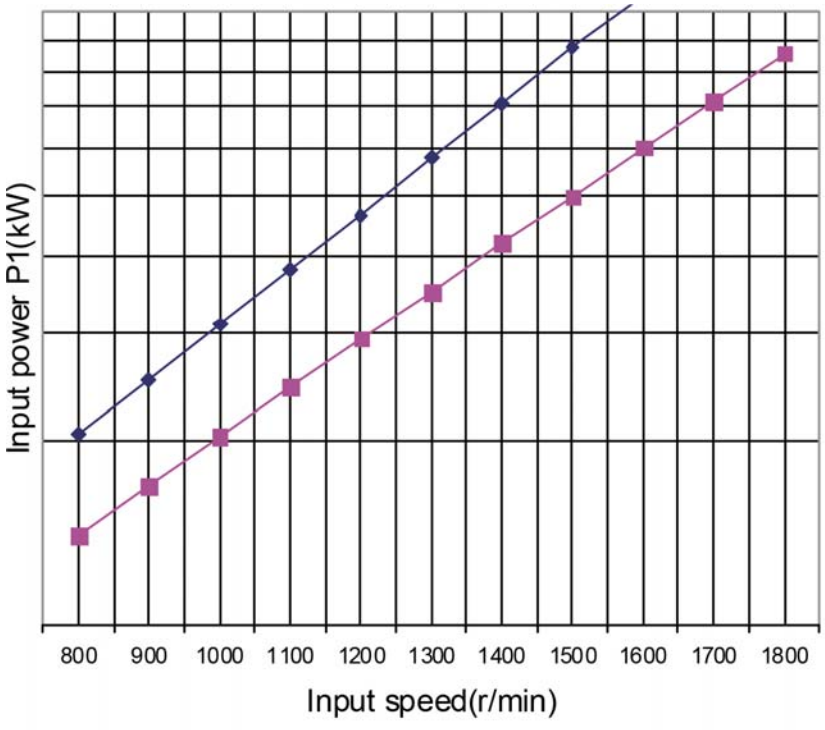

Fig1.1 Power Capacity Diagram of YOTFJ750/875 Coupling

4.2 Output characteristic

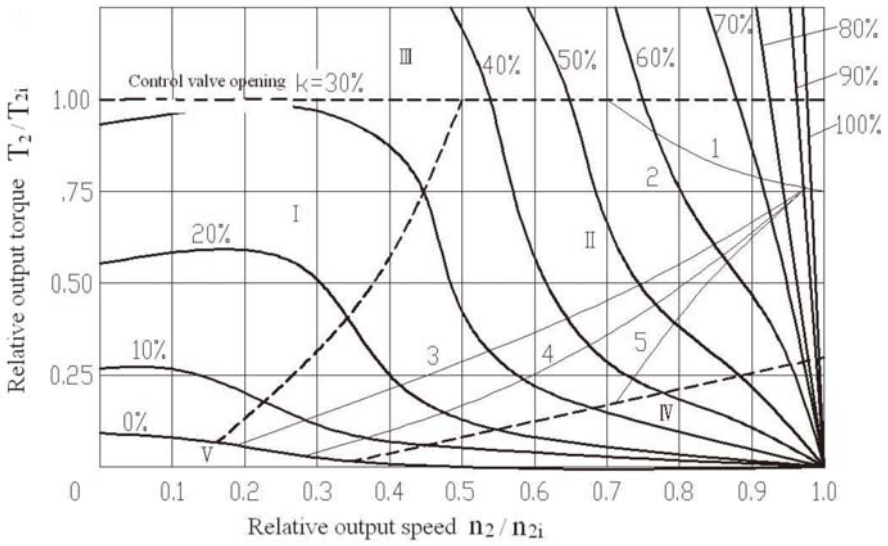

Fig 1.2 Non-dimension Output Characteristic Curve of YOTFJ750/875 Coupling

(The control valve opening K is 10%,20%,30%,.....,100% respectively as shown in Fig 1.2)

1-Characteristic curve of working machine with decreasing moment 2-Characteristic curve of working machine with constant moment 3- Characteristic curve of working machine with linear moment 4-Characteristic curve of working machine with parabolic moment 5- Characteristic curve of working machine with steep-rise moment

5. Structure Features

The hydraulic coupling reverse reducing gear box has the following structure features:

5.1 The fixed guide speed-governing technology is used for the coupling reverse reducing gear box, which is the first one in domestic. It is of the new structure, sensitive and reliable in speed governing and clutch control, and has its own features in system function and construction.

5.2 The output shaft of the coupling reverse reducing gear box is located 425mm above the center line of its input shaft and near the center height of the mud pump input shaft, which the diesel coupling reverse set can be connected directly with the mud pump through a universal coupling.

5.3 The coupling reverse gear box has one group of gears less than coupling ahead gear box, with about 1% higher transmission efficiency.

5.4 The lubricating system of coupling reverse gear box has been modified so as to meet the lubricating requirement of the bearing train with the working cavity of coupling reverse gear box being fully drained off (i.e. pump wheel rotates, while turbine speed is zero).

6. Performance features

6.1 The hydraulic coupling reverse reducing gear box has the following performance features:

6.1.1 Easy for installation. Both diesel coupling set and drilling pump can be wholly hoisted respectively for

installation.

6.1.2 Compared with the configuration of traditional single pump sets, driving belt is no longer used and there is no need to frequently adjust the tension of belt.

6.1.3 Having the function of clutch. When diesel engine is running, the coupling set can make smooth clutch on-off at any speed through oil feeding and draining of coupling without any impact and wear. It replaces the gas bag clutch and simplifies the drives parts.

6.1.4 Preventing torque overload. In case of the moment of output shaft increases suddenly, the coupling will have an increased slip by itself so as to protect the engine, mud pump and coupling reverse gear box from being damaged.

6.1.5 Reliable operation and long service life. The coupling reverse gear box is a flexible transmission device with mineral oil as medium. It has no impact and wear during operating and clutching. At the same time, it can absorb the vibration from the engine and mud pump. Therefore, its operation reliability and service life are obviously higher than the mechanical transmission devices with no coupling. It increases the life of the engine and transmission system of 40%~60% and reduces pulsating vibration amplitude of mud pump of 50%.

6.1.6 Forced splash lubrication is used for both bearing and gear, and oil passages are designed in the casing for lubricating and cooling the gear end face and bearing to ensure their normal operation.

6.1.7 Oil pressure taper interference fit is used for the connection of the turbine shaft and output shaft of gear train with the inner hole of gear, with features of large transferring moment, long service life as well as reliable and safe operation.

6.1.8 Non-contact centrifugal seal is used for both the input and output shaft ends, which never wear and have long service life.

6.2 Mounting mode

Mode 1: Combined water cooling, flange connection

Combined water cooling is used for the reverse reducing gear box. Its input end is connected to diesel engine with an elastomeric coupling(3) and both the coupling and engine are installed on the same common base(4), with features of reliable performance, compact design and easy to be moved and transported. It is the typical diesel coupling reverse set and also the main coupling reverse set recommended by our company.

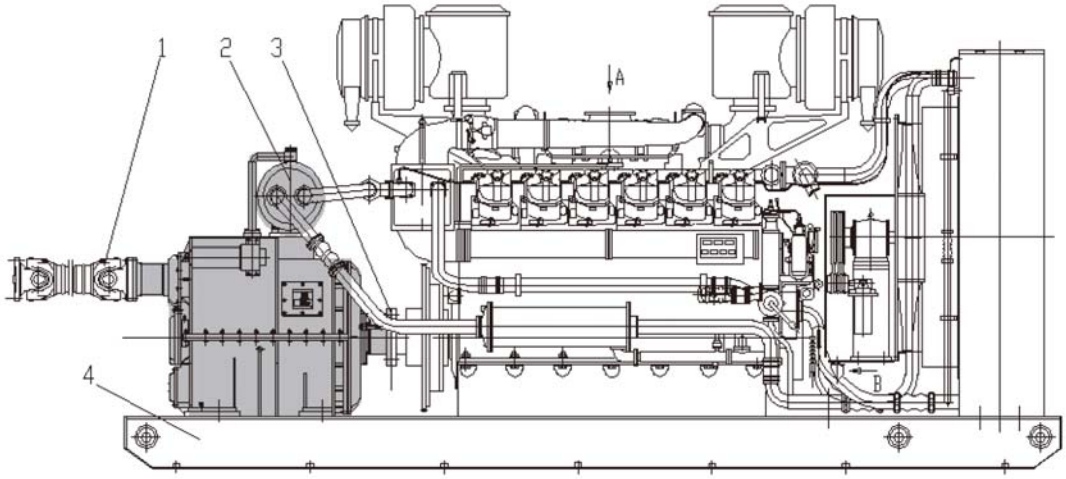

Fig 1.3 Combined water cooling, flange connection(on the common base)

1-Universal coupling 2-Oil cooler 3-Elastomeric coupling 4-Common base

Mode 2: Separate air cooling, independent mounting

The coupling reverse reducing gear box is separately air cooled and independently mounted on a separate base (4). It is connected to diesel engine through the universal coupling (3) and connected to mud pump input end with the universal coupling (1). With the flexible mounting mode, it can be packaged with different types and various models of prime movers, and is also suitable for modification of the conventional matching system of mud pump set. It only need to make a common skid according to site condition , connect the coupling with engine and install them on the skid to form a module unit for easy installation and transport

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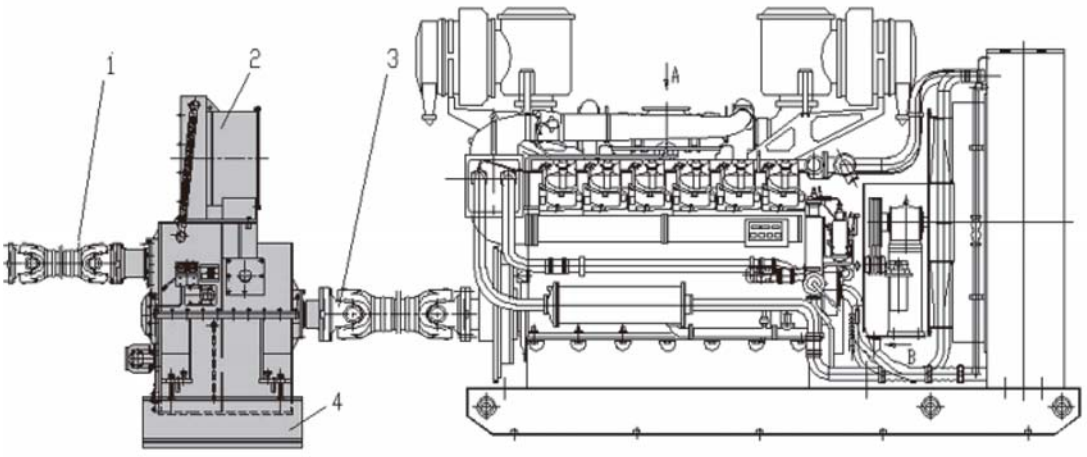


Chapter II Operation and maintenance

1. Precautions for Operation

Customers shall carry out correct operation and maintenance to the coupling reverse reducing gear box according to the requirements of this instruction .Operators should strictly abide by the following items during operation:

(a) Carefully read this instruction to make full understanding of the structure features and operating method of the coupling reverse reducing gear box.

(b) Select right working oil according to the types and grades specified in the instruction .Oil container should be clean and oil deposited and filtered before being used.

(c) Observe instrument values of the coupling reverse reducing gear box. The working oil pressure should be 0.15~0.45Mpa and oil temperature be lower than 100 when it runs at rated condition. In case of being separated with the working machine (mud pump), the working oil pressure should be 0.05~0.15Mpa when it runs at rated speed.

(d) Strictly and carefully carry out the technical maintenance works as per specified requirements.

(e) Observe running condition of diesel engine during operation of coupling set. In case of any abnormal situation occur, find out the trouble and shoot it.

(f) If a new coupling is beyond its storage period or an old coupling is reused after being stored for a long time, it can not be installed and reused directly. Complete inspection shall be made for the coupling before being used.

2. Working Oil

2.1 Hydraulic transmission oil is a kind of oil with high purity. If ambient temperature is higher than -20 , select 6# hydraulic transmission oil which is a light yellow transparent liquid; If ambient temperature is lower than -20 , select 8# hydraulic transmission oil which is a red transparent liquid. Keep the oil well during storing and using. Put it in a warehouse or in a dry place with good ventilation and prevent any contaminant and water from entering into it to avoid being emulsified.

2.2 Working period and oil change

2.2.1 In the initial operation period of a new coupling reducing gear box, the first oil change shall be performed after operating for 50~100 hours. The second oil change shall be done after operating for additional 300~500 hours (The changed oil still can be reused after being filtered).

2.2.2 Check the working oil once every three months. If available, send the oil to laboratory for sample inspection. Change the oil if it is in any of the following conditions:

a. Moisture content>0.2%

b. The oil viscosity is 6 centipoise higher than new oil at 50

c. Total contaminant (standard benzene un-dissolved matter) is up to 0.2%

d. Total salinity is 5% lower than new oil

e. High hydrochloric acid

f. Much more foam

If oil sample inspection in laboratory is not available, oil sample should also be taken on time and make visual inspection to see whether it is emulsified. If it smells odor or its color becomes darker, it need to do a corrosion test. That is, put an aluminum strip, an iron strip and a copper strip into the oil and boil them at 100 for 3 hours. If one of the metal strips is found corrosive, the oil must be changed.

It is better to change the oil after its circulating flow stopping for a certain time. Clean the oil filter at the inlet of oil supply pump during oil changing. Carefully observe if there is any chips and fragment of parts. Make disassembling for further check if necessary.

a. Oil should be changed with new one after 2000 hours operation, and the changed oil should be discarded.

b. Disassembling for check and middle overhaul are required after 5000 hours operation of a new coupling.

2.3 Method for oil change

2.3.1 Open sight cover;

2.3.2 Crank the input shaft of coupling, turn the drain screw at the excircle of pump wheel housing to the lowest position, drain off the working oil in the working cavity of coupling, and then open the drain valve and all oil plugs at the lower part of housing at the output end and drain off all working oil.

2.3.3 Close the drain valve and mount the sight cover.

2.3.4 Screw out the breather and fill new working oil from here.

2.3.5 An oil dipstick is fitted in the casing for checking the oil level. The method is: Draw out the oil dipstick and clean it with cotton yarn, then put it back into the oil dipstick holder and draw it out again to see the oil position on the dipstick. There are three mark lines on the dipstick. The oil level should be between the two lower mark lines when diesel engine is in normal operation. Before starting a new coupling set, the oil level should be near the top mark line, and oil level must not be lower than the lowest mark line when it is in normal operation. Notice: Observe oil level change during coupling operation. If abnormal rising of oil level is found, check immediately and try to find trouble. Check for cooling water leakage into oil. After trouble is shot, the oil should be changed with qualified one. If rapid falling of oil level occurs, check for any oil leaking. Fill working oil after trouble is shot

3. Maintenance

The valid storing period of the coupling reducing gear box after being delivered from the factory is half year. If it is stored for a longer timer or has a long downtime, make a check and perform maintenance in time. It is strictly forbidden that the coupling is placed outdoors. Drain off the working oil when it is stored.

Maintenance instructions are as follows:

1st class maintenance: maintain it once every working day

2nd class maintenance: maintain it once every 1000~2000 hours

3rd class maintenance: maintain it once every 5000hours.

Maintenance Items

Serial NO.	Items	Class		
		1	2	3
1	Clean the outside of coupling	▲		
2	Check oil level	▲		
3	Check working oil for any leakage	▲		
4	Check foot bolts for any loose	▲		
5	Check for any abnormal sound and vibration	▲		
6	Monitor the oil temperature and oil pressure values showed on gauges	▲		
7	Check the bolts of input and output flanges for any loose		▲	
8	Open the cover plate to check gear engagement		▲	
9	Clean control valve		▲	
10	Check for any water in working oil		▲	
11	Check oil inlet and outlet pressure difference of oil filter		▲	
12	Change working oil and clean oil filter at the suction port of oil pump		▲	
13	Remove, check and clean oil cooler			▲
14	Carry out overhaul according to Overhaul Regulations and Instructions			▲

Note: You must perform the items marked with ″▲″

Chapter III Trouble Shooting

The possible troubles, causes and trouble-shooting for the coupling reverse reducing gear box during operation:

Items	Possible causes	Trouble-shooting
Vibration	Low mounting accuracy	Readjust it
	Loose of foot bolts or connecting bolts of input and output flanges	Tighten all bolts and screws
	Torsional vibration of coupling set	Reduce vibration according to calculation
No oil pressure or too low oil pressure	Pressure gauge damaged	Change pressure gauge
	Low oil level	Fill oil
	Control valve seized at ″oil drain″ position	Clean or repair control valve
	Oil filter at the inlet of oil pump blocked	Clean or change filter gauze
Over high oil temperature(>110℃)	Oil cooler blocked	Clean and dredge oil cooler
	Over high oil level	Lower oil level
Abnormal sound	Mechanical parts such as bearing ,gear damaged	Dismantle and overhaul
Coupling can not be separated with mud pump	The control handle of control valve is not in the right position	Turn the hand wheel left to zero position

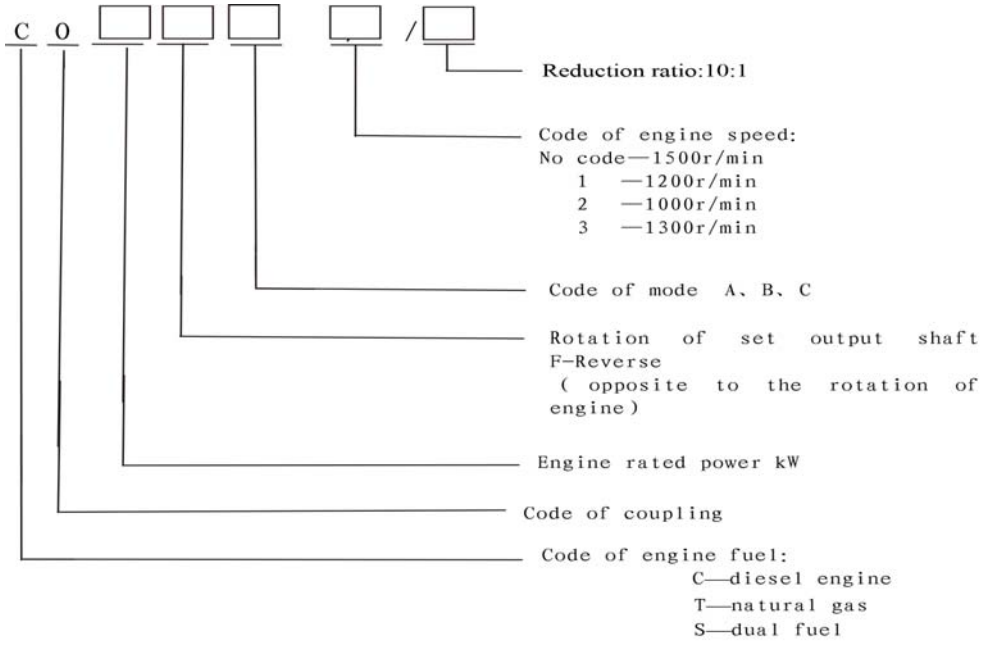
Chapter IV Packaged Coupling Set

1. Packaging Mode

Coupling reverse deducing gear box can be packaged into coupling reverse power set with series 2000, series 3000 and series 4012 diesel engines.

2. Model of Coupling Set

Model indication:



For example: CO810F-3/20

C: Diesel engine O: Coupling

810: Engine rated power is 810 kW F: Reverse

—3: Engine rated speed is 1300 r/min

20: Gear reduction ratio is 2.0

3. Installation and Packaging

3.1 Packaging mode

The coupling is connected to diesel engine with an elastomeric coupling and both of them are installed on the same common base. The diesel coupling set is combined water cooled with its output end connected directly to mud pump through a universal coupling, as shown in Fig 4.1. It is the packaging mode of the new mud pump set composed of coupling reverse set packaged with mud pump. Although the input end of the coupling reverse gear box has an opposite rotation to its output end, the mud pump is able to input from its

both ends. Forward rotation of the mud pump can be guaranteed by putting its power end to the left hand (viewed from coupling reverse set).When site working condition is specially required, customers can choose the reverse mud pump(R series) manufactured by Baoji petroleum machinery factory to keep the normal installation position of mud pump(i.e. putting its power end on the right hand).Since there are many drilling mud pump manufacturers, with different performance figures and interface dimensions, our company will carefully study the matching and choose the best packaging proposal according to the different demand of customers and working condition requirement, and also can provide design, manufacture, installation and commissioning of the overall matching system of mud pump set.

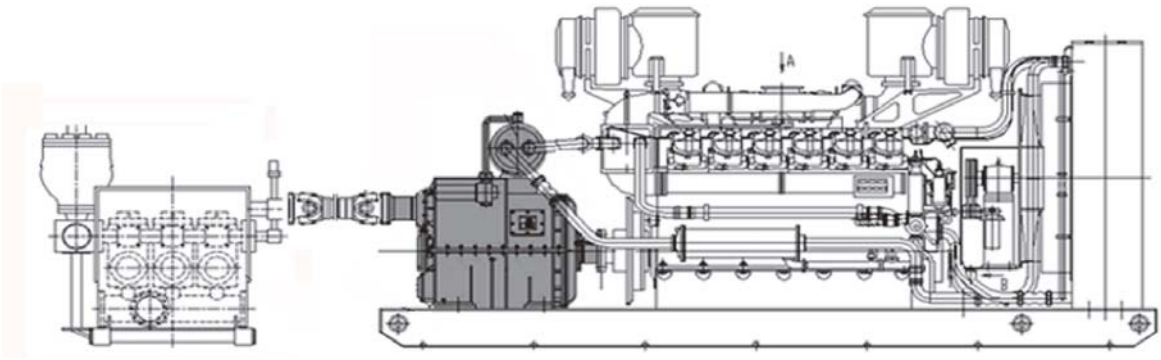


Рис. 4.1 Рисунок внешнего вида установки редуктора обратного хода гидроагрегата моноблочного насоса

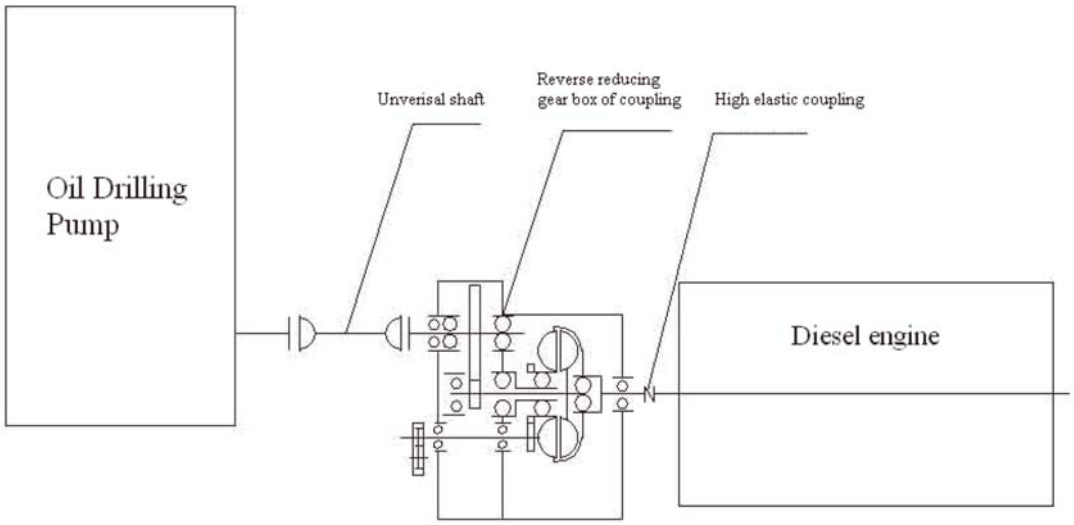


Fig 4.2 Transmission schematic Diagram of coupling reverse gear box of mud pump set

3.2 Recommended matching

Serial No	Model of coupling set	Model of mud pump	Mud pump manufacturer	Pumping number of mud pump
1	CO470F-1/33	3NB500C	Lanzhou Petroleum Machinery Factory	95
2	CO810F-3/30	3NB1000C	Lanzhou Petroleum Machinery Factory	110
3	CO1000F/33	3NB1300C	Lanzhou Petroleum Machinery Factory	120
4	CO1300F-3/30	3NB1600	Lanzhou Petroleum Machinery Factory	115
5	CO510F-3/20	F-500	Baoji Petroleum Machinery Factory	150
6	CO810F-3/25	F-800	Baoji Petroleum Machinery Factory	120
7	CO900F/25	F-1000	Baoji Petroleum Machinery Factory	140
8	CO1000F/30	F-1300	Baoji Petroleum Machinery Factory	120
9	CO1300F-3/25	F-1600	Baoji Petroleum Machinery Factory	120

The listening in the above table is the model series of the two major mud pump series (F and 3NB) mostly used in oil field packaged with coupling reverse set. It is presented here only for reference. Customers can propose suggestions and requirement according to actual working condition so as that we will provide you with excellent service.

4. Installation Requirements

4.1 First, turn on the air supply for the coupling control valve, with the pressure being at 0.5~0.8MPa.

4.2 Installation and alignment requirements for coupling set

During transportation or after operating for a certain period of time, the relative position accuracy of the coupling set may change, so check and adjustment will be needed. When you do this, the set should be filled up with oil and water. It is required that the axial displacement should be within ±2mm, the radial shift within ±0.2mm and the angular deviation within ±0.5° between the engine and coupler input end and between the coupler output end and the coupling input end.

Make the check and adjustment as follows:

(1) Put the holder of a magnetic micrometer (radial adjusting dial gauge A) on the input flange of coupling reverse gear box, with the stylus pointing to the outer circle of engine flywheel. Put the holder of the other micrometer (end face adjusting dial gauge B) on the input flange of coupling reverse gear box, too (the two meters are 90°to each other on the circle), with the stylus pointing to the end face of engine flywheel.

(2) Bar the coupling input flange and the runout of both the radial and end face adjusting dial gauges should be within ±0.2mm; or make the adjustment by adjusting the pushing bolt and the thickness of shim. If the end face runout is more than ±0.2mm, adjust the left or right adjusting bolts.

Special notice: You must tighten up the four M24 foot bolts and loosen the pushing bolts before making alignment with the dial gauge.

4.3 Connecting requirements

Upon the completion of the alignment between the coupling and diesel engine, fasten all the connecting bolts. The tightening torque for the connecting bolts should meet the requirements shown in the following table

Diameter	Pre-tightening force N	Tightening torque N.M
M8	16500	25
M12	38500	86
M16	73000	215
M20	113000	400

5. Operation and Control of Coupling Set

Before starting coupling set, check the operation of diesel engine according to the requirement and instructions specified in its manual. The control valve of coupling reverse gear box should be in ″off″ position (i.e. the valve of compressed air supply is in ″off″ state and hand wheel screw is back to the longest position).

Start the engine and let it run at idle speed for 5 minutes. Increase engine speed up to 1000 r/min and let it run for 5 minutes. Observe the readings of pressure gauge and temperature gauge of the coupling reverse gear box, with working oil pressure of 0.05~0.15 MPa and oil temperature of less than 60 . Check the operation of mud pump circulating system as per regulations. Turn on the air supply for the coupling control valve or turn the control valve hand wheel to the right (hand wheel screw is turned to the shortest position), the coupling control valve fully opens and coupling working cavity is fully filled with oil. Then the output shaft rotates slowly and speeds up to the corresponding speed. At this time, the mud pump speed should reach the relative pumping speed.

The coupling set runs for 5 minutes. Observe the readings of the pressure gauge and temperature gauge of coupling reverse gear box. The working oil pressure should be 0.1~0.2 MPa and oil temperature be less than 80 .

Adjust engine speed to the rated one. The working oil pressure should be 0.15~0.45MPa and oil temperature be less than 100 at the rated condition.

Special notice: When compressed air valve is used to control the opening of coupling valve, be sure to turn the control valve hand wheel left to zero position. When the hand wheel is used to adjust the opening of the control valve, compressed air supply must be cut off.

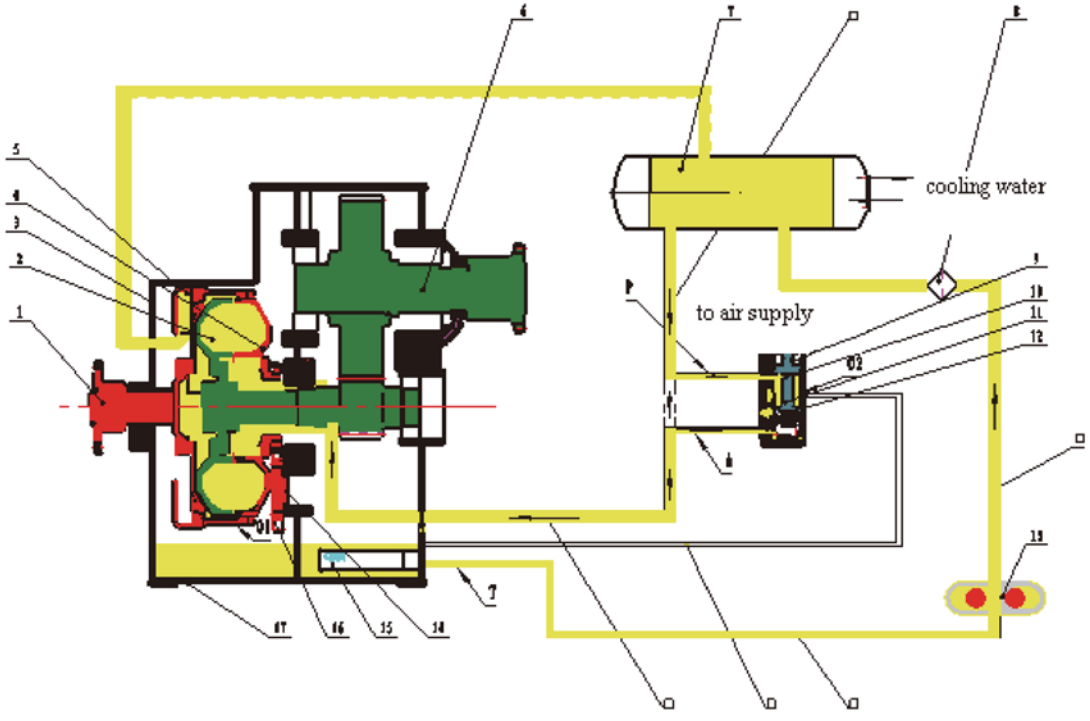
Attached Table 1 Packaging of series 2000 diesel coupling set

	Data of diesel engine			Engine model	Coupling model	Set model	Input power of coupling(kW)	Coupling efficiency(%)
	ge(g/kW.h)	N(r/min)	Ne(kW)					
Series 2012	209	1200	735	G1290V1ZL-1	YOTFJ750-22FlshA	CO735F-1/22	695	95
		1300	810	G12V190ZL-3	YOTFJ750-25FlshA	CO810F-3/25	770	
		1500	900	G12V190ZL	YOTFJ750-33FlshA	CO900F/33	860	
Series 2008	209	1300	510	G12V190ZL-1	YOTFJ750-20Flsh	CO510F-3/20	470	

Attached Table 2 Packaging of series 3000 diesel coupling set

	Data of diesel engine			Engine model	Coupling model	Set model	Input power of coupling(kW)	Coupling efficiency(%)
	ge(g/kW.h)	N(r/min)	Ne(kW)					
Series 3012	205	1500	1200	A12V190Z_L	YOTFJ750-33FlshB	CO1200F/33	1160	95
		1300	1100	A12V190Z_L-3	YOTFJ750-25FlshB	CO1100F-3/25	1060	
		1200	1000	A12V190Z_L-1	YOTFJ750-22FlshB	CO1100F-1/22	860	
Series B3012	202	1300	1210	BH12V190Z_L-3	YOTFJ750-25FlshB1	CO1210F-3/25	1150	
		1500	1360	BH12V190 Z_L	YOTFJ750-33FlshB1	CO1360F/33	1300	
Series 4012	202	12001	1200	L12V190 Z_L-1	YOTFJ875-22FlshA	CO1200F-1/22	1200	
		1300	1300	L12V190 Z_L-3	YOTFJ875-25FlshA	CO1300F-3/25	1300	

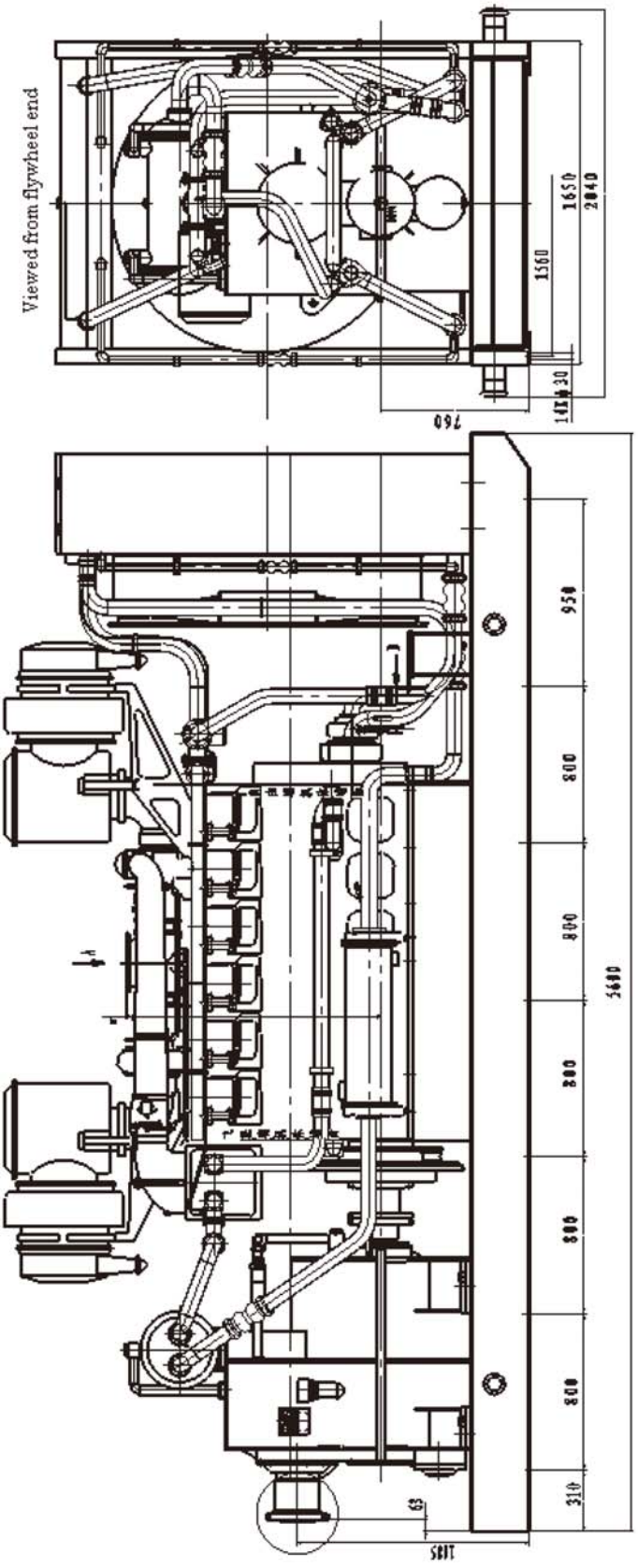
Note: The reduction ratio can be chosen in the range of 2.0~3.3 according to different requirement



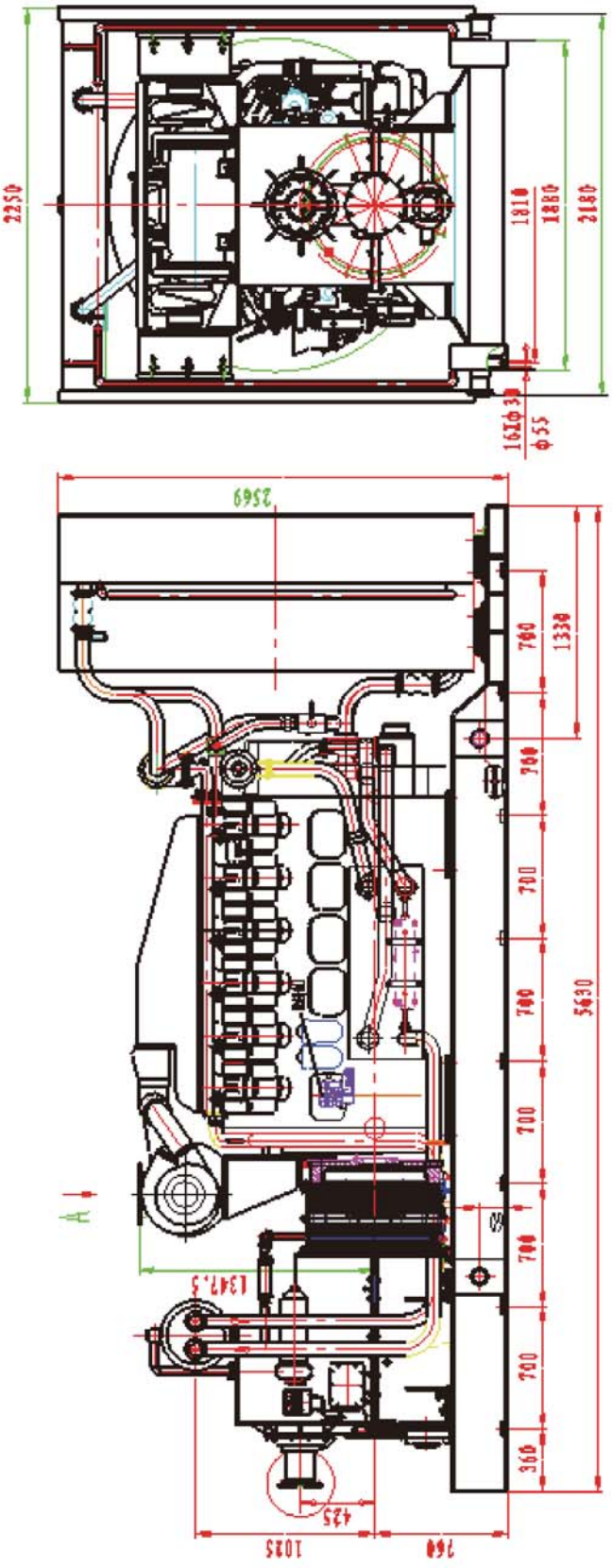
1-input supply
2-turbine
3-casing
4-pump wheel
5-fixed guide
6-output shaft
7-oil cooler
8-oil filter
9-control valve
10-pneumatic piston
11-hydraulic piston
12-spring
13-oil supply pump
14-oil pump shaft
15-oil filter
16-pump gear
17-oil tank

Driving
Driven
Fixed
Control
Working oil

Attached Fig 1: The working principle diagram of coupling reverse reducing gear box



Attached Fig 2:Outline dimensions of series 2000 diesel coupling reverse set



Attached Fig 3 :Outline dimensions of series 3000 diesel coupling reverse set

JCPC Hydraulic Transmission

中国石油装备
CNPC EQUIPMENT

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