Study on Erection of Tank Jacking Equipment

Srikanth M[1], Mohan Kumar S[2]
[1]*Student, Production Technology, Mechanical Engineering Department, VVIET, Mysore, Karnataka, India*
[2]*Assistant Professor, Mechanical Engineering Department, VVIET, Mysore, Karnataka, India*

Abstract - Erection, setting, adjustment, and alignment of sheet metal in petroleum storage tank construction are a very complicated and specialized job. This has to be carried by expert and experienced team of engineers, technicians and helpers. This paper has been prepared with intent to provide guide lines to such team for carrying out tank erection and commissioning. The paper covers planning, pre-erection activities, erection sequence. The erection technologies though explained quite in detail but as hydraulic machines are tailor made, the technologies may differ for a particular machine which has to be obtained from the manufacturer.

Keywords: hydraulic cylinders, Jaw gripping, Erection.

I. INTRODUCTION

A hydraulic cylinders or jacks are a device that uses force to lift heavy loads. The primary Implement the design mechanism with which force is applied varies, depending on the specific type of jack, but is typically a screw thread or a hydraulic cylinder. Jacks can be categorized based on the type of force they employ mechanical or hydraulic. Mechanical jacks, such as car jacks and house jacks, lift heavy equipment and are rated based on lifting capacity (for example, the number of tons they can lift). Hydraulic cylinder or jack tends to be stronger and can lift heavier loads higher. It is well known fact that machine includes a driving mechanism to provide motion to system. Hear jack acts as driving mechanism for the whole fixture; it includes jaws for locking the device with the application of pressure hydraulic jack, self weight and load exertion on the fixture. As pressure applied, hydraulic jack lifts the load at top portion of the fixture mean while bottom portion is locked by jaws before lifting. When required height is reached the top portion is locked mean while bottom portion is unlocked to achieve retraction position of the hydraulic cylinder or jack.

II. PRINCIPLE OF THE ERECTION SYSTEM

The tank periphery is marked out on the bottom plates spacers cum guide beams for guiding the sheets are placed at approximate centers in between and are tack-welded to the bottom plates. The first (upper most) shell ring is positioned on the spacer cum guide beams. The shell ring is checked to be exactly level.

The shell plates are placed with correct radius and in plumb. Roof beams are assembled and finally fastened to the uppermost shell ring; possibly some of the roof sheets are placed and welded. The location of the lifting trestles is marked out inside the erected shell ring. The division should be symmetrical with equal spacing between all tank trestles and the lifting equipment is installed. The first shell ring is lifted to a height at which the top edges of the tank trestles are below the roof sheets. If the height of the two uppermost shell rings added together is less than the height of the trestle, these two shell rings should be welded together before required height is reached. The roof sheets are placed and finally welded. Raise the completed part of the tank so that the next shell ring can be inserted below the first one.

The lifting can be stopped at any moment by putting the operating lever into the neutral position. The lift may not be exactly the same at all points. As soon as the required height is reached at one point, the lifting is stopped and the stop valve of that lifting point (jack) is closed. Then the lifting starts again until another point has reached the same height. This procedure is repeated until the correct height is reached at all the lifting points. All valves are thus now closed and the elevated part of the tank is now loading the lower grip-jaws of the climbing jacks.

Adjustment of the tank level can, if necessary, be made by lifting or lowering with one or more jacks at a time, in doing which the valves on the other jacks should be closed. The next shell ring is fitted and horizontally welded and for making the entrance to the tank easier, the placing of the final sheet is left as long as possible. The shell ring is finish welded on both sides. The climbing jacks and sliding chairs are lowered one at a time using a rope with chain. During this operation, both of the grip-jaw sets of the jacks must be in disengaged position.

Fig. 2.1 Base construction for tank.

Fig. 2.2 Placing of shell ring sheet

Fig. 2.3 View from inside the tank

Fig. 2.4 Partial constructed tank

Fig. 2.5 Fully constructed tank

The lifting and fend-off lugs are now welded to the next uppermost shell ring. The same procedure as above is now repeated for following shell rings. As the load on the lifting trestles has now increased, the oil pressure must be increased, but not more than necessary. Before the assembly of the last (bottom) shell ring, all the spacers cum guide beams are removed. If necessary the power pack can be placed outside the tank. After the last shell ring is welded to the tank wall, the lower edge of the last shell ring is welded to the bottom plates.

III. DETAIL STUDY OF JACKING UNIT

Jacking unit consists of following components

1. *RHS section.*
2. *Adjustable stay.*
3. *Base plate with attachments for RHS Section*
4. *Jack Rod*
5. *Hydraulic Jack*
6. *Slipper*
7. *Lifting arm.*
8. *Lifting Lug (welded to steel plate)*
9. *Guide (welded to shell plate)*
10. *Shut-off cock with coupling for high-pressure hose.*
11. *Shell plate.*
12. *Stay lug (welded to base plate)*

Fig. 3.1 Jacking device

Erection of jacking equipment

- Fixing of trestle base plate.
- Fixing of trestle box and stay pipes.
- Placing of jack and fixing of lugs.
- Hose connection.

Operation of hydraulic jacks

- Operating the jaw locks.

Fixing of trestle base plate

The trestle base plate is to be fixed such that the centre of the base plate is too aligned from the inner face of the tank shell. All the base plates shall be placed at equal distance from each other around the periphery of the tank. The trestle base plate shall be fixed parallel to the tank shell plate such that the distance between the shell plate and trestle base plate is the same at both the edges of the base plate. The side measuring shall be parallel to the tank shell plate. The base plate shall be welded to the tank bottom plate.

Fixing of trestle box and stay pipes

The trestle box is laid horizontally on the tank foundation with the bottom bolt in place and fixed to the trestle base plate. Two stay pipes are fixed to the trestle box with the stud bolt. The stay pipes are also laid on the ground horizontally. The loading point, sliding chair and lifting arm are fixed to the jack rod on the trestle box and slid to the end near the base plate. The complete assembly comprising of trestle box with 2 stay pipes are lifted up to vertical position. The jack rod should face the tank shell plate.

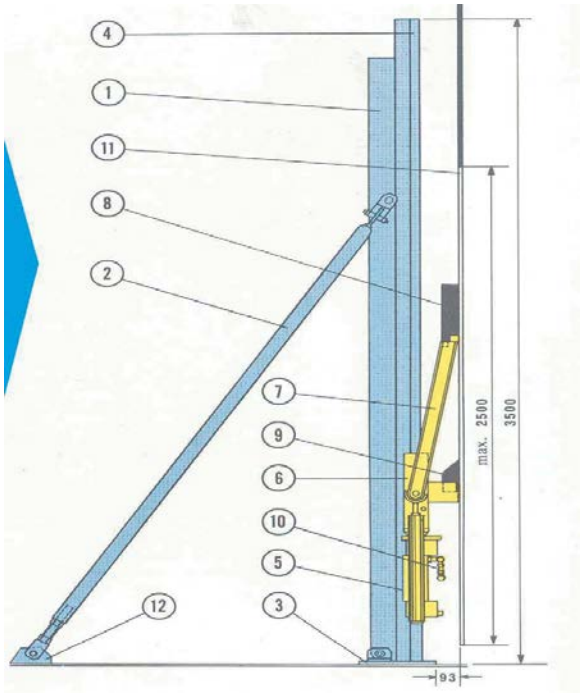

Fig. 3.2 Working view of jacking device

For positioning of the lower lugs, mark a point "X" on the tank bottom plate from the inner shell perpendicular to the trestle base plate. From this point mark two points perpendicular to the line joining the shell plate to the point "X", distance on either side of point "X". These two points are where the two lower lugs should be fixed and tack welded to the tank bottom plate. These distances are only indicative and may change depending upon the distance between the trestles. The angle forming between the two stays pipes should be between 60 degrees and 90 degrees. The trestle box should be proper plumb. This can be adjusted by rotating the stay pipes, which act like turn buckles. The tank shell plate is to be fixed on spacer cum guide beams at a height placed at centre around the periphery of the tank. This space allows for personnel to enter and exit from the tank when all the shell plates of a course / ring are fixed and welded. Before the trestle box and stay pipes are erected the following is to be ensured. At least two top most shell rings with a total height of more than the height of the trestle box

should be erected and then roof constructed should be completed.

Placing of jack and fixing of lugs

The jack is to be mounted onto the jack rod of the trestle box below the loading point (by manually lifting the loading point, sliding chair and lifting arm) such that the loading point sits on the jack. All the four jaw lock levers should be on "locked" or "closed" position. Weld the lifting lugs at a level slightly above the point where the lifting arm touches the tank shell plate. All the lifting lugs should be at the same level. Normally 6 mm fillet weld on both sides along the full length of the lug is done and this weld quality is checked using suitable methods. The fend-off lugs are welded to the tank shell plate in such as manner that there is a gap between the bottom edge of the fend off lug and the upper edge of the sliding chair, so as to ensure that no vertical load is transferred from the tank shell plate to the sliding chair. Before welding the lifting lugs to the shell plates, patch plates are welded to shell plates and the lifting lugs are welded to thick plates. For the Fend-off lugs, patch plates are welded to shell plates and the Fend off lugs are welded to plates. In addition, a curved ring fabricated of mild steel angle or plate is to be placed on top of the lifting lug and stitch welded to the tank shell plate in case buckling is observed. After the hose and power pack connection, lift all the jacks slightly so that the top of the lifting arm touches the bottom edge of the lifting lug. Now the jacking equipment is ready for lifting the tank.

Hose connection

The Power pack can be placed inside the tank or outside the tank. From the main outlet of the power pack, one hose pipe is connected to the manifold block. From this manifold block main distribution lines are fixed in radial direction. One hose is fixed to each jack through a stop cock valve. The other end of the hose is fixed to a Tee-connector, which in turn is fixed to other hoses forming a circumferential ring near the periphery of the tank. The main distribution hoses are connected to this circumferential ring using Tee-connections. Teflon tape should be used at each hose joint.

Operating the jaw locks

There are four jaws in each jack, an upper pair and a lower pair. Each jaw can be locked or unlocked using jaw lock levers. By turning the levers on the left side in clockwise direction and the levers on the right side in the anti clockwise direction, the levers can engage or lock the jaws. Always, both levers of either upper pair or lower pair should be operated simultaneously for locking and for unlocking. In the locked position, the jack can only move upwards and not downwards. Therefore, during lifting, both the pairs of jaws should be in locked position. Only when the jack is to be lowered down, the levers are to be unlocked, but at any point of time, any one pair of jaws should be in locked position, otherwise the jack will fall down possibly causing injury.

Application of lifting equipment

- Erection of tanks of steel or other materials.
- Repairs of tanks or tank foundations.
- Enlargement of storage capacity in existing tanks.
- Erection of other circular structures such as reactor shields in nuclear power stations, etc.

IV. CONCLUSION

The technology and experience in all aspects of lifting tanks makes right way for the purposes of correcting settlement problems, secondary containment, underfloor grouting, relocation or dismantling for re-erection. By adopting this kind of equipment results lower work place hazards, faster work progress which saves money, customer satisfaction can be achieved.

REFERENCES

[1] K. Sainath, Md Azam Ali Farooky, Mohammed Siddique Ahmed, Vol. 04, Issue 07 (July.2014),IOSR Journal.

[2] William Cox (July 2001), "Light Talk On Heavy Jacks", Old-House Journal: 37

[3] Electric Scissor Jacks, Jackmaster. "Electric Scissor Jacks". Retrieved 8 February 2014.

[4] Text Book Of Hydraulics By H. Meixner And R.Kober, Edn. 1990 Published By Fiesto Didactic Kg, D – 7300 Esslingen, 1977, 1988.

[5] A Text Book Of Hydraulics, Fluid Mechanics And Hydraulic Machines, R.S. Khurmi, - Edn.18, S.Chand & Co., Ram Nagar, New Delhi – 110 055, Ram Nagar, New Delhi – 2002.