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WORKING BENCH FOR RECONDITIONING HYDRAULIC CYLINDERS

Liliana DUMITRESCU[1], Alexandru Polifron CHIRIȚĂ[1], Corneliu CRISTESCU[1]

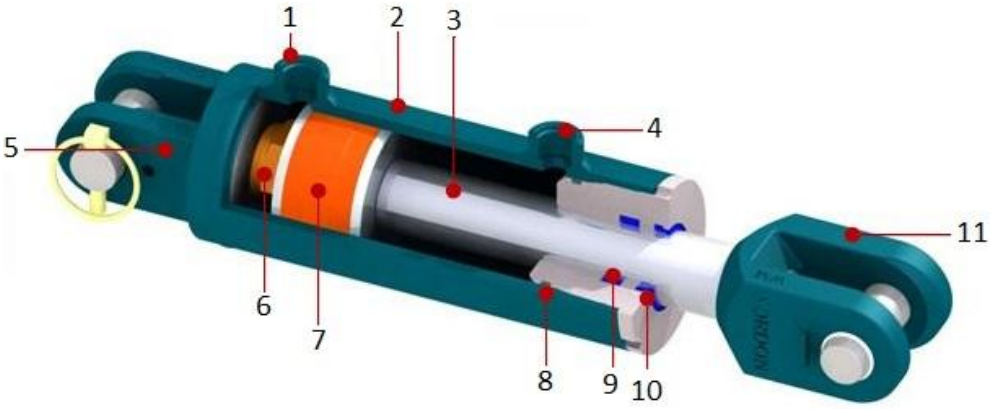
[1] Hydraulics and Pneumatics Research Institute INOE 2000-IHP; lilianad.ihp@fluidas.ro

Abstract: *Most of the Romanian companies that repair hydraulic cylinders manually perform their dismantling and repair operations after repair. Manual removal and fitting is done with great effort using tools and levers to increase hand strength. The article presents equipment that facilitates the operator's work using hydraulic power instead of arm strength. Hydraulic equipment is carried out under an "innovation check" funded by UEFISCDI through the P2 program to increase the competitiveness of the Romanian economy through research, development and innovation.*

Keywords: *Hydraulic cylinder, piston, rotary flange, unscrew / screw.*

1. Introduction

To repair the hydraulic cylinders, first disassemble them in component parts (washer, piston, guides, seals, etc.) and after reassembling them.



1 – Connection A
2 – Barrel/tube
3 – Piston rod/shaft
4 – Connection B
5 – Base mount
6 – Piston nut
7 – Piston seal
8 – O-ring and backup
9 – Rod seal
10 – Rod wiper
11 – Rod support

Fig. 1. Component parts of hydraulic cylinder [1]

Removing and then replacing the hydraulic cylinders involves a number of operations such as: unlocking the threads, unscrewing / threading the threaded assemblies, extracting / inserting the piston and rod into the cylinder barrel, etc.
For large hydraulic cylinders of heavy series (piston diameter over 200 mm and race over 2000 mm) for these operations, large rotating forces and torques are possible which can be achieved with mechanics driven by linear and rotary hydraulic motors.

2. Description and operation of the equipment

Hydraulic equipment for mounting / dismounting the hydraulic cylinders is shown in Fig. 2.

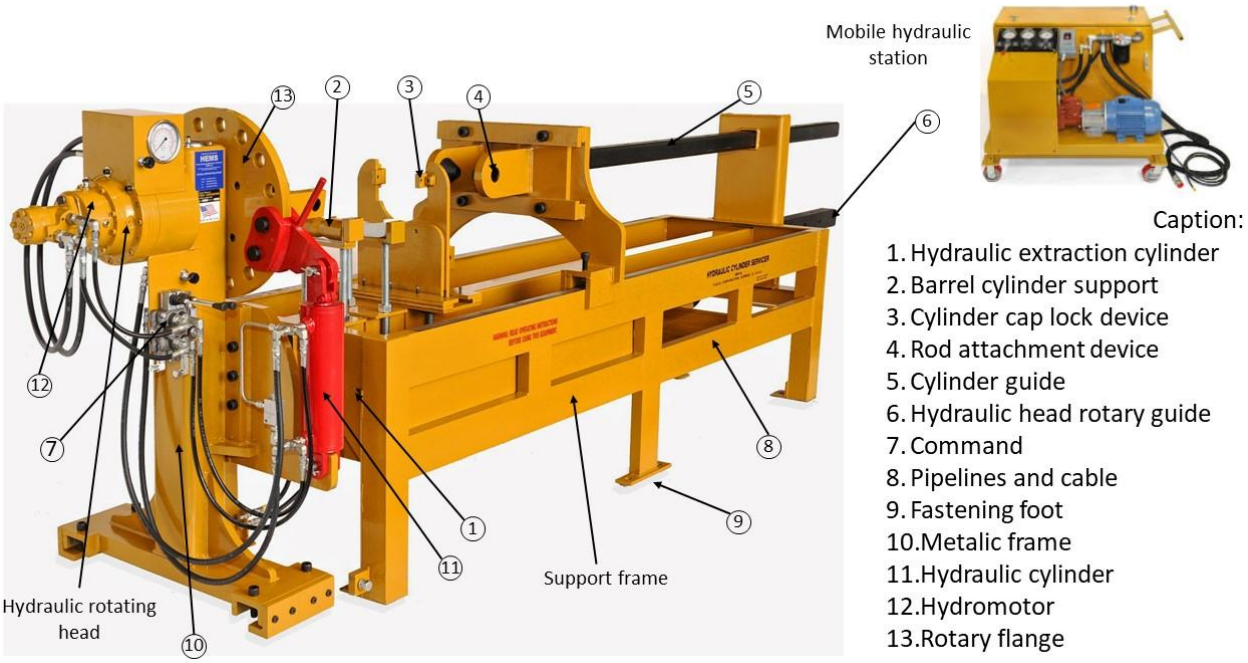
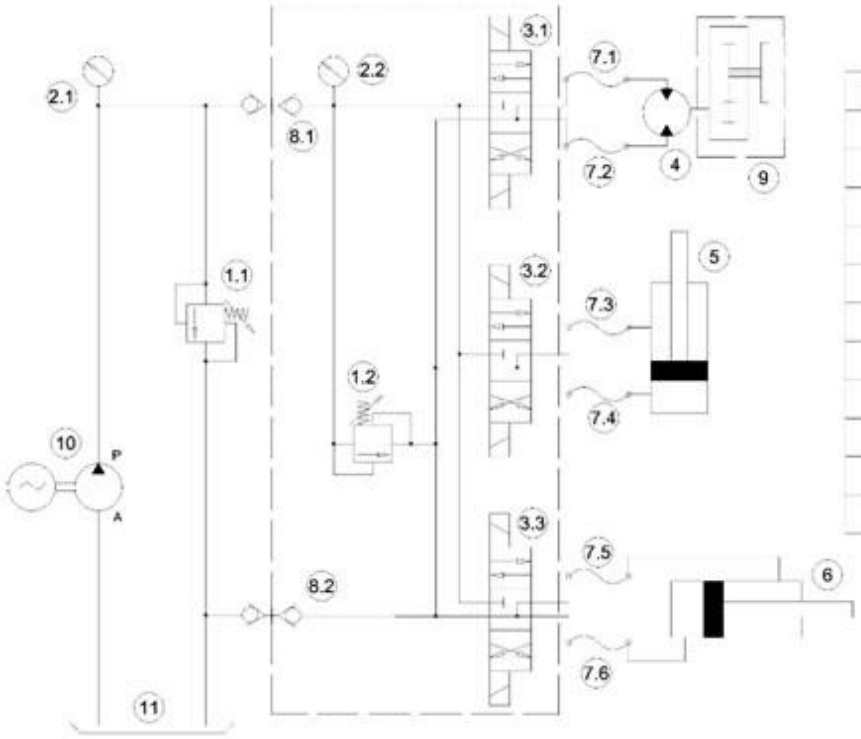


Fig. 2. Working bench for reconditioning hydraulic cylinder [2]

The hydraulic cylinder to be dismantled is fixed to the support frame and rests on the support 2. The roll of the cylinder barrel is fastened to the rotary flange and the cover of the barrel is blocked by the device 3.
The cylinder rod eye is fixed to the device 4. Depending on the length of the hydraulic cylinder, the device 4 moves longitudinally, being guided by the rod 5. The support frame is fixed to the floor by the fixing legs 9. The hydraulic cylinder 1, which is located inside the support frame, longitudinally moves the rotary hydraulic head by pulling the piston together with the rod in the cylinder tube. The longitudinal direction of movement is provided by the guide 6. The connection between the hydraulic station and the rotating head is made with the pipes 8, located inside the support frame. The equipment also has a number of devices that ensure fast fastening on the support frame so that the time for removing / mounting the cylinder is as small as possible.
The metal frame 7 fixes the component parts and hydraulic head. Hydraulic cylinder 1 is used to unlock threaded assemblies as it provides a high torque. The low-speed motor 2 is used to unscrew or screw the components of the cylinder assembled through the thread. The distributor 3 switches the hydraulic energy flow to the cylinder 1 or the hydro motor 2. The connection between hydraulic station and the hydraulic head is made with flexible pipes. The hydraulic station also provides the necessary energy for the pressure samples to which the hydraulic cylinders are repaired. After repair and installation, the cylinder remains attached to the pressure support frame. The repaired cylinder in ‘filled’ with low pressure oil. The high pressure required for the checks is provided by a pneumo-hydraulic accumulator that has been “charged” in the unlocking / locking of the threaded screws. [3]

3. Hydraulic scheme

The hydraulic scheme is presented in Fig. 3.



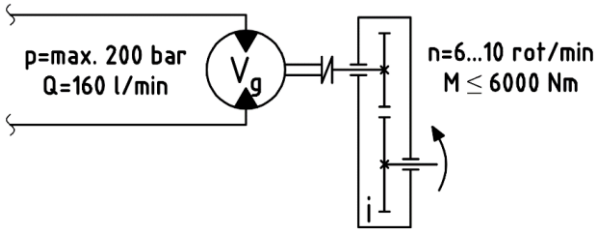
Item	Name
1	Safety valve
2	Manometer
3	Directional control valve
4	Hydraulic orbital engine
5	Hydraulic unlocking cylinder
6	Hydraulic drawing cylinder
7	Flexible connection
8	Quick coupling
9	Speed reducer
10	Electro pump
11	Oil reservoir

Fig. 3. Hydraulic scheme

The electro pump 10, the safety valve 1.1, the pressure gauge 2.1 and the assembled tank 11 are included in the hydraulic station. The hydraulic extraction cylinder 6 belongs to the support frame. The rest of the devices are part of the structure of the hydraulic head.
The hydraulic power required for the equipment is provided by the electropump 10 which sends the fluid under pressure to the distribution block. Hydraulic motor 4 performs screwing / unscrewing the threaded assemblies of the cylinder. The hydraulic motor spindle speed is reduced to 6...10 rpm, as is best for threaded assemblies, by the reducer 9. Reversing the rotating direction corresponding to the direction of thrust / unwinding is done with the directional control valve 3.1.
Unblocking / locking of threaded screws is done with hydraulic cylinder 5 and directional control valve 3.2 reverses the sense of motion corresponding to lock or unlock.
The extraction or insertion of the piston rod together with the piston into the cylinder barrel is accomplished by the hydraulic cylinder 6 and the reversal of the means of the directional control valve 3.3.

4. Technical features

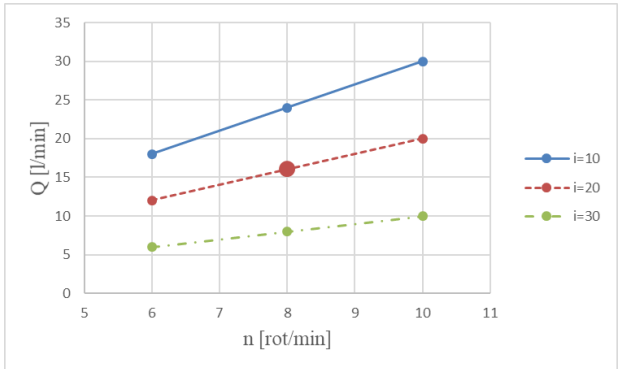
To screw / unscrew the threaded assemblies of the hydraulic cylinder, the equipment mush achieve a torque of up to 6000 Nm at a speed between 6 and 10 rpm. These are made up of an ensemble consisting of an orbital hydraulic motor and a planetary reducer, see Fig. 4.



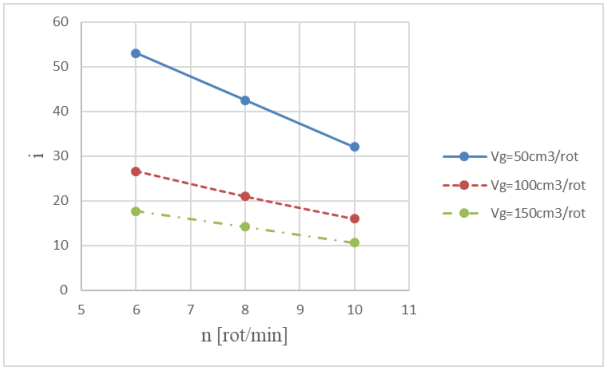
i – gear ratio of reducer
V_g – hydraulic engine capacity
n – screwing / unscrewing speed
M – screwing / unscrewing torque
Q – hydraulic engine flow
p – hydraulic engine pressure

Fig. 4. Assembly of hydro motor and speed reducer

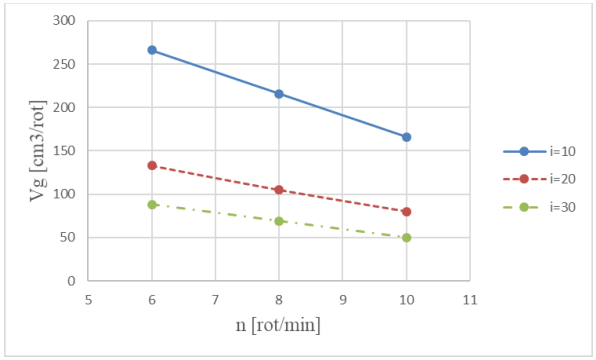
The hydro motor reducer assembly receives a flow rate of 16 l/min at a pressure of maximum 200 bar and must provide a maximum torque of 6000 Nm at a speed of 6 … 10 rpm. Three variants of orbital hydraulic engine with characteristics of V_g = 50, 100 and 150 cm^3/rev and three variants of transmission ratios of the reducer: i = 10, 20 and 30.
The results of the analyses are presented in the diagrams of Fig. 5.



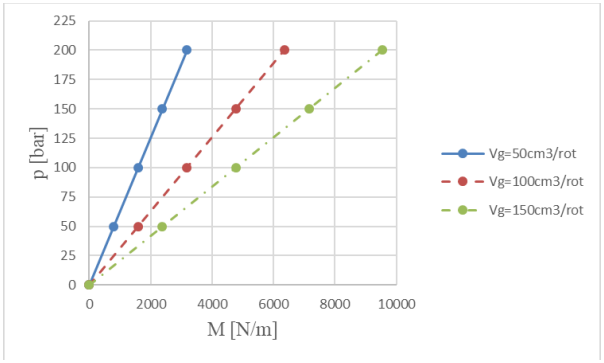
a) Diagram n – Q



c) Diagram n – i



b) Diagram n – V_g



d) Diagram M – p

Fig. 5. Diagrams

It follows from these diagrams that the optimal variant is that of the hydraulic motor with V_g = 100 cm^3/rev and the gear ratio with the transmission ratio i = 20. This combination provides a torque of M = 6000 Nm and a speed of n = 8 rpm, if it receives a flow of 16 l/min at 190 bar. At a pressure of 200 bar the developed torque is M = 6360 Nm.

5. Conclusions

The hydraulic equipment presented is a particularly useful tool for hydraulic cylinders “service” mainly because it facilitates the operator’s work by using hydraulic power instead of the strength of the arms.

The equipment provides the basic operations for the quick dismantling / refitting of hydraulic cylinders:

- unlocking threaded assemblies to loosen the cylinder caps and piston retaining nuts.
- quick screwing and unscrewing of cylinder caps and piston nuts.
- extracting and rapidly inserting piston rods into the cylinder.
- adjusting the position of the parts to ensure their coaxiality so as not to damage the seals during reassembly.

Acknowledgments

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