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REPLACEMENT OF THE MECHANICAL PLANISHING SYSTEM OF THE FORGING PRESS IHI 800 JAPAN

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Abstract: *Replacement of the mechanical planishing system of the forging press IHI 800 Japan. Realization of new progressive hydraulic solution. The survey of conventional and advanced drives and control systems.*

Keywords: ***Planishing, forging press, hydraulics.***

1. Introduction

More than two years ago, our company Žďas a.s., which is the leading manufacturer of forging presses with more than fifty-year experience, has been asked by a Japanese customer to prepare a technical offer for the reconstruction of an 800 t capacity pull-down forging press of Japanese make. The customer expected meeting the following requirements due to reconstruction:

- removal of the press mechanical drive
- increase in the number of planishing strokes
- forming speed increase

During a visit to a customer's place it was found that the year of production of the press is 1988. In the year 1992, a Japanese company carried out a reconstruction of the hydraulic drive. Unfortunately they had at their disposal a minimum of supporting drawings. When the company obtained finally the necessary drawings, there were not included last modifications made during the reconstruction. During the inspection visit, the measurements needed to connect new manifolds were carried out on the existing subassemblies.

2. Existing equipment description

The main motion of the press was carried out using two principles:

- For forging, when high working strokes (over 40 mm) are required, the hydraulic drive has been applied
- For forging, especially for finishing operations – strokes under 40 mm, the mechanical drive has been applied

2.1. Original hydraulic drive description

The installed hydraulic drive was composed of four pump units consisting of hydraulic high-pressure piston axial-flow pumps (Japanese make), which were connected via the flexible coupling to the electric motor. The deliveries of hydraulic pumps were connected to a common unloading manifold. A part of the drive was the tank with a capacity of 10 m^3 of working fluid. Mounted on the tank was the pre-filling hydraulic pump. A part of the tank was also the filtering and cooling circuit. Close to the press there were control manifolds for the press cylinder (Fig. 1), return and hold cylinders. The pressure pre-filling tank also belonged to the hydraulic station.

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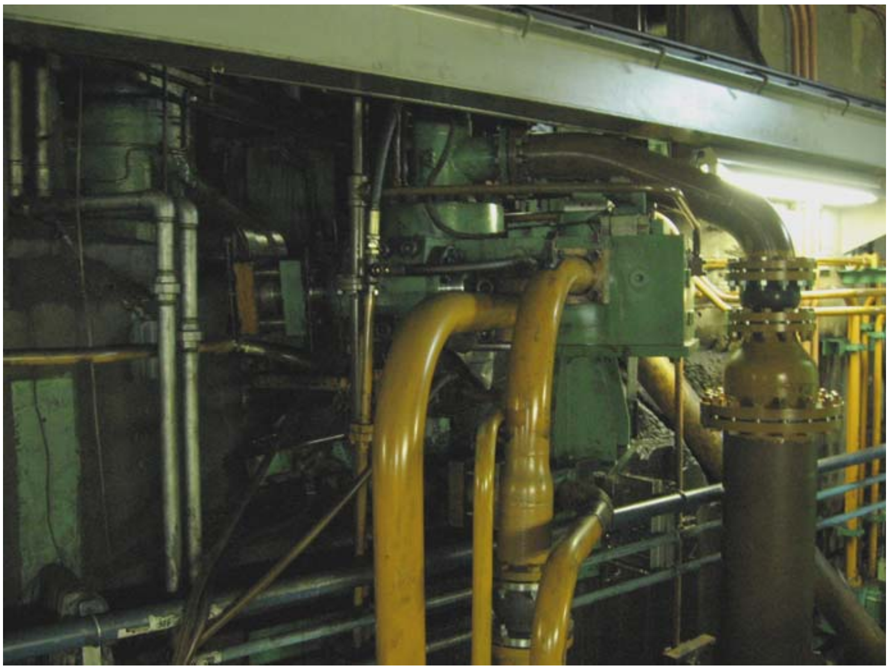

Fig. 1: Existing hydraulic manifold for press cylinder control.

2.2. Original mechanical drive description

The existing mechanical drive of the forging press (Fig. 3) was composed of the electric motor (1) of 800 kW output, the gearbox (2) and the eccentric shaft (3) to which the press cylinder (5) was pulled by means of hold cylinders (4). The electric motor revolutions were reduced by means of the gearbox (2) so that the press could reach 80 strokes at a constant path of 40 mm. The disadvantage of this solution was the impossibility to change the height of stroke during forging by means of mechanical drive and high energy demands.

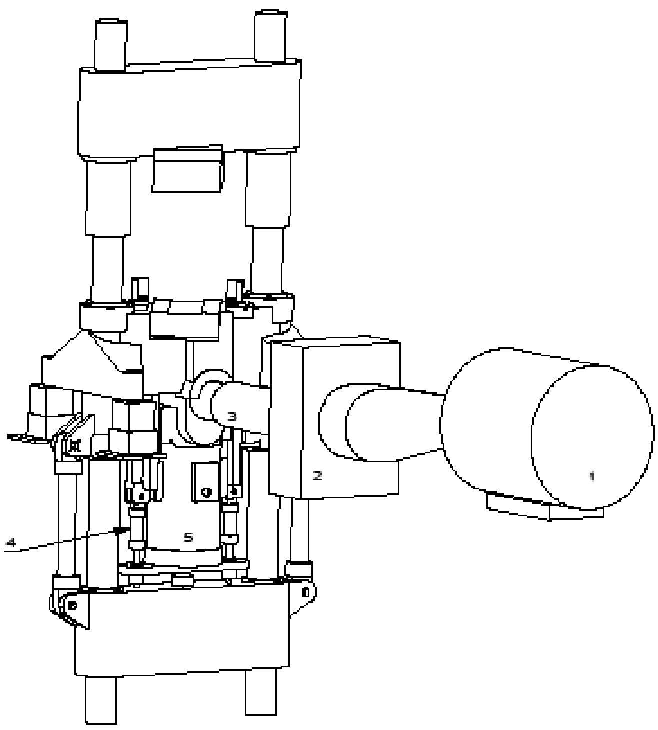

Fig. 2: Eccentric-shaft press drawing.

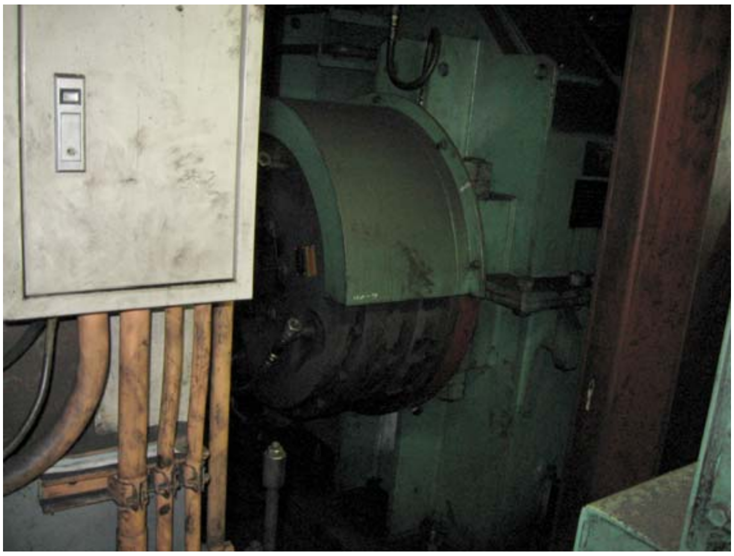

Fig. 3: Existing mechanical drive of the forging press.

3. Advanced solution proposed

The proposed advanced control of the drive is based on the idea of not changing the direction of fluid flow between the source – main pump unit and the press ram using the existing constant-displacement pumps. For this solution, the permanent connection of the return cylinders to the pressure source, i.e. to the accumulator station, has been applied, because it is an easy control of the press. The operation of the press is controlled only by one valve, i.e. by the forge valve installed close by the press ram. Under this control mode, the forging press can reach 120 strokes at a 10 mm height of stroke.

3.1. Press control principle using the forge valve (Fig. 4)

The working fluid is supplied by the main pump units (1) to the press cylinder (5) which is connected via the forge valve (7) with the pre-filling tank (12). When the forge valve is fully closed, the press is capable of forging at a maximum forming force, which is directly proportional to the main-pump delivery. At the moment of reversing command, the forge valve starts continuous opening due to a smooth course of decompression, thus finishing the downward motion of the press. The next opening of the forge valve results in flowing-off of working fluid into the pre-filling tank and then via the safety valve to the main tank. Due to the action of return cylinders (6), the press moves to the top dead centre. Before reaching the top dead centre of the press, the valve will close again and the whole cycle is repeated.

Return cylinders are permanently connected to the accumulators (7), which are refilled by means of the hydraulic unit (9) via the non-return valve (10). The return cylinder circuit is provided with a safety valve (8).

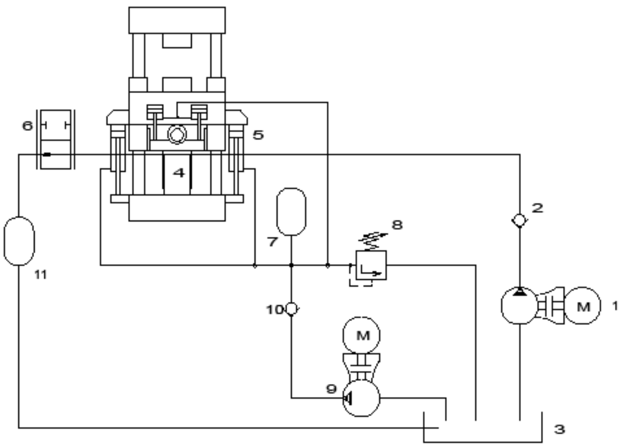

Fig. 4: Press control principle using forge valve.

To increase the forming speed, it was necessary to install a new constant-delivery pump unit Kawasaki LXV260 with pump-unloading manifold (Fig. 5). Because of new pump installation it was needful to solve the filling hydraulic pump. After performing the calculations, the existing filling hydraulic pump was proved to be unsatisfactory because of a small delivery of working fluid for the main hydraulic pumps. So a new filling hydraulic pump was necessary to be designed.

Fig. 5: New control manifold of new pump unit.

For the proposed solution, a problem had occurred concerning the location of control components for return cylinders – accumulator station and control manifold. This problem has been solved using design software Unigraphics NX3. By means of this system, the 3D design with the placement of individual components and their interconnection was created completely. This design was successfully presented to the customer and executed during the period of 10-12/2010 by the customer's approval. In the commissioning, a high speed of the press, i.e. 125 strokes per 10 mm path, has been achieved.

At present, the forging press under reconstruction has been in a test operation.

4. Conclusions

In the case of replacement of the mechanical planishing operation by the hydraulic one by means of advanced solution, a significant high speed of the press has been attained; this was one of the most important requirements of the client.

In the case of adjustment of the hydraulic drive, the value of 125 strokes per 10 mm path has been achieved compared to 80 strokes per 40 mm path in the original mechanical drive.

Another main feature of the hydraulic system is the option of operator to select the height of press stroke by means of automated system during finishing operations; this was not possible before.

The hydraulic solution of the quick-forging system is a full substitution for the same mechanical solutions. The hydraulic solution offers more advantages and higher flexibility.

References

Catalogue of the forging presses – ŽĎAS a.s. (2007).