6. Naučno-stručni skup sa sa međunarodnim učešćem
"KVALITET 2009", Neum, B&H, 04. - 07 juni 2009.

REGULATION WAYS OF SHOCK-ABSORBERS AND THE PURPOSE OF THEIR REGULATION

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ABSTRACT
In this paper is done the analyze of the valve characteristics of the shock-absorbers: This analyze is shown through the diagram gained basing on the equations:
Which shows the relation of pressure to the scale of bearing wherein are shown the effects on regulation of various sizes, as there are: parallel , serial, maximal spaces, the effect of pressure and the effect of clearance coefficient.

Key words: pressure, surface, space coefficient, valve, bearing quantity, solidity and discharge coefficient.

1. INTRODUCTION

Every shock-absorber can be processed from new parts of the valve in order to achieve different characteristics. The shock-absorber with adjustment, however is a quicklime hydrator that has characteristic features for adjustment without breaking down (demount-age). The purpose of adjustment is two folds:

(1) To optimize the vehicle performance or to adapt the driving for various conditions.
(2) To compensate consumption

The consumption of obscurantism results with bearing that is proportional with the increase of parallel hole, thus it can be compensated up to a determined limit by reducing parallel hole of the valve.
The shock-absorbers with adjustment can be classified basing on the way of adjustment as follows:

- Manual adjustment after its taking out from the vehicle
- Manual adjustment in its place
- Manual adjustment from distance (from driver's seat)
- Automatic adjustment

If it is required to remove the shock-absorber from the vehicle, (surely one edge of the shock-absorber), this is done in order to let the relative revolving of both edges. The adjustment in its place is done by revolving of lever. Usually the adjustment for pressure or extension can be independent, but sometimes such an adjustment can be effected in both directions.
The next step is the adjustment in automatic way according to the conditions of activity, it means, the quicklime hydrator for higher speed or if we have larger quicklime hydrator. In this case the driver is able to choose or strong quicklime hydrator, weak or automatic adjustment.

2. ADJUSTABLE VALLES

Fig. 1 shows basic valve. The valve has a parallel, serial hole and a hole with variable space , and it is determined with these characteristics:
(1) A_P: Surface of parallel hole
(2) A_S: Surface of serial hole
(3) k_A: Hole coefficient with variable space
(4) P_{VC}: Valve pressure during the immediate closing
(5) A_M: Maximal surface for the hole with variable space
For a variable hole simple linear, surface A_V is proportional with change of pressure, $P - P_{VC}$, so that:
$A_V = k_A(P - P_{VC}) \leq A_M$ wherein k_A is clearance coefficient, P is change of pressure, whereas P_{VC} is initial change in opening.
The resultant curve P(Q) is shown in fig. 1.1 Three parts of this curve compose phases:
Phase 1: Closing valve, bearing only through parallel hole, $P \propto Q^2$
Phase 2: The valve is partly opened
Phase 3: The valve is totally opened, again $P \propto Q^2$

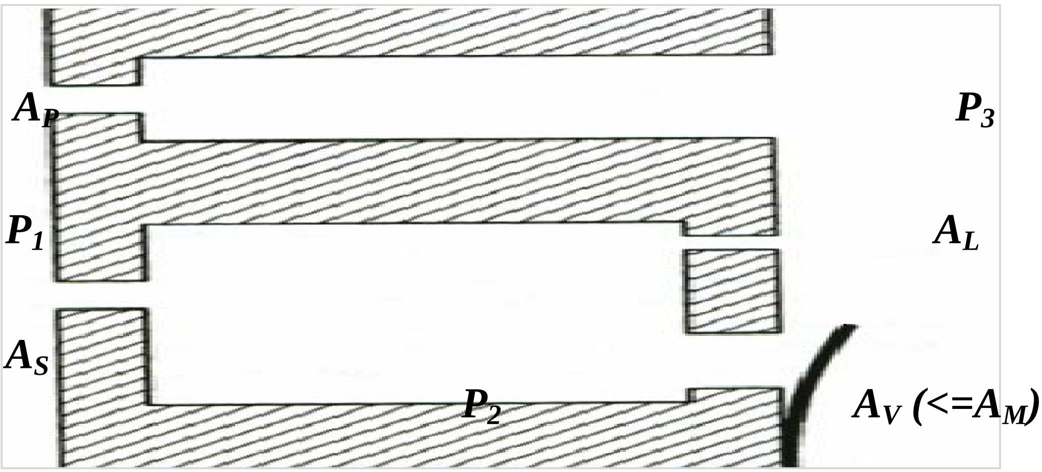


Figure 1. The valves spaces and pressures

Curve A determines entirely closed valve by allowing bearing only in parallel hole. Curve B is for entirely opened valve, by allowing bearing through the valve and parallel hole
In transitory region, with partly opened valve, we have proper transitory curve. These are not always exact as it is accepted. One is for linear function $A_V(P)$. As it is seen, resultant curve didn't deviate so much from linear function P(Q), almost in entire interval, somewhere under Q_{VO}. Thus, this approach gives good results with careful solution of parameters by using simple linear components, with low price and reproduces. Also if it is required non-linearity, there are possibilities to construct them indoors. Transition about the first opening of the valve is called "the knee of curve".

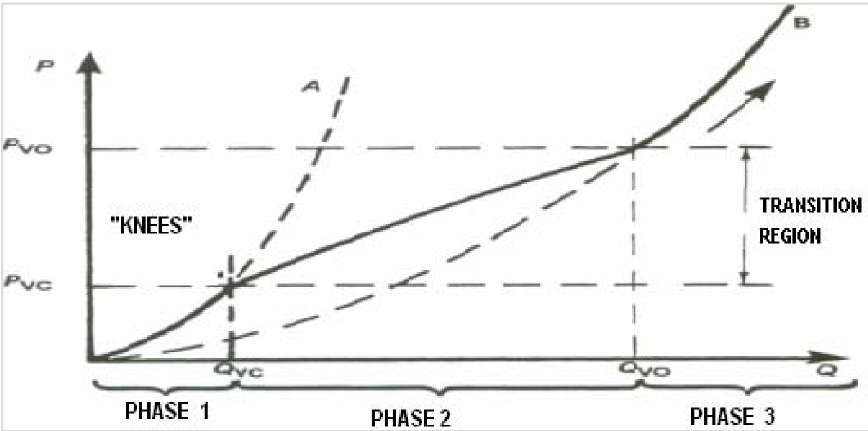


Figure 2.Transitions characteristics P(Q)

The pending between pressures and bearing quantity is given through the equation:

$$P = C_1 Q^{2/(1+2n)}$$

Fig. 2 to 6 show the effect of these changes, curves which are gained from numeric solutions basing on characteristic theory of valve that is shown below.
The main data for figures 2 to 6 are:

$A_P = 2\ mm^2$
$A_S = 50\ mm^2$
$A_M = 10\ mm^2$
$P_{VO} = 1$ MP a
$k_A = 3\ mm^2/MPa$

3. PARALEL HOLE

Intentionally of easy implementing, change of parallel hole clearance is one of the most frequent forms of quicklime hydrator adjustment fig.2. The parallel hole increases the bearing for any change of pressure, so that this change mainly displace the actual curve in a larger or smaller bearing (left and right in diagram), by having effect in whole interval of the activity of valve. The smallest satisfactory aspect is that the effect is proportionally bigger in a little speed, so the quicklime hydrator in speed can achieve small values not satisfactorily. The change of parallel clearance of the valve from 0 to 10 mm^2 with pace of 2 mm^2. Bearing scale (cm^3/s)

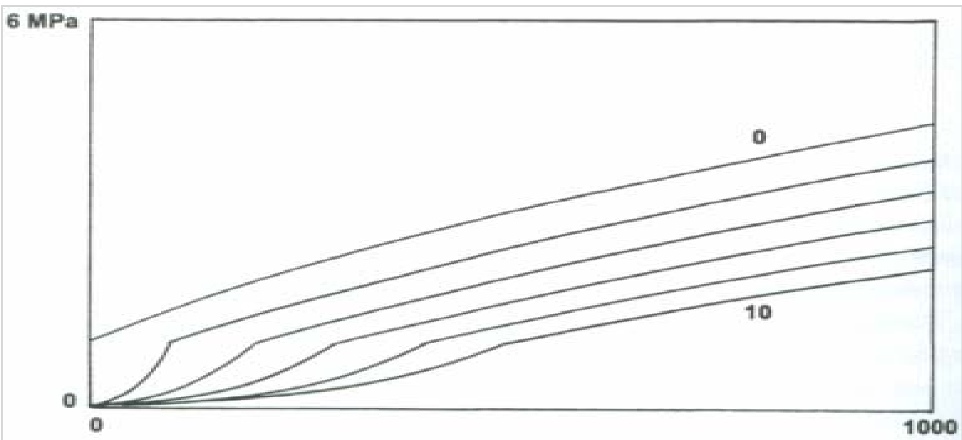


Figure 3. The adjustment effect of paralel clearance, A_P

4. SERIC HOLE

The change of serial hole has an effect in the middle and high speed, as in fig.3, with entirely different progressive increase with change of parallel hole. The effect is huge of the high speed. The low speed, phase 1, doesn't have any effect. The effect is non-linear to the clearance, so that the sizes of hole should select carefully.
The clearance coefficient k_A(mm^2/MPa) can be adjusted with the change of solidity or to the valve with coil, through turning
The adjustment of serial holes is used at least to a quicklime hydrator in race cars. There are some advantages during the implementation with the change of parallel hole. The reason is in a slight combination of two types of holes.
The change of serial clearance of valve from 5 to 30 mm^2 with a pace of 5 mm^2
Bearing scale (cm^3/s

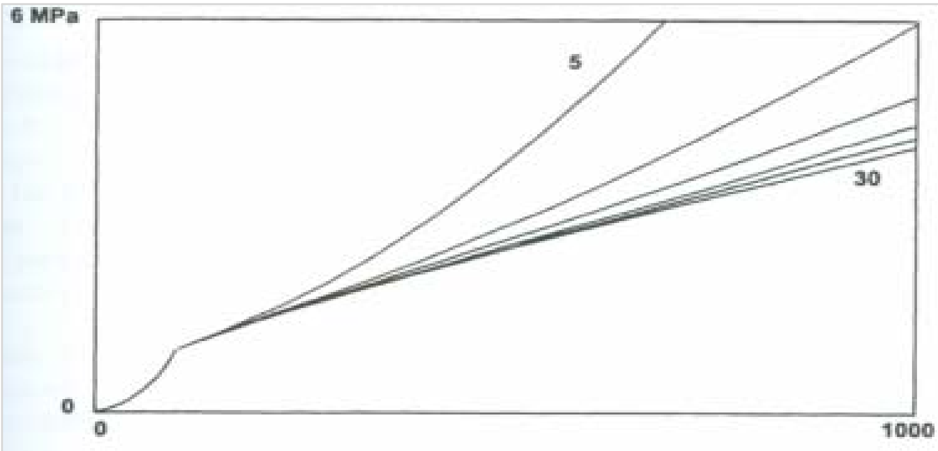


Figure 4. The adjustment effect of seric space, A_S

5. MAXIMAL CLEARANCE

The change effect of maximal clearance of valve, as in fig. 4, shows adjustment of high speed, since regarding to definition this causes only the third phase. Notwithstanding, also it has an effect in the initial bearing scale of the third phase, thus for a small maximal clearance, the effects are seen in low bearing. Starting is much more sharp than to serial restrictive holes. For bearing scale and lower pressure than is necessary for entirely opening of valve, won't have any effect in general.
The change of maximal clearance of the valve from 1 to 8 mm^2 with a space of 1 mm^2
Bearing scale (cm^3/s)

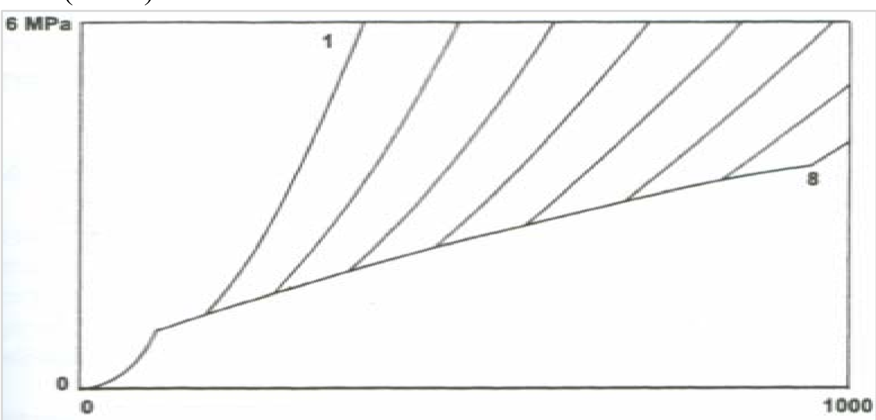


Figure 5. Adjustment effect maximal clearance A_M

6. PRESSURE IN OPENING

The initial pressure in opening (i.e., P_{VC}, pressure of just closed valve) is directed from recharge of valve and shows a method suitable for adjustment, even though it shows a complicated montage fig. 5. The increased recharge doesn't' have an influence within first interval, but it extends the interval. Thus the increased recharge postpones the beginning of the second phase; increases the level of pressure within phase 2, i.e. this part of the graphics is vertically upraised. The increased recharge continues in the upper part of phase 2, by pushing the entire opening of valve, but also within phase 3 there isn't any effect . A good scale of adjusting is achieved along the main interval of speed, but to high recharge is obviously non-linear.
The pressure change of valve in opening from 1 to 5 MP a with pace 1 MP a
Bearing scale (cm^3/s

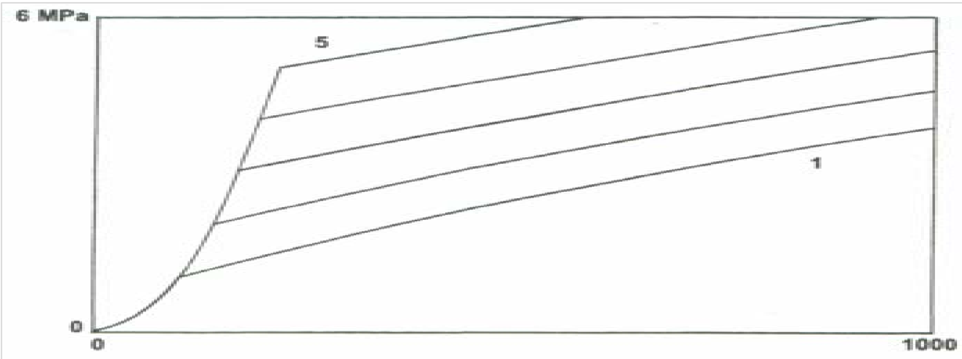
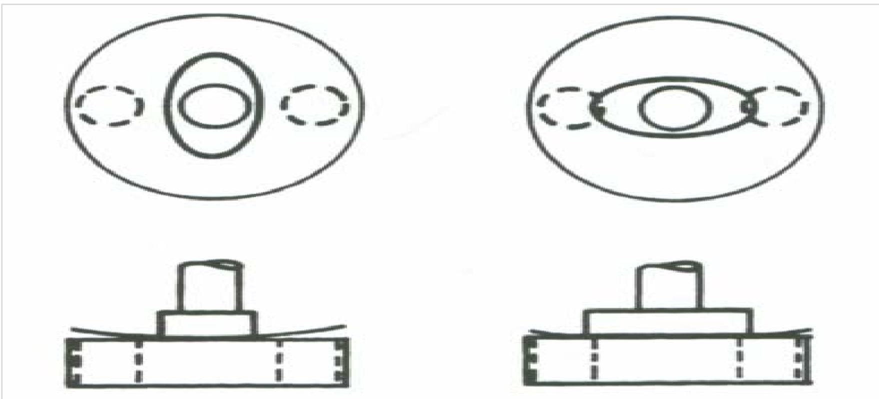


Figure 6. The adjustment of pressure in opening (just closed), P_{VC}

7. CLEARANCE COEFFICIENT (SOLIDITY)



a) b)

Figure 7. Valve with different solidity with turning of boss, by changing the underneath lever length
a) Soft position; b) Solid position

Of a coil in order to change the effective length of opening so that the given position of axial coil increases the effective clearance of bearing. Thus the valve with under sheet with two holes, with undershoots that are linked with double bosses, show the solidity and the clearance coefficient k_A that is depended from turning position of support as in fig. 6, even though this can change the maximal clearance Fig. 6.1 shows the change of clearance coefficient, wherein can be seen that phase 1 is unimportant, but phase 2 has an excellent

change. The small clearance coefficient k_A (large solidity) gives high pressure and pushes the end of the phase 2. When phase 3 is achieved, there isn't any effect.
The change of valve clearance from 1 to 5 mm^2/MPa with pace 1 mm^2/Mpa, Bearing scale (cm^3/s).

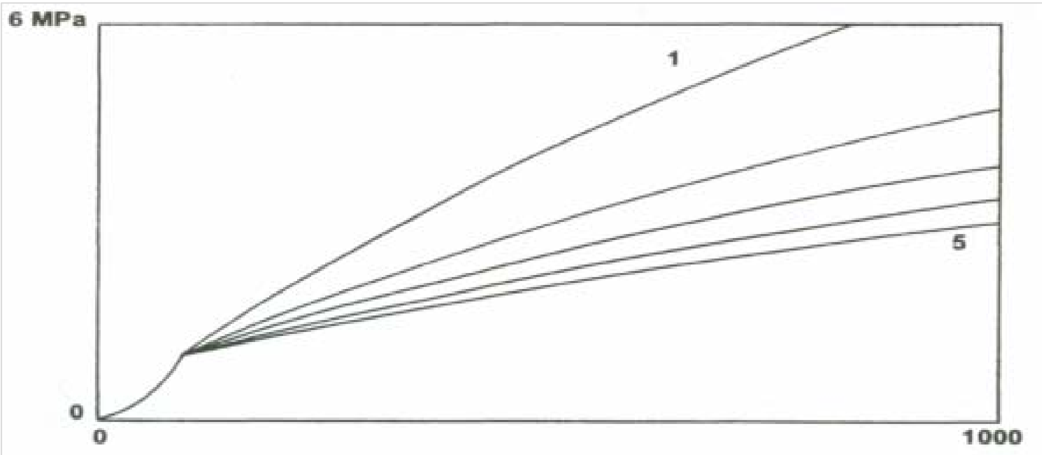


Figure 8. The effect of clearance coefficient adjustment, k_A

8. SUMMARY

The comparison of diagrams shows the influence of different forms of adjusting in the change of valve characteristics in entirely different ways, and in different speeds. Thus, to use the quicklime hydrator with adjustment, it is very important to know the regulator type of that quicklime hydrator. Main characteristics of these figures is that they include recharge of valve. This is not necessary , but it helps to illustrate more clearly the influence of different adjustments.
The above data are based mainly in the idea of valve with manual adjustment, but it is also applied to the valves with electrical adjustment that can be changed in the same way with slowly reply. Nevertheless, with valve with electrical adjustment with fast reply, the characteristic of quicklime hydrator within the limits can be adjusted entirely with software, basing on sensor data. In this case , characteristics can be with nearly similar form with that wanted, and also to be dependent from other factors but not by the speed of quicklime hydrator.

9. REFERENCE

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